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Abstract

We describe a set of stylized facts on India's manufacturing productivity, showing that aggregate productivity growth in India has slowed considerably in the past decade, and has been on average negative in the past several years. There is also substantial variation in productivity across India, even when controlling for state and industry effects. We focus on one potential determinant of this variation, namely, firms' investments in their workers. There is a robust positive association between such investments and firm output per worker, even within state and industry. This relationship suggests, but does not dispositively demonstrate, that investing more in workers causes productivity improvements. We therefore review the literature on four categories of investments in workers that show high potential to raise productivity: soft skills, voice, environmental conditions, and managerial quality. In each case we focus on studies that demonstrate the relationship between investments and productivity causally, most often via prospective randomized controlled trials (RCTs). We end with a description of reasons why firms may be systematically underinvesting in workers – as well as why more evidence is needed to understand firm behavior in this regard.

Introduction

India's manufacturing sector is widely held as a key to the ongoing structural transformation of its economy, the pathway for millions of low-income Indians to grow their incomes out of poverty, and India's overall economic competitiveness on the global stage (Aggarwal and Kumar, 2015). Indian manufacturing is particularly important given the accelerating global demand to shift supply chains away from China (Ghosh and Mukherji, 2020). The United States, the EU countries, and other large economies view India as a primary destination towards which key aspects of global production could move. But absorbing this potential demand would require a massive expansion of manufacturing capacity within India. Raising manufacturing's share of GDP in the coming decade is a key stated goal of the Government of India. The government's "Make in India" push – to reduce dependence on China and other major sources of imports – also aligns with the emphasis on manufacturing growth (Anand et al., 2015). These goals consequently imply that manufacturing productivity is of critical importance as India wishes to position itself as a major player in the global "friendshoring" trend, as well as for India's own desire to be more self-reliant in the production of consumer goods.

We thus begin by examining trends in India's manufacturing productivity, with the goal of establishing some basic stylized facts related to aggregate productivity growth and the dispersion in productivity across states and industries. Our takeaway from these statistics is that the growth in manufacturing productivity, as measured by sales per worker, has slowed considerably in the past decade, particularly in the several years leading up to the start of the Covid-19 pandemic in 2020. There is also considerable heterogeneity in productivity across Indian states: states in Western and Central India tend to have the highest average productivity, while states in the East and South have the lowest. These cross-state differences persist when controlling for state industrial composition. More generally, in alignment with the large economics literature on productivity dispersion, the difference in productivity across the most and least productive firms is vast in India, even after controlling for state and industry effects.

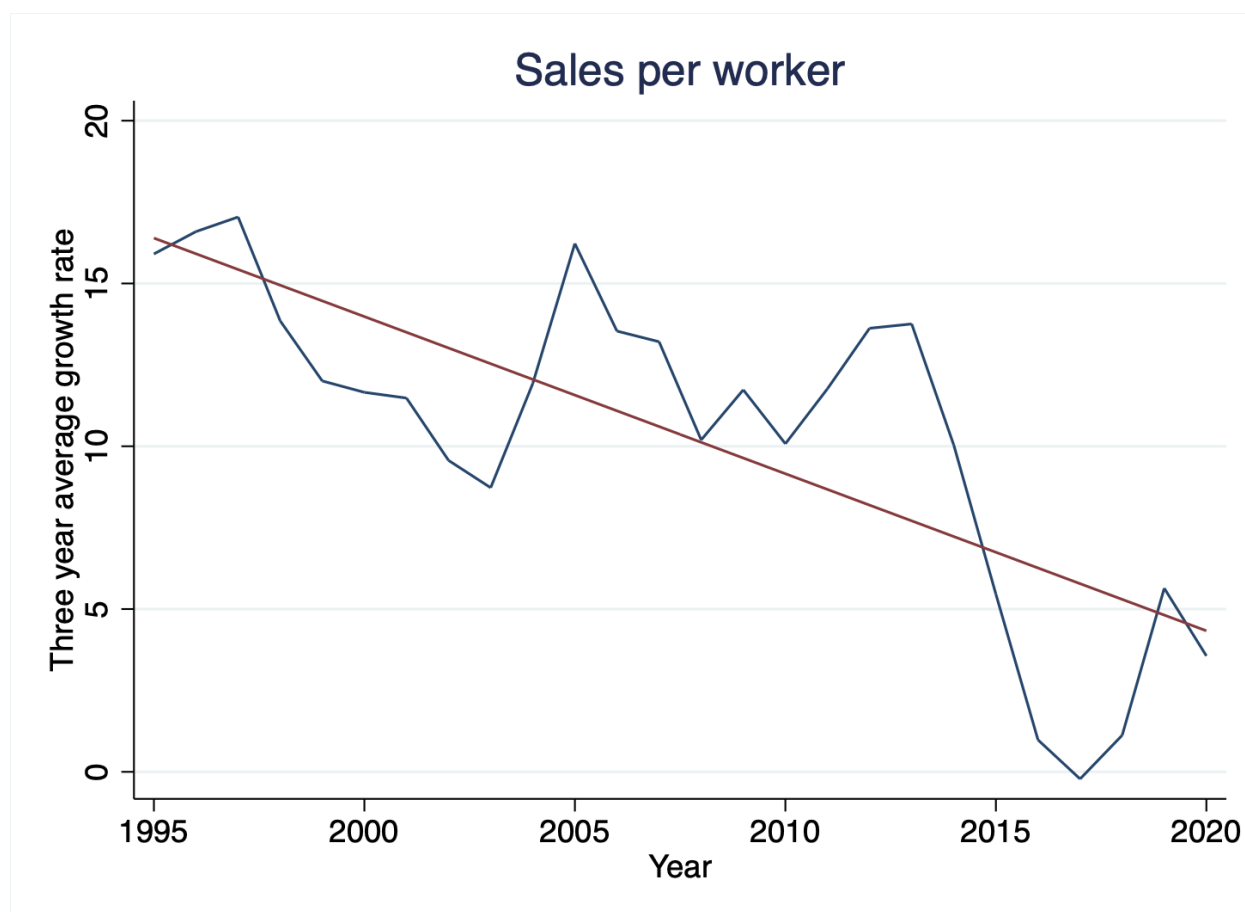
Having established these trends, we focus next on one potential determinant of firm productivity that we contend has received less academic and policy attention than others – e.g., capital misallocation, regulatory distortions, etc. – namely, firms' investments in their workers. While studies in economics have long recognized the importance of on-the-job human capital accumulation – e.g., Mincer (1962), Becker (1960) – advances in the estimation of causal treatment effects via randomized controlled trials or plausibly exogenous variation in investment have made possible the investigation of the impacts of such investments in the real world, particularly in low-income country contexts, where worker productivity is on average low (Bloom et al. 2010). To begin, we study this phenomenon across India by examining the relationship between productivity and so-called emoluments, which include wages as well as the value of all benefits provided to employees. We find that the two variables are very closely positively associated, indicating that the elasticity of productivity with respect to emoluments is nearly one-for-one in percentage terms. This magnitude remains unchanged when controlling for state-by-industry fixed effects, as well as a host of additional controls.

