Does Piece Rate Pay Impact Perceived Occupational Hazards in Garment Factories?

Evidence from Vietnam

26
DISCUSSION PAPER

JUNE 2018

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International Labour Organization

IFC International Finance Corporation WORLD BANK GROUP

BetterWork

ILO CATALOGUING IN PUBLICATION DATA

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International Labour Office

piece rate/ work environment/ perceived risk/ Vietnam

June 2018

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First published June 2018

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Does Piece Rate Pay Impact Perceived Occupational Hazards in Garment Factories?

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Key words: piece rate, work environment, perceived risk, Better Work, Vietnam

ACKNOWLEDGEMENTS

The data used in this study were collected as part of the Better Work global programme, a joint initiative of the International Labour Organization and the International Finance Corporation.

What this paper adds:

- Piece rate work has been linked to increased occupational accident and injury risk. However, the impact of the piece rate on worker perceptions of hazards within their work environment has not previously been identified.
- Piece rate work compared to hourly pay is consistently shown to significantly increase worker concerns of occupational hazards in their work environment.
- This paper lends support to suggest an important mitigating role of worker perceptions in understanding the impact of the piece rate on occupational health and safety.

ABSTRACT

Piece rate pay remains a common form of compensation in developing world industries, such as 'pay by the piece' in the garment sector. While the piece rate may boost productivity, it has been shown to have unintended consequences on occupational safety and health, including increased accident and injury risk. This study uses a large survey of garment workers in 109 Vietnamese factories along with compliance data on occupational health and safety standards collected between 2010 and 2014 to explore the relationship between how workers are paid and their perceptions of occupational hazards. A random effects logit model is estimated that controls for factory and year, predicting perception of work environment hazards as a function of pay type, worker demographics, and factory characteristics. Wage incentives such as piece rate and quota work provide the most consistently significant evidence of an effect on worker perceptions of all the variables in the model, including the factory's own performance on occupational safety and health compliance measures. The conditional odds of reporting a hazardous work environment concern for piece rate or quota workers ranges between 1.34 and 2.30 times that of hourly paid workers. These results provide initial evidence to support an important role for worker perceptions in understanding the relationship between piece rate work and occupational health outcomes.

Key words: piece rate, work environment, perceived risk, occupational hazard, Vietnam, Better work, garment sector

BACKGROUND

Performance-based pay systems such as the piece rate are frequently used to encourage workers to be more productive on the job. Piece rate pay, which rewards speed and intensity at the expense of health promoting behaviors such as machine safety maintenance, taking work breaks, and accessing medical services (MacDonald and Marx, 2001), has been associated with increased job injury and accident risks (Johansson et al., 2010). This form of compensation is particularly common among low wage industries in the developing world where output is measurable, such as agriculture (by the bushel) or apparel (by the garment), and where the intrinsic motivation to work for exploitative wages may be low (Rourke, 2014).

While the piece rate is generally understood as an effective means of boosting worker performance (Gielen et al., 2010; Laear, 2000; Lazear and Oyer, 2007; Shearer, 2004), the impact on profits is less straightforward (Asch 1990; Freeman and Kleiner, 2005). Recent evidence suggests that gains in productivity may be offset by maladaptive worker behaviors (including those detrimental to health) that ultimately increase operating costs and lower profits (Artz and Heywood, 2015). Intuitively, the connection between piece rate and worker health makes sense, as financial incentives that speed the pace of work may also result in less worker investment in safety precautions, particularly those that slow the pace of work. MacDonald and Marx (2001) suggested that the piece rate leads workers to shirk on health promoting activities such as machine safety maintenance, work breaks, and medical visits that would otherwise reduce job injury and accident risks. Based on the existing research, it is unclear whether there remains a modern day business case for piece rate pay in occupationally hazardous industries such as the garment sector. This is particularly true in the developing world, where a culture of abuse can notably lessen a worker's sense of control over their own output, which could weaken or even reverse the standard productivity boost from piece rate pay (Lazear and Oyer, 2007).

