Investments in Worker Health and Labor Productivity: Evidence from Vietnam

Massimo Filippini[1] & Suchita Srinivasan[2]

[1]Centre for Energy Policy and Economics, ETH Zürich, Zürich, Switzerland and Universita della Svizzera Italiana (USI), Switzerland

[2]Centre for Energy Policy and Economics, ETH Zürich, Zürich, Switzerland

UNU-WIDER Development Conference, Bangkok, Thailand

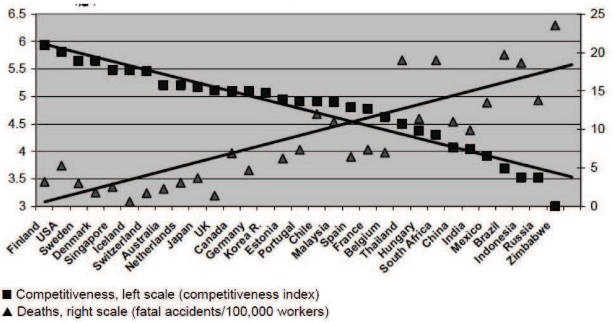
11th September, 2019

Introduction

- Human capital investments have important repercussions on the quality of labor, and thus on firm-level performance (Currie and Madrian 1999).
- A critical component of these investments are investments in worker health and safety (such as occupational health and safety (OHS) measures) and they have important economic (and moral) implications.
  - OHS measures have an impact on the health of workers, and thus on wages, labor force participation, and job choice (Currie and Madrian (1999)).
  - OHS measures have been shown to have an impact on competitiveness of firms (Gopang et al. (2017), ILO (2006)).

Graphical Evidence on the Importance of OHS

Figure 1: Correlation between competitiveness and the incidence of accidents at work (Source: ILO (2006))



Motivation

- About 2.3 million women and men around the world succumb to work-related accidents or diseases every year; around 340 million occupational accidents and 160 million victims of work-related illnesses annually worldwide (ILO World Statistic).
- In developed countries, policies such as regulations, information disclosure and financial incentives like compulsory accident insurance have tried to plug these gaps, even though literature is ambiguous on their effectiveness (Viscusi 2006, Pouliakis and Theodossiou 2013).
- Workers in developing countries (where a higher proportion of the population is engaged in manual labour and regulatory enforcement is weak) are more vulnerable.

Objective and Main Results

To shed light on the role of investments to improve worker health and safety (such as in air quality, lighting, and heat and noise mitigation systems) on labor productivity in manufacturing firms, using data on small and medium enterprises (SMEs) in Vietnam.

- Investments in worker health and safety have a strong effect on worker productivity among SMEs in Vietnam.
- Increasing investment in health by about 0.90 USD per worker per year can increase labor productivity by about 21%.
  - Workers may be experiencing better health outcomes due to these investments, which enables them to work more (plausibly due to lower risks of illness, accident or disability).
- We find that this effect is particularly strong in firms that belong to polluting industries, and that it is largely driven by larger firms.
- The results are robust across different specifications.

Why Vietnam?

- Vietnam came into limelight in the 1990's for poor working conditions in the international media (New York Times (1997), Newsweek (2018)).
- Companies such as Nike, Samsung, Unilever and others have been in the news in recent years for low wages, and poor working conditions.
- Regulations are in place, but improvements in working conditions for laborers have been slow (in many cases, non-existent).

Contribution to literature

- Studies that adopt a structural approach based on the estimation of a production function to study the impact of workplace practices or information technology on labor productivity outcomes (Black and Lynch 2002, Lee et al. 2013, Bloom and Van Reenen 2007).
- Studies that adopt a reduced-form approach to study the impact of ambient pollution on worker productivity and rely either on natural experiments or quasi-experimental settings (Ostro 1983, Hanna and Oliva 2015, Lichter et al. 2017, Zivin and Neidell 2012, He et al. 2019, Carson et al. 2011, Walker 2011).
- We adopt a structural approach based on production function estimation, to better understand whether a specific type of "good" workplace practice has had an impact on labor productivity, in a context where working conditions have historically been poor.

Methodology- I

- A natural starting point is the Cobb-Douglas production function estimation methodology using a fixed effects methodology.

$$ln\frac{Y_{i,T}}{L_{i,T}} = \alpha_0 + ln\frac{K_{i,T}}{L_{i,T}}\alpha_1 + ln\frac{M_{i,T}}{L_{i,T}}\alpha_2 + ln\frac{N_{i,T}}{L_{i,T}}\alpha_3 + ln\frac{I_{i,T}}{L_{i,T}}\alpha_4 + \mu_{i,T} \quad (1)$$

- Dependent variable is the log of labor productivity (or revenue ($Y_{i,T}$) per production worker $L_{i,T}$).
- Our main variable of interest is the value of health capital (or total investments undertaken by the firm in worker health) $I_{i,T}$ per production worker $L_{i,T}$.
- Following Grossman (1972), we consider health to be a durable capital good in the production function, and our measure comprises investments made in protection against poor air quality, noise protection, heat protection and lighting up to period T, measured in '000 Vietnamese Dong (VND), per unit of production labor.