Though quite robust, the positive association between worker investment and productivity is not necessarily causal: unobserved choices of the firm may be correlated with both wage and benefit provision to employees on the one hand and productivity on the other. We then focus for the remainder of the paper on various categories of investment in workers and the causal evidence for their impacts on productivity. We look in particular at the potential impacts of investments in enhancing/ameliorating soft skills, voice, environmental conditions, managerial quality, and health for workers. Within each category, we review studies that establish causal impacts via prospective randomized controlled trials or via the use of credibly exogenous variation. We highlight the productivity impacts of such investments when these estimates are available, but also study other worker outcomes of relevance to the overall profitability of firms, e.g., turnover, absenteeism, task complexity, etc. Finally, we end with a discussion of a variety of reasons why firms might be underinvesting in their workers – what particular barriers might be faced, as well as market-related reasons for non-investment – and highlight the need for more research to understand firm behavior in this regard.

Some Stylized Facts on Manufacturing Productivity in India

Fact 1: Productivity growth in Indian manufacturing is slowing.

Throughout this section we use data from the Annual Survey of Industries (ASI), which comprises a representative sample of Indian manufacturing firms (and a census of large firms). We define productivity as revenue (sales) per worker. Figure 1 below shows the trend in the three-year moving average of aggregate (pan-India) annual productivity growth in manufacturing from 1990 to 2020. The figure reveals a general downward trend in productivity growth since the 1990s, accelerating in the mid-2010s and in the years leading up to the Covid-19 pandemic. The growth rate of productivity fluctuated between 10 to 15 percent in the 1990s and 2000s; productivity growth began to stagnate after 2015, and this negative trend accelerated into the several years preceding the pandemic.

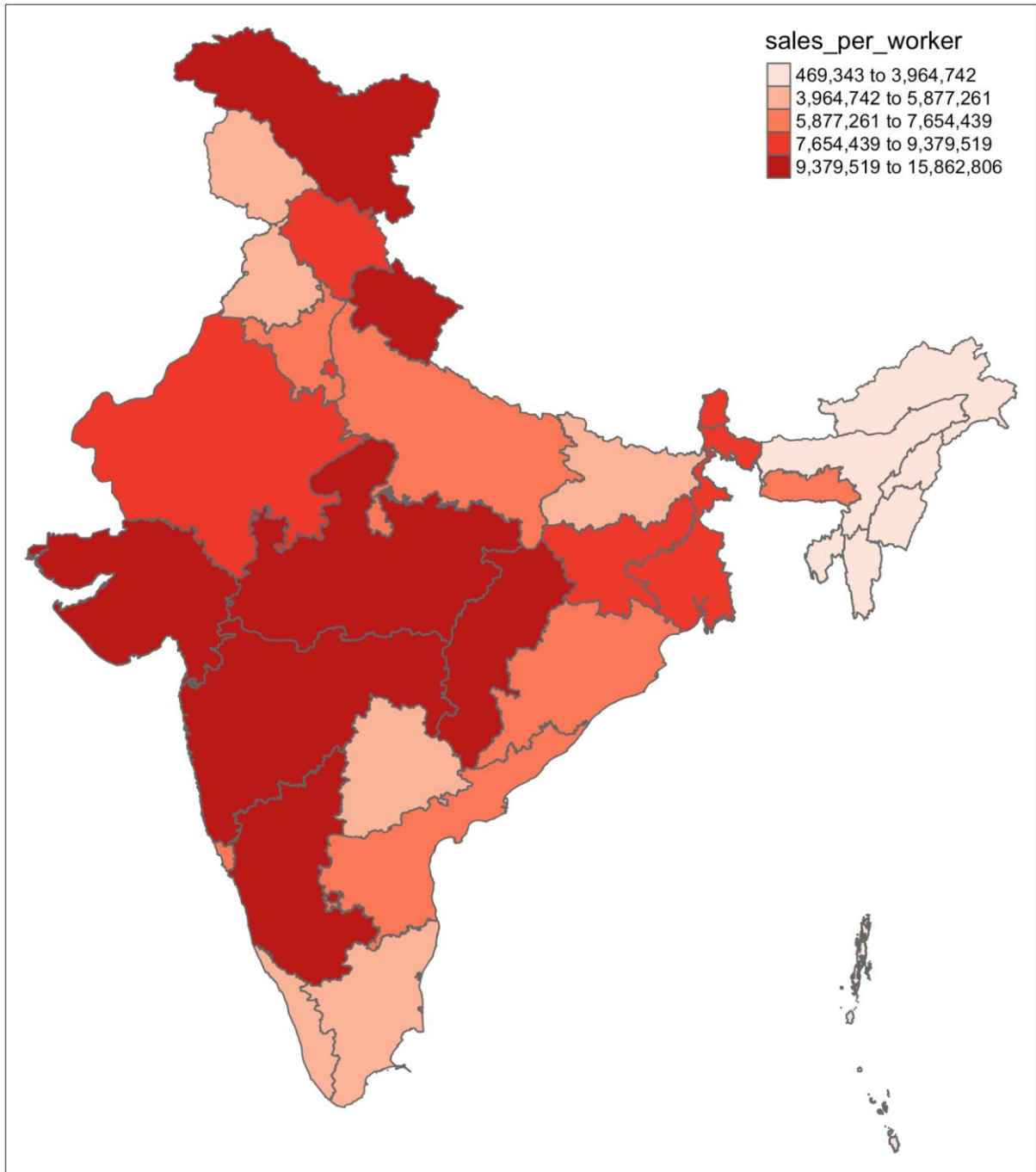


Fact 2: Indian manufacturing productivity is several times lower than that of the United States.

