The role of labour unrest and skilled labour on outward foreign direct investment in Taiwan, Republic of China (ROC)

Yu Cheng Lai

Shih Chien University, Kaohsiung, Taiwan (ROC)

Santanu Sarkar

XLRI Xavier School of Management, Jamshedpur, India

Supplemental File

Several scholars have already applied a Difference-in-Difference-in-Difference (DDD) estimation method (see Lai and Sarkar, 2013, 2017; Lai, 2019) while using repeated cross-sectional data, such as the MUS, to test the effects of labour standards on labour market outcomes. We also adopted the approach based on the difference of values between treatment and control groups as no database gives panel data for overall manpower in Taiwan. We used the offshoring industry, $OFDIII_{jt,}$ as a dummy variable to measure the difference in the effect of high outward FDI vs low outward FDI (see Equation 4). To measure firm compliance with high labour standards, the DDD removed industry fixed effects from unobservable industry-specific factors (Zveglich Jr. and Rodgers, 2003). Large 'Covered' firms complied with high labour standards to attract skilled workers (Kan and Lin, 2011; Lai and Sarkar, 2013, 2016). So, we used the $Cover_{ijt}$ variable as a proxy for high labour standards. However, $Cover_{ijt}$ was subject to endogeneity biases, [i]so we adopted a family income (FI_{ijt}) variable (that is, log family income deflated by the value of USD in 2016 from other household members in the same family) as an instrumental variable to correct the endogeneity bias. Our estimation strategy corrected for endogenous policy liability coverage that might have occurred when large firms attracted skilled workers, reducing labour unrest through the fixed effects term of $Cover_{ijt}$ (Rosenzweig and Wolpin, 1986).

We estimated skilled workers' choice for work in Covered firms plus non-workers in stage – I. Keeping in view studies where the multinomial logit method was used (Lai and Sarkar, 2013, 2017), we applied a similar approach to measure the effects of skilled workers and labour unrest on employment in Covered firms and wrote Equation 1. In Equation 1, we used the multinomial logit method to estimate the probability of a female or male skilled worker being employed within a given industry.

$$Prob.(X = x) = \frac{exp(\alpha^x + a^x SWijt + b^x HLUIt + c^x SWijt \times HLUIt + \sum_{i=1}^{20} d_i^x Y_{ijt})}{1 + \sum_{x=1}^{2} exp(\alpha^x + a^x SWijt + HLUIt + c^x SWijt \times HLUIt + \sum_{i=1}^{20} di^x Y_{ijt})}, x = 1 \text{ or } 2 \quad (1)$$

In Equations 1 and 4, we included a vector of variables, Y_{ijt}, as a matrix of input factors that influenced the supply of employee *i* in industry *j* at year *t*. In addition, we added macro variables to Y_{ijt}, such as industry variables, occupations, lag change in an offshoring industry, market size, exchange rate, and time trend.

$$\begin{aligned} DProb_i &= DDD_{\text{Covered firm and OFDIII}} (X = 1) - DDD_{\text{Uncovered firm and OFDIII}} (X = 2) \\ &= Prob.(X = 1) - Prob.(X = 2) \\ &= \{Prob.[SW_{ijt} = 1 \text{ and } HLUI_t = 1 \text{ when } X = 1] \\ &\quad - Prob.[SW_{ijt} = 0 \text{ and } HLUI_t = 0 \text{ when } X = 1]\} \\ &\quad - \{Prob.[SW_{ijt} = 1 \text{ and } HLUI_t = 1 \text{ when } X = 2] \\ &\quad - Prob.[SW_{ijt} = 0 \text{ and } HLUI_t = 0 \text{ when } X = 2]\} \\ &\qquad i = \text{women or men} \end{aligned} \quad (2)$$

$$DDDDD = DProb_{women} - DProb_{men}$$

(3)

We found differences in predicted probabilities evaluated at means of Y_{ijt} with SW_{ijt} and $HLUI_t$ dummies changing from 1 to 0 in Equation 2. $DProb_i$ calculated from Equation 1 is the DDDD estimator to measure the employment effect. It contained two parts. DDD Covered Firm and offshoring industry (X = 1) and DDD Uncovered Firm and offshoring industry (X = 2) were calculated from Equation 1 in which individuals who were part of the treatment group are skilled workers working in firms with 100 or more employees in the offshoring industry during a time of high labour unrest vs control group comprising unskilled workers working in firms with less than 100 employees employed in the non-offshoring industry during a time of low labour unrest were included to build four-level differences.[2] To measure the gender difference effect in employment, as in Equation 3, we calculated the value from $DProb_{women}$ minus $DProb_{men}$.