Methodology- II

- A natural starting point is the Cobb-Douglas production function estimation using a fixed effects methodology.

$$ln\frac{Y_{i,T}}{L_{i,T}} = \alpha_0 + ln\frac{K_{i,T}}{L_{i,T}}\alpha_1 + ln\frac{M_{i,T}}{L_{i,T}}\alpha_2 + ln\frac{N_{i,T}}{L_{i,T}}\alpha_3 + ln\frac{I_{i,T}}{L_{i,T}}\alpha_4 + \mu_{i,T} \tag{2}$$

- Fixed effects methodology addresses unobserved heterogeneity, but concerns of endogeneity of input choice persist (due to correlated unobservables, simultaneity in input choice, and measurement error).
- We thus also estimate the Ackerberg Caves and Fraser (ACF) (2015) production function and a dynamic panel data (DPD) model using a system GMM approach (our main specification).

Methodology- III

- Another econometric challenge that we face is that the variable for health capital is populated with zero values for about 47.18% of observations in our sample (since not all firms undertake investments in health capital).
- We use two approaches to deal with this:
  - Inverse hyperbolic sine transformation (Pence 2006, Kristjánsdóttir 2012, Muehlenbachs et al. 2017, Jayachandran et al. 2017).
  - Battese (1997) approach which is less likely to result in biased estimators of the parameters of the production function

$$ln\frac{Y_{i,T}}{L_{i,T}} = \alpha_0 + X\beta + D_{i,T}\alpha_4 + max(ln\frac{I_{i,T}}{L_{i,T}}, D_{i,T})\alpha_5 + \mu_{i,T} \quad (3)$$

  - We estimate the production function using three kinds of estimation methodologies, and using both approaches to deal with the zero-observation problem.

Data- I

We use data from the UNU-WIDER Vietnam SME firm-level database which tracks a sample of 2500 firms (largely SMEs) in nine provinces of Vietnam biennially over the period 2011-2015, creating an unbalanced panel.

Table 1: Summary Statistics of Variables in Regression Sample

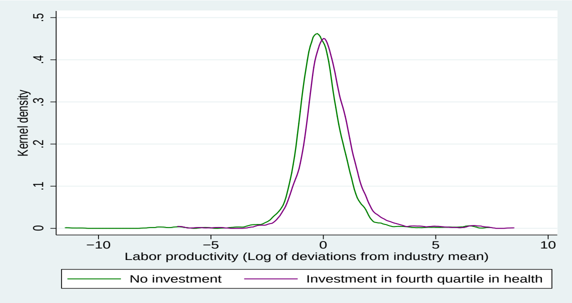
Variable	Number of observations	Mean	Standard Deviation	Minimum	Maximum
Labor productivity (in VND)	5,609	61.8 million	1.16 billion	78	49.1 billion
Value of capital (in '000 VND) per worker	5,609	53,300	116,000	8.247	2,120,000
Value of raw materials (in '000 VND) per worker	5,609	25,016.97	122,399.5	20.226	6,942,254
Number of non-production workers per worker	5,609	0.88	2	0.03	99
Value of health capital (in '000 VND) per worker	5,609	1630.33	19,999.77	0	1,102,125

Notes: Source: UNU-WIDER Vietnam Database. The amount-related variables are measured at constant (2010) prices.

Data-II

Descriptive evidence suggests that higher per capita levels of investment in worker health and safety have had a positive effect on the distribution of labor productivity outcomes among firms in Vietnam.

Figure 2: Kernel Density Plot of Deviation of Labor Productivity from Industry Means



Results- I

Table 2: Production function estimation using the IHS transformation on health capital

Dependent Variable: Log of labor productivity Column	Fixed effects (1)	ACF (2)	DPD without controls (3)
Value of health capital per production worker (in '000 VND)	0.067*	0.039***	0.121
	(0.040)	(0.012)	(0.111)
Log of value of equipment/machinery per production worker	0.105***	0.246***	0.281***
	(0.026)	(0.024)	(0.038)
Log of value of raw materials and input inventories per production worker	0.112***	0.112***	0.046
	(0.020)	(0.031)	(0.036)
Log of number of non-production workers per production worker	0.254***	-0.095	0.333***
	(0.031)	(0.092)	(0.083)
Observations	5612	3180	5612
Hansen J-Statistic			90.33
P-Value			0.036

Notes: Dependent variable is the log of labor productivity (measured per production worker). Specification in column (1) includes includes firm-level and year fixed effects. Specification in column (3) includes lagged values of the endogenous variables in levels as instruments for the difference equation, and lagged differences as instruments for the equation in levels. Industry-year and year fixed effects are included as instruments in the levels equation. *,** and *** respectively denote significance at 10%, 5% and 1% levels. The coefficients of the constant are not reported.