Consistent with a large literature documenting differences in productivity across countries, the level of manufacturing productivity in India (\$94,249) in 2020 was close to a fifth of manufacturing productivity in the United States (\$484,862, taken from the US Bureau of Labor Statistics (2021)). This is true even after adjustment for purchasing power (after accounting for PPP, Indian productivity rises to \$296,000 per worker, still only three-fifths of the figure in the US).

Fact 3: There is large dispersion in manufacturing productivity across Indian states and industries.

Figure 2 below depicts the dispersion of sales per worker across Indian states (using data from 2019-2020). Evidently there is substantial variation in the average productivity of states. For example, the sales per worker of the state at the 10th percentile of this productivity distribution is 1,731,143 INR (\$23,714) compared to the 90th percentile, which is 10,546,626 INR (\$144,474). This difference remains substantial even after accounting for state-level industry composition (using three-digit NIC categories). The industry-adjusted difference is still large: 3,397,654 INR (\$46,543) at the 10th percentile v. 8,815,486 INR (\$120,760) at the 90th. The adjusted difference is nearly 80% of the average productivity level across India. Western and Central Indian states tend to have the highest average productivity in manufacturing, while the Southern and Eastern states have the lowest. This is in contrast to the GDP per capita ranking of states, in which Southern states tend to have higher incomes than their Western and Central counterparts.



Fact 4: Productivity is strongly correlated with firms' investments in their workers.

We next examine firms' investments in workers and how these relate to productivity. As a proxy for investment we use so-called emoluments, data on which are collected for every firm in the ASI. Emoluments are defined as total payments made by the firm to its employees, which include wages as well as all goods or services provided to employees free of cost or at a subsidized rate (e.g., medical facilities, recreation, festival bonuses). Using 2019-2020 ASI data aggregated to the state level, we plot emoluments against productivity in Figure 3 below. As is evident, there is a tight positive association between the two across states. Disaggregating to the firm level, we regress log productivity on log emoluments (controlling for firm size), finding an elasticity close to

1 in percentage terms (see Table 1). This relationship is robust to the inclusion of state and industry fixed effects, as well as state-by-industry effects. This last, most stringent specification reflects the idea that the positive association between investments in workers and productivity persists even when comparing firms operating in the same industry and located in the same Indian states. Striking also is the fact that the coefficient changes very little with the addition of progressively more stringent fixed effects and controls.

Figure 3: Association between log productivity and log emoluments, aggregated data at state level for 2019-2020

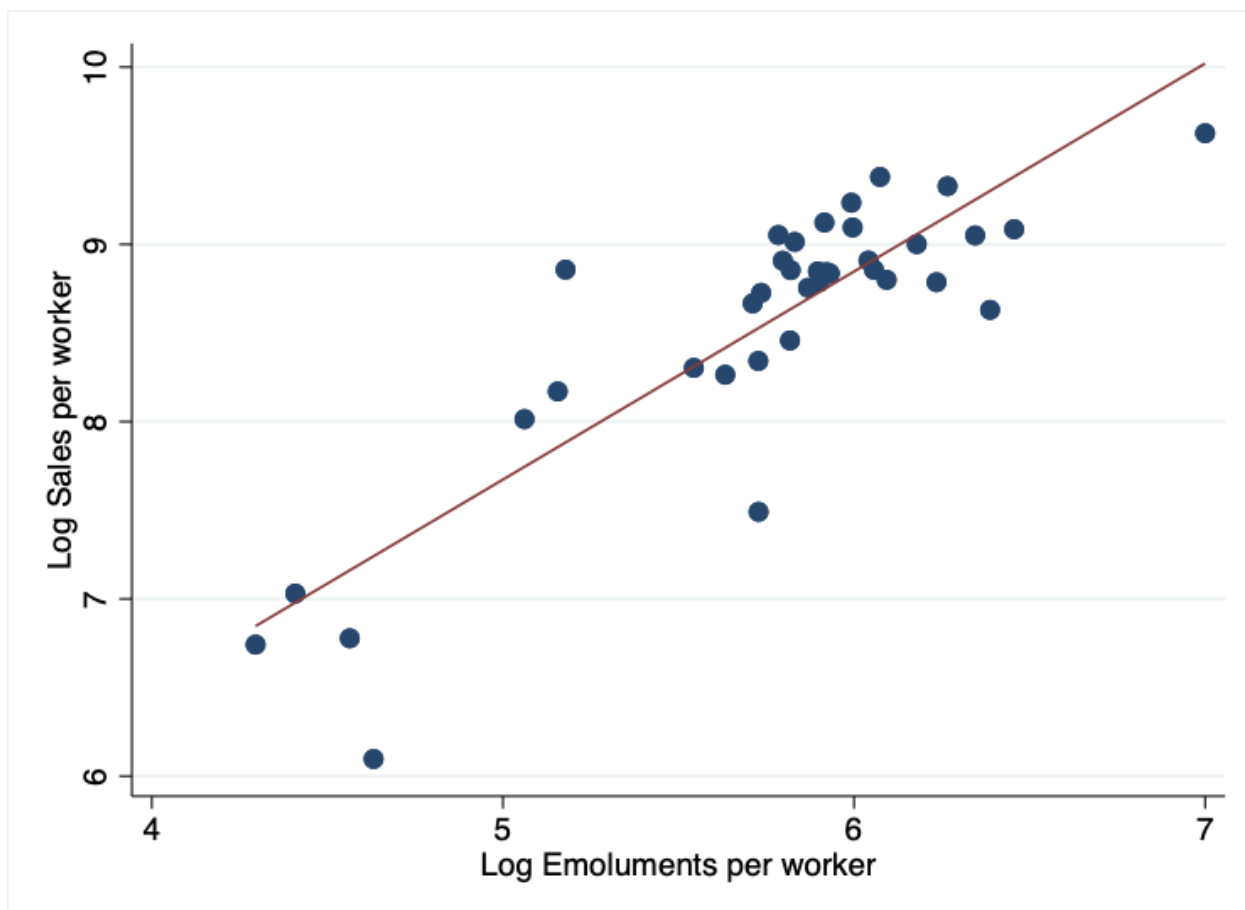


Table 1: Association between log productivity and log emoluments, firm-level data for 2019-2020

	Log (Sales)			
	(1)	(2)	(3)	(4)
Log(Emoluments)	1.047*** (0.006)	1.019*** (0.006)	0.997*** (0.006)	0.946*** (0.006)
Fixed effects:				
State	No	Yes	Yes	Yes
Industry	No	No	Yes	Yes
State X Industry	No	No	No	Yes
N	53009	53009	53009	53009

Notes: Standard errors in parentheses.