The understanding that piece rate incentives might have a detrimental effect on worker health is nothing new. Adam Smith conjectured as early as 1776 that 'workmen…when they are liberally paid by the piece, are very apt to overwork themselves, and to ruin their health and constitution in a few years' (Smith, 1776). Subsequent studies have shown an elevated accident and injury risk of piece rate pay in a number of industries (McCurdy et al., 2003; Saha et al., 2004; Sundstroem-Frisk, 1984). Cross-industry analyses in Europe (Bender et al., 2012) and the United States (Artz and Heywood, 2015) provide additional support for the negative effect of piece rate on occupational health outcomes. Increased medical symptoms have also been observed among piece rate workers, including elevated heart rate (Toupin et al., 2007), absenteeism (Frick et al., 2013), medication usage (Vinet et al., 1989), body mass index (Foster and Rosenzweig, 1994), lower levels of self-reported health (Bender and Theodossiou, 2014), and higher levels of depression and somatic complaints (Shirom et al., 1999). In a study of Vietnamese garment workers, workers paid by the piece reported worse physical and emotional health than workers paid by the hour (Davis, 2016).

An important yet unexplored aspect of piece rate work is the extent to which this system of compensation impacts worker *perceptions* of hazards within their physical work environment. Using a large-scale dataset of garment workers across 109 factories in Vietnam 2010-2014, this study provides evidence of higher levels of work environment concern among piece rate workers versus hourly paid workers. Variability in perceived hazards across pay types may be responsible for some of the observed differences in accident and injury risks, and represent and important mitigating factor in understanding how the piece rate impacts occupational safety and health.

METHODS

In response to growing international concern over working conditions in the global garment sector, a program known as Better Work was founded in 2007 as a joint initiative of the International Finance Corporation and the International Labour Organization. Better Work provides monitoring and assistance on compliance with international and national labour laws in participating countries, and has been operating in Vietnam since 2009. As part of their effort to provide support and encourage improvements in working conditions in the Vietnamese garment industry, Better Work has been conducting annual surveys of workers and managers in a subset of participating factories since 2010. These surveys provide critical information at the worker level on perceived occupational stressors and hazards. Specifically, workers report whether they are concerned about temperature, dangerous equipment, accidents, air quality, and chemicals. The survey data also include information on worker demographic characteristics, factory operations, and worker compensation, which is further broken down by production quota and piece rate pay. A list of the relevant survey questions are provided in Table 1. The survey protocol was approved by the Tufts University Institutional Review Board.

Worker survey data are available from a total of 109 factories between 2010 and 2014, with a target sample of 30 workers surveyed at each factory. However, not all factories were available across all years, resulting in an unbalanced data panel. Despite the original intent of the study design to resurvey the same workers every year, turnover was a major challenge and it is unclear from the available data whether a worker represents a repeat observation. Additionally, data on factory-level compliance with occupational safety and health regulations were also available, allowing us to link differing OSH compliance rates at the factory-level with individual worker perceptions of these same hazards.

Table 1: Description of Survey Questions

	Survey Question
Worker Self-Reported Occupational Safety Concerns	
Temperature	Are workers concerned that this factory is too hot or too cold?
Dangerous Equipment	Are workers concerned about dangerous equipment or machinery?
Accidents	Are workers concerned about accidents or injuries in this factory?
Air Quality	Are workers concerned about dusty or polluted air in this factory?
Chemicals	Are workers concerned about bad chemical smells in the factory?
Performance Based Pay	
Piece Rate	How is your pay determined?
Quota	Does your supervisor set a production target or quota for you?
Worker and Factory Variables	
Sex	What is your gender?
Age	Calculated based on – What year were you born?
Education	What is your highest level of education?
Marital Status	What is your current marital status?
Sewer	What is your job in the factory? Sewer?
Tenure	Have you been in this position for more than one year?
Hours Worked	Total number of hours worked in a week
Monthly Pay	In Vietnamese Dong, monthly estimates calculated based on reported typical paycheck
Current Employees	Estimate of the current number of employees at the factory
Injury Treatment	Have you visited a health facility in the past year for treatment of injury?
Illness Treatment	Have you visited a health facility in the past year for treatment of illness?
OSH Compliance*	Average performance on all compliance questions related to occupational safety and health