Results- II

Table 3: Production function estimation using Battese (1997) Methodology

Dependent Variable: Log of labor productivity Column	Fixed effects (1)	ACF (2)	System GMM without controls (3)	System GMM with controls (4)
Max of the log of value of health capital (in '000 VND) and dummy	0.06	0.077***	0.275***	0.210**
	(0.038)	(0.033)	(0.112)	(0.109)
Dummy for zero investment in health capital	-0.075	0.491**	1.848**	1.422*
	(0.074)	(0.237)	(0.871)	(0.866)
Log of value of equipment/machinery per production worker	0.106***	0.192***	0.209***	0.188***
	(0.026)	(0.033)	(0.049)	(0.056)
Log of value of raw materials and input inventories per production worker	0.111***	0.168***	0.065*	0.077**
	(0.020)	(0.053)	(0.037)	(0.038)
Log of number of non-production workers per production worker	0.241***	0.066	0.304***	0.404***
	(0.031)	(0.142)	(0.117)	(0.105)
Respondent and firm controls	No	No	No	Yes
Observations	5612	3180	5612	5609
Hansen J-Statistic			79.71	99.71
P-Value			0.157	0.01

Notes: Dependent variable is the log of labor productivity (measured per production worker). Specification in column (1) includes year and industry dummies. Specification in column (2) includes firm-level and year fixed effects. Specifications in columns (3) and (4) include lagged values of the endogenous variables in levels as instruments for the difference equation, and lagged differences as instruments for the equation in levels. Industry-year and year fixed effects are included as instruments in the levels equation. *,** and *** respectively denote significance at 10%, 5% and 1% levels. The coefficients of the constant are not reported.

Robustness Checks

Table 4: Robustness Checks

Dependent Variable: Log of labor productivity Column	Polluting industries (1)	Investments in sample period (2)	< median number of workers (3)	> median number of workers (4)	Controlling for certification (5)
Max of the log of value of health capital (in '000 VND) and dummy	0.346***	0.201**	0.123	0.204**	0.178*
	(0.109)	(0.105)	(0.151)	(0.096)	(0.103)
Dummy for zero investment in health capital	1.475*	1.386*	0.915	1.500**	1.101
	(0.874)	(0.826)	(1.124)	(0.725)	(0.805)
Log of capital per production worker	0.100	0.193***	0.225***	0.150***	0.165***
	(0.062)	(0.056)	(0.073)	(0.065)	(0.061)
Log of raw materials per production worker	0.145**	0.077**	-0.016	0.199***	0.098***
	(0.068)	(0.038)	(0.035)	(0.050)	(0.041)
Log of number of non-production workers per production worker	0.107	0.402***	0.591***	0.168	0.405***
	(0.162)	(0.103)	(0.149)	(0.118)	(0.086)
Whether firm has an environmental standards certificate					0.695***
					(0.192)
Whether firm has fire prevention certificate					0.021
					(0.177)
Respondent and firm-level controls	Yes	Yes	Yes	Yes	Yes
Observations	3106	5581	2733	287	6 5609
Hansen J-Statistic	48.78	99.57	72.12	85.85	85.79
P-Value	0.562	0.017	0.254	0.06	0.051

Notes: Dependent variable is the log of labor productivity (measured per production worker). All models are estimated using the system GMM methodology (the specification of column (4) of Table 4). All specifications include firm-level and year fixed effects. Specifications include lagged values of the endogenous variables in levels as instruments for the difference equation, and lagged differences as instruments for the equation in levels. *,** and *** respectively denote significance at 10%, 5% and 1% levels. The coefficients of the constant are not reported.

Conclusion and Policy Implications

- Investments in worker health (through air quality investments, protective equipment against heat and noise, as well as in more lighting) are likely to improve the working conditions of workers, and thus likely to positively affect labor productivity.
- Increasing investment in health by about 90 cents per production worker per year can increase labor productivity by about 21%.
- Results hold true for some of the most pollution-intensive industries in Vietnam, where workers have suffered due to poor working conditions.
- Our results suggest that OHS may be important, both as a form of human capital investment and as a workplace practice, and that it may be particularly biting for workers in the manufacturing sector in developing countries.
- Policy implications concern regulations that are often weakly implemented in many such contexts, and policies regarding pollution and environmental quality too.

Thank you for your attention.

Amount invested by type of investment in worker health and safety

Table 5: Investments in Worker Health by Firms in Vietnam

Type of investment	Percentage	Mean Amount of Investment	Median Year of Investment
Air quality	12.75	4795	2010
Protection against Noise	8.12	5462	2009
Protection against Heat	41.06	2220	2010
Lighting	39.41	2520	2010

Notes: Source: UNU-WIDER Vietnam Database. The mean amount of investment is measured in '000 VND. The investment amounts are measured at constant (2010) prices.