All regressions include log (number of workers) as control. For industry fixed effects, three digit NIC codes are used.

* p<0.05, ** p<0.01, *** p<0.001

Causal Evidence on the Impacts of Investments in Workers

Category 1: Soft Skills

In the manufacturing sector, most emphasis on worker training has been focused on the 'technical skills' due to, amongst other reasons, the repeated nature of tasks expected from these workers and the labor-intensive nature of the job. While these are crucial skills, particularly for frontline tasks, a growing pool of evidence has showcased the benefits of developing non-technical or “soft” skills (Bassi et al., 2022; Borghans et al., 2008; Deming, 2017; Groh et al., 2012; Guerra et al., 2014; Heckman and Kautz, 2012; Heckman et al., 2006; Montalvao et al., 2017). This body of work, largely focused on the OECD countries, documents that soft skills — e.g., time management, effective communication, problem-solving, teamwork, leadership, emotional processing, and self-regulation — are substantial contributors to earnings and job quality (and sometimes eclipse the contribution of so-called hard skills). These associations suggest that soft skills may be effective in a professional setting, and may also spill over to personal habits that impact the quality of worker development and performance.

The linkage between training and productivity has been established quite convincingly in high-income countries via randomized controlled trials. For example, in the Netherlands, De Grip and Sauermann (2012) tested the impact of providing soft skills training to call-center employees in the Netherlands. Employees in the treatment group were taught various skills, including; problem-solving, working under pressure, and effectively dealing with customer grievances. The control group received no training intervention. The researchers found that employees in the treatment group received ten percent higher ratings from customers than those in the control group who still needed the training.

In low-income countries, similarly, there is a growing body of recent evidence on the impacts of soft skills training for young people and workers. The lack of workers with such skills and emphasis on soft skills may reflect rooted social and economic issues, including low-quality education and cultural norms, especially around the role of women in society. An RCT in Turkey Alan et al., (2019) showed that teaching grit (defined as “perseverance in a productive task”) to schoolchildren increased math and verbal test scores. This study suggests that some of these school performance improvements could translate into improved outcomes in adulthood, given that better school outcomes increase the chances of high quality employment in future. Imparting soft-skills training to children at an impressionable age creates benefits in learning and may thus lead to better labor market outcomes.

Similarly, a study in Zambia, Ashraf et al., (2020) tested the impact of a soft skills training program on young girls. In the study's context, girls were found to drop out of school in large numbers despite good test scores. An explanation for this was that existent cultural and social contexts played a role in displayed behaviors; families had a limited budget and chose to educate boys instead of girls due to the belief that only men would be able to earn good incomes if educated. The researchers intervened in an attempt to correct this outlook by providing girls with more agency via negotiation skills, using a training program adapted from Harvard Business School's core course on negotiations. Girls who received the training were better able to negotiate for more time in school by helping out, doing household chores, and being nicer to their parents. This resulted in measurable movement in school enrollment for treated girls compared to controls. When considering soft-skills interventions in developing economies, this evidence demonstrates the benefits of investing in soft skills for school children, which may translate to adult labor market impacts through improvements in educational enrollment and performance.

The benefits of soft skills training on adults has also received attention in recent work. For instance, Campos et al., (2017) evaluated how improvements in the soft skills of micro-entrepreneurs impacted these businesses' sales effectiveness and profitability in Togo. The study provided two different types of training intervention; a standard business training on best practices (examples of modules taught included: record keeping, stock control, and marketing skills) and a novel soft skills training program that focused on changing mindsets around self-starting behavior, innovation, identifying and exploiting new opportunities, goal-setting, planning, feedback cycles, and overcoming obstacles. The researchers found that the entrepreneurs given soft skills training increased their sales by seventeen percent and their profits by thirty percent compared to the control group without training. They were also better at diversifying their product range and adopting new business practices, which gave them an edge over competitors in the market. The business training had no significant effect on firm outcomes. This result is interesting in not only helping us understand how soft skills can prove effective in the individual productivity of workers and affect profitability as a whole but how there may be a benefit to prioritizing training programs that encompass these traits as opposed to a standard form of training observed and adapted by business that focuses on best-practices. In addition to this, this study also highlighted the benefit of adapting training with consideration of the gender of the worker in mind. Results showed that while overall, the training had benefits for male and female entrepreneurs,

the soft-skills training proved particularly effective for women compared to the traditional business training, suggesting that training in soft skills could be used not only to improve productivity in general but also to close gender gaps in the workplace.

Given that information about job candidates' soft skills is likely poor, particularly in frictional labor markets in low-income country contexts, how might the ability to signal a high level of soft skills to employers change candidates' prospects? Bassi and Nansamba (2022) worked with a sample of young vocational training graduates, assessing each of the graduates' soft skills and creating certificates to signal results of these assessments. Examples of soft skills included communication and trustworthiness, which employers generally agreed to be important but difficult to observe. The young workers were eventually matched with small and medium enterprises (SMEs) for job interviews, where the researchers disclosed the certificates to the worker and the firm manager. This study found that this disclosure led both sides (worker and manager) to respond to certificates in terms of their beliefs; with workers, the certifications increased their labor market expectations, and with managers, it led to a positive re-evaluation of the workers' skills — the revision of beliefs led to improved assorted positive matching and higher wages. When followed up, these workers earned eleven percent more than their initial earnings two years later.

Firms can choose to bundle soft skills training with technical or on-the-job skills to provide more opportunities for workers to boost their earnings and for firms to increase their productivity by hiring and retaining 'well-rounded' workers. In Chioda et al. (2021), the researchers studied the effects of a three-week skills development program for high school students in Uganda. The program featured two treatments: the hard-skills MBA featured a mix of approximately 75% hard and 25% soft skills; the soft skills curriculum had the reverse mix. After a three-year follow-up, the results showed that the training effectively improved both hard and soft skills. However, only soft skills were directly linked to self-efficacy, persuasion, and negotiation improvements. The skill upgrade resulted in substantially higher earnings, 32.1%, and 29.8% increases for those who attended hard- and soft training, respectively, most of which was generated through self-employment. Furthermore, youth in both groups were more likely to start enterprises and more successful in ensuring their businesses survival. The program led to significantly larger profits (24.2% and 27.2% for hard- and soft- treatment arms respectively) and larger business capital investments (38.4% and 32.6% for hard and soft, respectively). This documents the value of soft skills for employers and how the lack of information on the skills of workers can contribute to keeping wages and productivity low by impeding the efficient matching of workers to firms. A credible signal from a trusted institution can significantly reduce information frictions.