*OSH: Occupational Safety and Health

Analytical Approach

A logit model was used to predict worker concerns based on a series of covariates reflecting worker and factory characteristics, as well as pay type. The model was adjusted with a random effects intercept to control for factory level differences, along with year-specific dummy variables to control for changes over time. More specifically, the xtlogit command in STATA 14 (College Station, TX) was used to estimate the following equation:

$$I_{it}=\alpha_0+ \beta x_{it}+ \delta W_{it}+ \varphi PayType+ \sigma_i+ \kappa_t + \varepsilon_{it}$$

where i and t index factories and years, I is the presence of perceived hazard, X is a vector of worker demographic characteristics, W is a vector of factory characteristics, PayType is the existence of performance based pay (in this case, piece rate or quota), σ is the random factory effect and κ represents year-specific dummy variables. The logit model coefficients and p-values are reported for all variables, as well as the conditional odds ratios for the piece rate pay variables.

The PayType variable specifications represent binary responses to the survey questions about whether the surveyed worker is subject to a production quota (no=0, yes=1) or is paid at least some percentage by piece rate (hourly=0, piece=1). Additionally, piece rate is further broken down into three separate categories [hourly=0, partial piece (1-99%), all piece=2] to determine whether variability in scope of the piece rate impacts worker perceptions. The partial piece rate

definition allows us to assess whether a hybrid pay system of hourly pay plus production incentives has a differential impact on worker perceptions of OSH hazards in their work environments. A final alternative specification of the model ran separate regressions by year to eliminate potential bias from the repeat workers in the sample.

RESULTS

Table 2 summarizes the survey data, including worker perceptions of occupational hazards and demographic characteristics, as well as factory-level data and compensation information. Only 3-12% of sampled workers reported some concern with their work environment, with the highest level of concern related to temperature. Nearly 37% of workers reported that they faced a production quota (either daily or weekly), while 28% reported to be paid at least in part by the piece produced (alternately, 72% of the sample represented hourly wage workers). The demographic data suggests a dominantly female workforce in their early thirties, working in a factory with on average 5,000 other workers. Over half of the population was married and educated through lower secondary school. Approximately half of the sample worked as sewers, and most had worked at their present factory for at least a year. The Vietnamese garment workers in this sample worked an average of 90 hours per week, earning the equivalent of $156 US per month or 40 cents an hour. Two percent of workers were reportedly treated at a medical facility for injuries in the past year, while a quarter had been treated for illnesses. Finally, a composite measure of compliance with occupational safety and health (OSH) standards as determined by Vietnamese and international labor law was generated as an average value of all OSH compliance checks performed by Better Work at the factories. The composite OSH compliance index shows a relatively high degree of compliance within the sampled factories, with an average of 86% compliance rate.

Tables 3-5 describe the results of the analyses by piece rate and quota pay systems. The existence of wage incentives consistently and significantly increased worker concerns about their occupational environments. Interestingly, when the piece rate is broken down into partial versus all piece rate pay (Table 4), the consistently significant effect comes from the partial piece rate system. As noted in Table 6, the conditional odds of a piece rate worker reporting concerns were between 1.34 and 2.30 times that of workers under set hourly wages. The results are similar for workers under a production quota, with increased conditional odds of reporting an occupational safety concern between 1.26 and 1.99 times the hourly wage worker. The results for age and marriage suggest a negative effect on reported concerns (young unmarried workers were more likely to report concerns), while higher levels of education were significantly associated with greater concern. An increase in the number of hours worked per week had a decreasing effect on the odds of reporting concern, while increased tenure on the job (>1 year) was significantly associated with elevated concern over temperature. A factory's compliance with existing occupational standards had a statistically significant impact on worker concerns only as it related to chemicals in the piece rate specification.