Evidence from India shows similar patterns to research on investment in soft skills training, focusing on the benefits of training individual female workers and its effect on their well-being, overall productivity, and its contributions to the manufacturing sector. Working with workers from an Indian garment industry in Bangalore, Adhvaryu et al. (2022b) evaluated a soft skills training program and its impacts on employee and employer outcomes in a trial covering approximately 2,700 workers. The program tested was the Personal Advancement and Career Enhancement (P.A.C.E.) training program (developed by Gap, Inc.) on female garment workers, which emphasized Communication skills, Time management, Decision-making skills, Financial literacy, and

Problem-solving skills via weekly workplace group sessions. Women workers interested in the program signed up for a lottery, and amongst those interested, approximately a third were assigned to treatment, in which workers received the P.A.C.E training, and the remainder to control, where no training was received. The researchers measured workplace outcomes such as; retention, productivity, and salary via firm administrative data and survey data measuring changes in baseline levels of knowledge, behaviors, and personality traits of workers. Overall, the study found that workers trained by P.A.C.E displayed higher self-regard and sociability, which also translated to behaviors and attitudes (for example, trained workers were more likely to save for their children's education and use state-sponsored health care and pension schemes). Women also demonstrated relative confidence on the job about furthering their employment; they were fifteen percent more likely to request training in technical skills and approximately eight percentage points more likely to report that they expected a promotion within the next six months. On the employer side, performance increased with workers being more productive by seven percentage points post-training. Their retention was also three percent higher when enrolled in the program.

There appears to be a clear benefit of investing in soft skill training of workers in developing countries (where we observe a lack of soft skill emphasis), with the best approach being heavily dependent on the situation. Imparting soft skills show the benefits of improving educational and labor outcomes of individuals that can translate into higher productivity. Considering the investment of programs that impart these skills in schools can not only lead to increased test scores and improved educational outcomes, but it can also provide students (especially women) agency and control via better negotiation skills and confidence which can help overcome barriers and constraints they may be facing related to access to education and assimilate them better into the labor market. The value of soft skills is shown to improve the mindset of workers, who tend to view themselves in a more positive light after being trained and graded on their level, and this extends to employers as well, who are more likely to re-hire these employees. In India, the existing evidence on the benefits of soft skill programs points to the positive effects of such skilling (especially for female workers), emphasizing higher productivity for the firm and better worker outcomes on the job in their personal life.

Category 2: Voice

The relationship between employers and workers is of paramount importance to productivity. When that relationship becomes strained, both productivity as well as worker outcomes (job satisfaction, utility) could suffer. Hirschman (1970) famously championed the idea of "voice" in many domains of life, particularly around the idea of voice in the employment relationship. When faced with a challenge or grievance that threatens the relationship between employers and employees, workers face a choice, Hirschman argued. They can voice their discontent and precipitate improvements in this relationship, or they can exit the employment relationship by leaving the firm. Increasing workers' ability to use their voice could thus generate improvements to the relationship between workers and their employers, thus increasing productivity, via reductions in turnover, greater workplace effort, and/or improved information flow and coordination (Malcomson, 1983; Freeman & Lazear, 1995). In this subsection, we look at voice as a potential lever for productivity and review studies that estimate the causal impacts of increased voice.

While direct causal evidence generated in this space is limited, recent research has shown the benefits of amplifying workers' voices in differing industries. Cai & Wang (2022) conducted a study among auto workers in China, in which workers were allowed to evaluate their managers on managerial quality and well-being-related metrics. To address the reduction in productivity and increase in turnover observed in factories in China, the researchers tested an intervention that allowed workers to participate in their supervisor's evaluation. They found that by letting workers participate in the evaluation process, essentially turning a top-down process into a so-called "360" evaluation that includes the experiences of subordinates. Workers that participated in the manager evaluation were 6.2 percentage points less likely to quit the job, relative to the control group which corresponds to a treatment effect on worker turnover of over 50%. Although the evaluation system did not affect individual performance, team-level performance indicators (KPI) did increase significantly. This result is driven by the fact that trained teams have less worker turnover than control teams, and high turnover reduces productivity because new workers typically perform poorly at the beginning of their term and may need substantial training. In addition to this result, the study also observed a significant increase in the happiness and well-being of workers in teams who were allowed to evaluate their manager.

The capacity to enforce or update existing labor regulation is often weak in low-income country contexts (Dal Bó and Finan, 2016). In the case of the manufacturing sector, many multinational corporations (MNCs) enforce global standards of labor rights for their suppliers. Boudreau (2020) conducted an RCT in Bangladesh to assess the effects of MNC enforcement on establishments' compliance with Bangladesh's Safety Committees (SC) law. This law was an amendment passed in light of the Rana Plaza tragedy in 2013, but enforcement of the law was uneven. The study tested a six-month SC intervention to bring establishments into meaningful compliance with the law. This entailed monitoring SC activities and limited capacity building for SC members. The results of this study showed that the intervention group was more likely to comply with the SC law. The effects translated to better safety practices within treated factories, where workers within these factories were found to be far more likely to adhere to safety procedures than the control group. Despite this, full compliance with regulations was not achieved, and the likely reason for this is due to communication barriers between workers and management. Results on job satisfaction were mixed, with some workers expressing dissatisfaction due to poorly managed systems and disappointment with their establishments' SCs (particularly where overall managerial quality was low). This study highlights the importance of enforcement of workplace safety regulation and the effect it can have on worker safety (without accompanying reductions in productivity).