Table 2: Summary Statistics

	Obs	Variable	Mean	Median	SD
Worker Self-Reported Occupational Safety Concerns					
Temperature	5,813	0=No, 1=Yes	12.3%		
Dangerous Equipment	5,804	0=No, 1=Yes	3.1%		
Accidents	5,795	0=No, 1=Yes	3.1%		
Air Quality	5,801	0=No, 1=Yes	11.1%		
Chemicals	5,800	0=No, 1=Yes	6.7%		
Incentive Pay Type					
Quota	5,758	0=No, 1=Yes	36.7%		
Piece Rate	5,687	0=By the Hour 1=Partial by the Hour and by the Piece 2=All by the Piece	0=72.0% 1=8.1% 2=20.0%		
Worker and Factory Variables					
Sex	5,823	0=Male, 1=Female	81.4%		
Age	5,819	Continuous	31.58	30.0	7.18
Education	5,882	1=Primary School or Lower 2=Lower Secondary School 3=Upper Secondary School or Higher	1=12.4% 2=58.7% 3=28.9%		
Marital Status	5,823	0=Not Married, 1=Married	58.0%		
Sewer	5,816	0=No, 1=Yes	49.9%		
Tenure	5,821	0=No, 1=Yes	78.7%		
Hours Worked	5,621	Continuous	90.13	94.17	25.57
Monthly Pay	5,669	Continuous	3,511,652	3,500,000	3,217,357
Current Employees	5,030	Continuous	1,544.59	984	1,577.24
Injury Treatment	5,808	0=No, 1=Yes	2.1%		
Illness Treatment	5,808	0=No, 1=Yes	25.0%		
OSH Compliance	6,514	1=Non-Compliant, 0=Otherwise	0.14	0.13	0.09

Table 3: Worker Self-Reported Occupational Safety Concerns by Piece Rate[t]

	Temperature	Air Quality	Chemicals	Accidents	Dangerous Equipment
Piece Rate	0.29**	0.29**	0.40**	0.50**	0.39*
Sex	0.20	0.09	-0.02	-0.09	-0.32
Age	-0.03***	-0.01	-0.02	-0.02	-0.04**
Education 2	-0.11	0.19	-0.07	0.12	1.15**
Education 3	0.07	0.39**	0.29	0.66*	1.64***
Marital status	-0.10	-0.18	-0.43***	-0.42**	-0.39*
Sewer	0.04	-0.01	-0.22	-0.60***	-0.18
Tenure	0.32**	0.18	0.01	-0.25	0.08
Hours Worked	-0.001	-0.01***	-0.003	-0.01***	-0.01***
Usual Pay	2.49e-08	8.23e-09	-1.91e-08	2.08e-08	4.68e-08**
Current Employees	3.46e-06	0.00002	-0.0002	2.05e-08	-0.00004
Injury Treatment	0.19	-0.18	0.42	0.74	0.67
Illness Treatment	0.24**	0.17	0.11	0.02	0.23
OSH Compliance	1.07	1.84*	2.29*	1.15	1.30
Constant	-2.30***	-3.03***	-2.62***	-2.21***	-3.24***
# Obs	4,606	4,601	4,601	4,602	4,604
# Factories	109	109	109	109	109

[t]All random effects logit models control for year and factory; *** p<0.01, ** p<0.05, * p<0.10

Table 4: Worker Self-Reported Occupational Safety Concerns by Structured Piece Rate[t]