In India, recent research highlights the potential impacts of enhancing worker voice on satisfaction, effort, retention, and productivity. After a disappointingly small statutory minimum wage increase in 2016, Adhvaryu et al., (2022c) conducted an RCT within a ready-made garment firm to understand the importance of furthering workers' voices, especially during times of general discontent within a workplace. Workers were asked at random to fill out a feedback survey in which they were asked about their feelings regarding their supervisors, overall worker satisfaction, satisfaction with the firm, their wages, and their jobs. The treatment effect estimates show that enabling workers'

voices reduced the probability of quitting by 20 percentage points in the months following the wage hike. This effect was most substantial for workers most disappointed with the wage increment. At the average deviation from wage hike expectations (about 17 USD), treated workers were 19% less likely to quit than control workers; however, the treatment did not affect those whose expectations were exactly met. The negative interaction between voice and disappointment persisted even when heterogeneity was allowed in the voice effect across individuals with different outside options and other worker-level characteristics

Adhvaryu et al., (2021) evaluate the impact of increasing worker voice through a two-way, SMS based anonymous communication tool in two garment factories in India through an RCT. In the intervention, the workers can send their grievances and suggestions through an SMS. The phone numbers of the sender are masked by the system ensuring anonymity of the sender. The factory HR sends a request for any additional information or provides an update of the case to the workers through the platform without knowing the phone number of the workers. The tool was used by only 5% of the treated workers but they found reduction in absenteeism (5%) and attrition (10%) in the treated workers compared to the control group workers. In continuation of Adhvaryu et al., (2021), Adhvaryu et al., (2023a) tested a voice and SMS based anonymous two way communication tool in 43 garment factories in India with randomization at the factory level. A treatment arm that provided incentives to the HR department to resolve the cases in a timely and accurate manner. This treatment arm increased the productivity of the firm by 7.2%.

Category 3: Environmental Conditions

The physical environment of a worker likely has a significant influence on well-being and productivity. The growing rates of extreme heat and pollution, particularly in urban settings in low-income country contexts, which are accelerating due to climate change, potentially threaten both worker health and well being as well as firm performance.

Most major cities in India have faced increasingly worsening air quality. In 2022, India had 14 out of the 20 most polluted cities in the world regarding PM 2.5 concentrations, with other cities in the country also registering high levels of PM2 (Hindustan Times, 2022). There are clear consequences for health, such as decreased lung function, vision problems, and cognitive difficulties for people who live in these areas and breathe polluted air over long periods, which could generate substantial productivity losses for workers and firms. The Clean Air Fund (2019), for example, estimates that India loses three percent of its GDP due to air pollution every year. This is mainly due to workers falling sick and decreased footfall for businesses when people stay home.

The causal effects of pollution on workers have been examined in recent work. Zivin & Neidell (2012), for example, find that increased ozone exposure results in decreases in worker productivity for agricultural workers. Chang et al., (2019) study call center workers in China. The researchers set out to measure the effects of pollution on productivity by looking at the air pollution index (API), an aggregate of particulate matter and other airborne pollutants. This study shows sizable negative effects of pollution on productivity: a 10-unit increase in the API decreases the number of daily calls a worker handles by 0.35 percent. In India, studies in this space have examined the impact of air pollution and temperature on productivity and attempted to understand

and implement viable solutions to increase productivity and improve working conditions for manufacturing sector employees. Somanathan et al., (2021), for example, studied the effects of rising temperatures on worker productivity in Delhi and Gujarat, focusing also on how these effects vary between manual laborers and laborers in automated manufacturing settings. The researchers found that for a 1 degree Celsius increase in temperature, productivity subsequently saw a two percent reduction. These results show substantial heterogeneity across sectors. The link between ambient temperatures and productivity is not as strong in highly capital-intensive firms with many mechanized systems, while in labor-intensive industries, temperatures have a large effect on productivity. In these industries, when firms invest in cooling technologies, the authors show that the magnitude of the effect of temperature on productivity declines.

An important consequence of rising temperatures accelerated by climate change is increased heat exposure for workers on factory floors. In Adhvaryu et al., (2020), researchers estimated the productivity consequences of adopting energy-saving technology (LED lighting) using daily production line-level data from large garment firms operating factories in and around Bangalore, India. The garment factories initially used incandescent bulbs, the heat emanating from which would increase temperatures on production floors, affecting workers' productivity especially on exceedingly hot days. The authors show that introducing LED lighting on factory floors contributes less heat to the factory environment, and thus attenuates the negative relationship between mean daily outdoor temperatures and productivity. Specifically, introducing LEDs eliminates roughly eighty-five percent of the negative impact of temperature on worker efficiency during relatively hot days, which accounted for firm-wise productivity increases and shifted the overall break-even point for the firm from over three and a half years to less than eight months.

Coping with harmful air pollutants in a production setting is a challenge countless managers worldwide face. As it is often implausible to eliminate the cause of air pollution, managers must develop strategies to deal with unforeseen absenteeism when it affects a worker's health. To better understand what characteristics enable managers to best cope with the presence of air pollutants to ensure their workers remain productive, Adhvaryu et al., (2022a) studied how workers' productivity varied in the presence of fine particulate matter, a type of air pollution in garment factories across Delhi. The researchers used detailed administrative manager, line productivity, and survey data that captured their answers to task assignments and managerial characteristics. In addition, air pollution measurements were collected using five particulate matter monitors (PM) positioned at different locations at the garment factory. The monitors were placed to measure impacts using fluctuations in exposures to PM levels that vary at the line segment-by-hour level with sufficient variation across hours of the day for each worker and across workers positioned on different segments of different lines within an hour. The results show that fairly sizable particulate matter pollution shocks are commonplace and that worker- and line-level productivity suffer during these shocks. This relationship between pollution and productivity is small and linear; a one-standard-deviation increase in pollution decreases efficiency (a standardized productivity measure in the ready-made garments sector) by half a point. Further event study analysis confirms that large pollution shocks immediately affect worker productivity, with impacts varying across the tasks the worker performs and

the worker themselves; impacts are sixty percent larger for workers performing complex tasks and thirty-five percent larger for older workers. In addition to this, they also find differences in the way workers are allocated to tasks in production lines; managers who notice productivity declines in particular workers may find it optimal to reassign these workers to tasks in a way that reflects the limited ability of affected workers to exert effort in their assigned jobs. The probability of task reallocation on production lines increases by three percentage points following a one standard deviation increase in pollution. This shows that during a "pollution shock," workers are allocated away from the tasks that they are (idiosyncratically) "best" at in non-shock periods. This is because pollution shocks affect workers' performance most for baseline high-efficiency tasks; it may be optimal for managers to assign workers to tasks they are not well-suited to, especially in the absence of shocks.

In sum, environmental risks can hurt firm productivity by directly contributing to outcomes that can harm workers health and well-being. Investing in cost-effective solutions designed to alleviate some of the negative externalities commonly observed can be an excellent next step for firms to consider.