	Temperature	Air Quality	Chemicals	Accidents	Dangerous Equipment
Hourly Pay (Reference Group)					
Partial Piece Rate	0.44**	0.25	0.65***	0.83***	0.64**
All Piece Rate	0.17	0.33*	0.16	0.20	0.16
Sex	0.19	0.09	-0.03	-0.11	-0.33
Age	-0.03***	-0.01	-0.02	-0.02	-0.04**
Education 2	-0.12	0.19**	-0.08	0.10	1.13**
Education 3	0.05	0.40	0.27	0.60*	1.61***
Marital status	-0.09	-0.18	-0.42***	-0.41*	-0.38*
Sewer	0.05	-0.01	-0.22	-0.58***	-0.17
Tenure	0.32**	0.17	0.01	-0.25	0.08
Hours Worked	-0.001	-0.01***	-0.003	-0101***	-0.01***
Usual Pay	2.47e-08	8.35e-09	-2.09e-08	2.04e-08	4.64e-08**
Current Employees	3.41e-06	0.00002	-0.00002	4.40e-07	-0.00004
Injury Treatment	0.16	-0.18	0.39	0.69	0.63
Illness Treatment	0.24**	0.17	0.11	0.01	0.22
OSH Compliance	1.08	1.84*	2.35*	1.31	1.44
Constant	-2.28***	-3.03***	-2.58***	-2.18***	-3.22***
# Obs	4,606	4,601	4,601	4,602	4,604
# Factories	109	109	109	109	109

[t]All random effects logit models control for year and factory; *** p<0.01, ** p<0.05, * p<0.10

Table 5: Worker Self-Reported Occupational Safety Concerns by Quota[t]

	Temperature	Air Quality	Chemicals	Accidents	Dangerous Equipment
Quota	0.39***	0.23**	0.69***	0.66***	0.66***
Sex	0.17	0.04	-0.08	-0.15	-0.46
Age	-0.03***	-0.01	-0.02	-0.02	-0.03*
Education 2	-0.16	0.15	-0.13	0.001	1.15**
Education 3	0.02	0.33*	0.14	0.48	1.56***
Marital status	-0.11	-0.16	-0.41***	-0.37*	-0.34
Sewer	0.03	-0.001	-0.28*	-0.64***	-0.20
Tenure	0.28**	0.15	-0.04	-0.27	0.04
Hours Worked	-0.001	-0.01***	-0.003	-0.01***	-0.01***
Usual Pay	2.04e-08	6.84e-09	-2.52e-08	1.62e-08	4.22e-08**
Current Employees	2.48e-07	0.00001	-0.00004	2.45e-06	-0.0001
Injury Treatment	0.06	-0.33	0.24	0.42	0.37
Illness Treatment	0.18*	0.16	0.11	-0.02	0.23
OSH Compliance	1.18	1.89*	2.48**	1.15	1.29
Constant	-2.27	-2.92***	-2.62***	-2.09***	-3.27***
# Obs	4,664	4,658	4,658	4,656	4,660
# Factories	109	109	109	109	109

[t]All random effects logit models control for year and factory; *** p<0.01, ** p<0.05, * p<0.10

Table 6: Reported Odds Ratios for Worker Self-Reported Occupational Safety Concerns

	Temperature	Air Quality	Chemicals	Accidents	Dangerous Equipment
Piece Rate	1.34** (1.01-1.77)	1.34** (1.01-1.77)	1.49** (1.06-2.10)	1.65** (1.08-2.52)	1.48* (0.95-2.30)
Quota	1.47*** (1.20-1.78)	1.26** (1.02-1.56)	1.99*** (1.51-2.60)	1.93*** (1.34-2.79)	1.93*** (1.33-2.80)
Hourly Pay (Reference Group)					
Partial Piece Rate	1.55** (1.09-2.20)	1.28 (0.88-1.85)	1.91*** (1.26-2.90)	2.30*** (1.37-3.85)	1.90** (1.11-3.27)
All Piece Rate	1.19 (0.85-1.66)	1.39* (0.99-1.93)	1.17 (0.76-1.79)	1.22 (0.71-2.08)	1.18 (0.68-2.04)

Table 7 presents the conditional odds ratios estimated separately by year for the binary specifications of quota and piece rate pay. Overall, the reduced sample sizes and lack of substantial variability within a given year for some of the categorical variables made interpreting the separate annual regressions problematic. Although the trends remain generally consistent with the primary estimates presented in the full data analyses, the confidence intervals are much larger in the year specific models. Also notable are the larger point estimates on the conditional odds ratios, particularly as it relates to the relationship between the quota and increased concern over occupational hazards.