Category 4: Managerial Quality

Managers play an essential role in firm performance. Hiring and training good managers can help improve workers' well-being, boost productivity, and ultimately improve the firm's profitability. Evidence on the causal link between managerial quality and productivity is still relatively limited, especially in low-income country contexts. In microenterprises in Sri Lanka, De Mel et al. (2014) found that the most commonly used business training course offered among female entrepreneurs in Sri Lanka has little impact on business profits, sales, or capital stock. McKenzie & Woodruff (2014) assess evidence from several training programs in microenterprises in seven developing countries. They conclude that most training programs have insignificant effects on outcomes due to a lack of impacts on improving business practices and argue that more intensive training programs may be needed. Training programs for small entrepreneurs in developing countries are ineffective, which stresses the need for firms to find new ways to improve management abilities, either via mentoring or communication within a firm between managers. There are effective ways of improving management quality, yet this will depend on the approach a firm uses to tackle this problem and the content the training tackles.

International Finance Corporation (2009) evaluated the effects of a supervisory skills training program for garment factory supervisors in Cambodia, which aims to improve supervisor-worker relations by teaching supervisors effective leadership and communication skills. Supervisors were randomly chosen to enroll in a four-day, six-hour-a-day training course. Survey responses and factory administrative data were used to examine whether trained supervisors had better relationships with workers and whether workers' productivity was higher if supervisors were trained. The results indicated that the training program positively impacted the perception of job satisfaction and productivity. In this study, training managers at different levels yielded different effects. In particular, training direct (lower-level) supervisors is more important for improving the "soft" dimensions of the work environment, such as job satisfaction and day-to-day guidance, while training indirect (higher-level) supervisors matters most for "hard" dimensions, such as improved productivity. Evidence from this

study suggests that managerial skills are indeed teachable and do matter for both productivity and labor relations.

When targeting managerial quality, the important question arises: which specific management practices matter? Further, is there evidence on the effects of particular interventions to target those practices? In Bloom et al. (2012), improved managerial practices led to higher productivity through improved quality and efficiency and reduced inventory. The researchers showed that training firms in record-keeping and storage practices lead to a significant fall in inventory and dead stock. In the longer term (three years following the start of the intervention), firm size increased for these firms because the adoption of management practices allowed owners to oversee more production activities and delegate more decisions to their plant managers. These findings suggest that it is essential to look beyond the short and medium term to analyze long-term business outcomes, including longevity and business growth, and that policy interventions that target larger firms may be more desirable.

Similarly, Menzel (2021) documents how a management practice encouraging information sharing and knowledge exchange within a firm could increase productivity. The author ran a randomized experiment in which their supervisors instructed random pairs of workers to share production knowledge and experience when one worker started producing a garment the other had already produced. The results suggest that the intervention has a positive impact on the initial productivity of the later-starting workers. Therefore, managerial quality may affect productivity by providing a better environment for organizational learning.

Performance monitoring and the resolution of bottlenecks are important contributors to overall managerial quality. Adhvaryu et al. (2022d) study the impact of the introduction of a monitoring technology that allowed managers to track worker performance at drive-thru stations of a quick service restaurant chain in Puerto Rico. They find a 5% increase in sales in the two to three months following the technology's introduction, but this impact reduces to half that size after a few months. An important factor mediating this diminishing effect is the attention to skill levels of workers by the managers. Managers who utilize "refresher" training for workers before the technology's introduction had more persistent gains, and also utilized this training "technology" more intensively post-technology introduction, highlighting the importance of managers' ability to devote attention to worker skill stocks in mediating the impact of performance monitoring technologies.

Recent work in India sheds light on the relationship between managerial quality and productivity. In Adhvaryu et al. (2022d), the researchers study what specific aspects of managerial quality are most related to performance, and what workplace policies might allow for better selection and training of managers. They begin by noting that productivity amongst garment factory workers increases as teams spend more time making the same type of garment, with learning occurring faster when teams work on new orders. Teams also retain what they had previously learned (from making prior similar garments), and this knowledge decays over time. Their study leveraged survey data from managers of around 120 production lines and complemented this with two years of granular productivity data. These data provided insights into how management characteristics relate to these productivity dynamics. They find that factors related to

managerial attention and control are the most important for enabling line productivity, both more impactful than traditionally emphasized dimensions like cognitive skills and tenure. They document that one mechanism by which specific managerial practices contribute to productivity is by way of enabling faster learning-by-doing. In-sample pay patterns suggest potential net gains from screening for or training in less readily measured dimensions of managerial quality, as pass-through of productivity contributions to pay is incomplete.

Building on this work, Adhvaryu et al. (2023b), evaluated the impacts of a nine-month soft skills training program administered to garment production line supervisors in a set of Indian factories. For workers in these production lines, their interactions with the supervisors are a considerable portion of their day-to-day life and their experience with work. Having a more effective manager may increase productivity as well as compensation of workers. The training focused on the individual competencies of the supervisor, followed by their roles as supervisors, team members, and, ultimately, as leaders. After randomizing access to this training program for workers and supervisors, the researchers found that lines supervised by trained supervisors were on average seven percent more productive during training and six percent more productive in the post-training period. The study also highlights the role of middle management in the allocation of such training. Supervisors' managers were asked to help nominate supervisors from their teams for training, and randomization was conducted within these nomination rankings. The core result from this part of the study was that supervisors who were highly recommended demonstrated zero productivity gains, while supervisors who were less recommended showed large and persistent gains in productivity. The study goes on to show that this misallocation of training was due to competing incentives of middle management, particularly around the costs of supervisory turnover. This study demonstrates one way in which firms may face difficulties in implementing productivity-enhancing investments due to misalignment of incentives along the managerial hierarchy. (We discuss this nuance further in the next section of this paper.)

In sum, adopting productive management practices and improving the managerial skills of supervisors can significantly increase worker productivity and firm profitability. Emerging evidence demonstrates that improving managerial quality can generate considerable productivity increases. Some supervisory skills training programs have improved labor relations and narrowed the gender gap in managerial leadership. However, changing practices may face resistance from workers and result in adverse short-term effects on productivity. In addition, firms must design programs that fit their needs actively, given the size and skill level of the managers they hire.

Why don't firms invest more in workers?

Given the documented causal impacts of worker investments of various types on productivity, and in many cases, the documented substantial returns on such investments, why do firms not invest more in their workers? This question is similar to the so-called "innovation paradox" (Cirera and Maloney, 2017), which posits that despite the well-documented returns to innovation and investment, developing countries invest less in technology and innovation than advanced economies. We review several potential explanations below. We contend that this area of inquiry requires

much more rigorous empirical investigation, to understand which barriers to adoption are most salient in various contexts.