Table 7: Reported Odds Ratios for Annual Regressions

		Temperature	Air Quality	Chemicals	Accidents	Dangerous Equipment
2010 (Obs=1,060)	Piece Rate	0.56** (0.35-0.90)	1.00 (0.6-1.63)	1.05 (0.61-1.83)	1.25 (0.57-2.75)	1.27 (0.60-2.69)
	Quota	2.05*** (1.38-3.05)	2.36*** (1.52-3.69)	1.96*** (1.20-3.21)	2.32** (1.12-4.81)	1.62 (0.80-3.28)
2011 (Obs=1,004)	Piece Rate	0.89 (0.54-1.46)	0.77 (0.44-1.33)	0.88 (0.48-1.60)	1.20 (0.52-2.79)	0.64 (0.25-1.64)
	Quota	1.46* 0.98-2.16)	1.89*** (1.24-2.87)	2.42*** (1.52-3.86)	2.60*** (1.29-5.28)	2.05** (1.07-3.93)
2012 (Obs=1,015)	Piece Rate	1.15 (0.78-1.69)	1.00 (0.70-1.42)	1.16 (0.72-1.89)	1.48 (0.71-3.10)	1.01 (0.45-2.26)
	Quota	1.82*** (1.25-2.66)	1.09 (0.77-1.54)	1.66** (1.03-2.67)	2.50** (1.18-5.27)	2.71** (1.21-6.07)
2013 (Obs=1,253)	Piece Rate	0.95 (0.63-1.42)	1.06 (0.67-1.68)	0.70 (0.31-1.57)	0.99 (0.36-2.73)	3.24** (1.15-9.11)
	Quota	0.80 (0.55-1.15)	0.70 (0.45-1.08)	1.15 (0.58-2.27)	0.76 (0.30-1.97)	1.31 (0.50-3.43)
2014 (Obs=292)	Piece Rate	4.99** (1.37-18.19)	4.32** (1.36-13.69)	1.07 (0.30-3.79)	4.06 (0.58-28.61)	8.54* (0.79-92.04)
	Quota	2.78* (0.97-8.00)	1.90 (0.72-5.00)	2.28 (0.75-6.97)	1.85 (0.34-10.25)	2.85 (0.49-16.50)

CONCLUSIONS

The evidence presented in this paper provides initial support for the presence of worker *perceptions* as a mitigating factor in understanding how the piece rate impacts important indicators of occupational health and safety. The results suggest that wage incentives such as quota and piece rate pay impact worker perceptions of hazards within their work environment. Worker concerns with temperature, air quality, chemicals, accidents, and dangerous equipment were all statistically and significantly elevated for workers compensated by performance based pay systems. In fact, these wage incentives provide the most consistently significant evidence of an effect across all of the demographic and factory level variables in the models, including the factory's own performance on occupational safety and health compliance measures.

These results present a new concept within the occupational safety literature, addressing the relationship between how a worker is paid and their perception of work environment hazards. Although the available literature on the topic suggests that the piece rate has negative consequences for worker *health*, no other research has explored the extent to which worker *perceptions* of occupational hazards might also be affected by differences in pay type. Future research is needed to better understand the relationship between wage structure, perceived hazards, and occupational health outcomes before specific policy recommendations and conclusions can be drawn from this work.

Limitations

The dataset present represents a rich source of worker level information, covering more than 5,000 workers at 109 Vietnamese garment factories during a five-year period. However, short of running all regressions separately by year (see Table 6), it was impossible to control for potential bias related to repeat surveys of workers in the full model due to the lack of personal identifiers linking workers across years. Also, although information was available on compliance with occupational standards as well as worker reported medical visits for illness and injury, the survey did not collect systematic and detailed information on accidents and injuries within the factories. These data would have been useful to parse out the effects of perceived hazards from actual accidents and injuries, and to better understand the mechanism behind performance based pay and poor occupational health outcomes.

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