Information frictions. Firms may not know about the importance of worker investment in various categories, or may systematically underestimate the magnitudes of the impacts of such investments on productivity, lowering the perceived value of investment. This idea has received some recent attention in the public sector. Hjort et al. (2021) study the adoption of best practices, as identified by rigorous research, into the policymaking process by Brazilian politicians (mayors). They find that mayors are willing to pay to learn the results of impact evaluations, and incorporate these findings into their knowledge base when making policies. Informing mayors about research on the impacts of reminder letters for taxpayers increases the probability that their towns implement such a policy by 10 percentage points, suggesting that information frictions are quite salient in the non-adoption of best practices identified by research. The same argument could be made for top decision-makers at firms with regard to policies that research has identified as beneficial for productivity.

Even when some agents among the firm are well informed about the value of investing in workers, information frictions and high costs of communication within the firm could drive non-adoption if information does not flow to the right decision makers. In Sandvik et al. (2020), for example, the researchers studied call center workers in the US, running an RCT to test whether improving knowledge flow across workers improved productivity. Workers were assigned to random meetings with their peers in which they discussed sales techniques. The results showed that the meetings significantly improved employee performance as measured by revenue per call. In Menzel (2021), a similar experiment was conducted with three Bangladeshi garment firms. Supervisors overseeing a production line starting to produce a "non-first style" (a style of garment already produced elsewhere in the factory) were randomly required to meet with the supervisor of the original line. Productivity on the first day of the new line was higher as a result. These results taken in sum are consistent with the hypothesis that information sharing within firms is critical but highly frictional.

Risk aversion. Firms might not make worthwhile investments if there is uncertainty in the value of investments and decision-makers are risk averse. This might lead to classic under-experimentation (compared to a risk-neutral decision-maker) with investments in workers that might on average be very profitable. While little evidence exists on this motive within firms, it stands to reason that this explanation might be most relevant in the low-income country context, in which firms tend to be smaller and less resourced (or more credit constrained) than their higher-income country counterparts. This is similar to underinvestment in other realms, for example, in decisions to engage in temporary migration (Bryan et al., 2014).

Limited attention. Managers typically have a limited amount of attention which they can allocate toward activities within their span of control. Managerial inattention could impede the ability of the firm to either invest or implement effective strategies that seek to further worker productivity. There is a growing body of evidence supporting the general idea of managerial inattention being salient for productivity within firms. For instance, in the research highlighted above, Adhvaryu et al. (2022a) find that more attentive managers (i.e., those managers who monitor frontline workers more

frequently) – or perhaps managers whose idiosyncratic attention costs are lower – are more likely to relocate workers in response to adverse worker-level productivity shocks from pollution exposure and are better able to mitigate productivity losses on their lines. Similarly, in Bandiera et al., (2020), working with CEOs in six different countries, including India, the authors show firm performance is positively correlated with the amount of time CEOs spend in high-level, multi-function meetings rather than production activities. Finally, Lemos and Scur (2019) show that family-operated firms, for whom attention of top management is often stretched thin given that firm control is limited to family members, led to less adoption of structured management practices and worse firm performance. These various studies therefore suggest the important role that scarce managerial attention can play in reducing productivity, perhaps through the reduction of attention on profitable investments in workers.

Misalignment of incentives. Conflicting interests at varying levels of the firm hierarchy may cause frictions in the adoption of profitable practices, including investment in workers. For example, Atkin et al. (2017) introduced a new technology to make soccer balls more efficiently to 35 firms in Pakistan. They found that only six firms adopted the technology fifteen months into the trial. Through conversations with employers and workers, they found that while the new technology would have reduced waste and sped up production (and both parties knew this), workers found ways to discourage adoption because their incentives were not aligned with greater firm performance. The researchers conducted a second experiment to address this misalignment: employees received a bonus of a month's salary if they demonstrated the productivity benefits of the new technology in the presence of their employers. This generated a significant increase in adoption by firms, suggesting that a conflict of interest within the firm had been at least partially responsible for the initially slow adoption.

In a similar vein, in a study discussed earlier related to managerial training (Adhvaryu et al., 2023b), middle managers were asked to nominate their supervisors for the managerial training program. Randomization was then done within nomination ranks, thus allowing for the identification of heterogeneous effects by middle manager nomination categories. The authors find that supervisors who were highly recommended by their superiors actually had zero treatment effect on productivity, but a large treatment effect on retention. Low-recommendation supervisors showed exactly the opposite effects: they had large improvements in productivity but almost no impact on retention. The authors make sense of these results by elucidating a wedge between the incentives of the firm's upper management, which cares about maximizing firm productivity alone, versus middle managers, who care about productivity but also have high personal costs to supervisory turnover in terms of finding and onboarding replacements. Thus, recommendations deviate from the optimal in terms of productivity gains, because supervisor retention is particularly valuable to middle managers. This divergence in incentives could lead the firm to conclude that supervisory training is not very effective (if highly recommended supervisors were alone given access to the training), and generate non-adoption of an otherwise very profitable investment.

Turnover erodes the value of investing in workers. Becker (1960) famously contended that firms in perfect labor markets should not invest to train their workers in general skills. This might lead to underskilling in equilibrium if, for example, workers are very

credit constrained, as they might be particularly in low-income country contexts. Becker distinguished the skills a worker can learn on the job and the different valuations of these skills in the labor market as either specific or general. *General skills* are defined as those that are useful to all employers. In contrast, specific skills only increase a worker's productivity in their current job. He remarked that when labor markets are perfectly competitive, workers would be the sole beneficiaries of the improvements in their productivity – i.e., if training increased marginal productivity, the labor market would ensure that firms would have to pay these workers more, or they would leave and earn more elsewhere as a result of their increased marginal products. This would mean the return to the firm from training in general skills would be zero. Thus, there is no economic incentive to invest in workers' skills from the firm's point of view when labor markets are perfect; workers would have to invest in their own skills to improve their productivity. Under different assumptions of frictions in the labor market (in the form of information asymmetry, slow employer learning, or search frictions), however, as Acemoglu and Pischke (1999, 2000), Autor (2001), and others have pointed out, there could in equilibrium indeed be a wedge between workers' wages and marginal products, setting up a rent from general training for the firm. Therefore, underinvestment in worker skills could arise in equilibrium if labor markets were fluid enough.

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