We included the log value of real monthly wage ($Wage_{ijt}$) as the dependent variable in Equation 4. $Wage_{ijt}$ is a worker *i*'s monthly wage obtained from the MUS and adjusted by prices in 2016. In the second stage, λ^x was included as a white noise term.

By $OFDIII_{jt}$ in our Equation 4 together with the *SW* dummy and *HLUI* dummy, we provided DD (the coefficient f_1 and f_2 of $OFDIII_{jt} \times SW_{ijt}$ and $OFDIII_{jt} \times HLUI_t$) and DDD (the coefficient f_3 of $OFDIII_{jt} \times SW_{ijt} \times HLUI_t$) estimators. However, $OFDIII_{jt}$ multiplied by increasing skilled labour (SW_{ijt}) and labour unrest ($HLUI_t$) and their intersection ($OFDIII_{jt} \times SW_{ijt} \times HLUI_t$) may include effects of other factors. So, we multiplied $OFDIII_{jt}$ by control variables (Y_{ijt}), which is $OFDIII_{jt} \times Y_{ijt}$ in Equation 4.

We wanted to measure the differential effect of skilled labour on outward FDI in offshoring industries during labour unrest. To calculate this, the DDD estimate ($OFDIII_{jt} \times SW_{ijt} \times HLUI_t$) in Equation 4 was worked out from differences in predicted probabilities of $SW_{ijt} \times HLUI_t$

between skilled workers and high labour unrest in outflows of FDI in offshoring industries in Equation 4.

$$Wage_{ijt} = a_0 + a_1 OFDIII_{jt} + a_2 Covered_{ijt} + b_1 SW_{ijt} + b_2 HLUI_t + b_1 SW_{ijt} \times HLUI_t + \sum_{i=1}^{20} c_i Y_{ijt} + d_1 Covered_{ijt} \times SW_{ijt} + d_2 Covered_{ijt} \times HLUI_t + d_3 Covered_{ijt} \times SW_{ijt} \times HLUI_t + \sum_{i=1}^{20} e_i Covered_{ijt} \times Y_{ijt} + f_1 OFDIII_{ijt} \times SW_{ijt} + f_2 OFDIII_{jt} \times SW_{ijt} + f_3 OFDIII_{jt} \times SW_{ijt} \times HLUI_t + \sum_{I=1}^{20} g_i OFDIII_{jt} \times Y_{ijt} + h_1 OFDIII_{jt} \times Covered_{ijt} \times SW_{ijt} + h_2 OFDIII_{jt} \times Covered_{ijt} \times HLUI_t + h_3 OFDIII_{jt} \times Covered_{ijt} \times SW_{ijt} \times HLUI_t + \sum_{i=1}^{20} k_i OFDIII_{jt} \times Covered_{ijt} \times Y_{ijt} + \delta \lambda^x + u_i \quad (4)$$

To measure differential effects of skilled workers and high labour unrest on wages on covered industries and outflows of FDI in offshoring industries, $OFDIII_{jt}$ x $Covered_{ijt}$ x SW_{ijt} x $HLUI_t$ was used to measure the effect of DDDD. The h_3 coefficient of DDDD estimator for interaction $OFDIII_{jt} \times Covered_{ijt} \times SW_{ijt} \times HLUI_t$ measured the main effects of outward FDI in offshoring industries and industrial unrest on wages for female and male skilled workers. Individuals who were part of the treatment group comprised skilled workers in firms with 100 or more employees in the offshoring industry during high labour unrest vs the control group comprising skilled workers in firms with less than 100 employees in the non-offshoring industry during low labour unrest helped build a four-level difference. We measured the gender difference between women and men (DDDDD) using the difference in the coefficient of h_3(women) -

h_3(men). This explained the gender difference in the earnings of skilled workers from Covered firms during labour unrest and industrial peace and whether individuals working in the control group will influence wages.

The combined effect of high labour unrest and an increase in skilled workers should have increased wages in offshoring industries (Equation 4). Conversely, outward FDI should have been reduced in offshoring firms employing skilled workers. Therefore, the effects of outward FDI in offshoring industries, skilled workers and high labour unrest on wages depended on whether the impact of high labour standards had overridden other factors. Outward FDI in offshoring industries is likely to be protected by regulations more than others.

Wage estimates were derived based on the wage equation that controlled sample selection bias caused by employment. λ^x is a sample selection term, σ is the coefficient of λ^x and u_i is the error term. To obtain consistent estimates, we used a two-stage least squares method. Based on the results of the increase in skilled workers, we calculated each person's predicted probability of gaining employment and included it as an explanatory variable. We built estimations by weighted least square (WLS) regression to correct heteroskedasticity, as in Equation 4, as the errors were greater when using OLS with Huber-White robust standard errors.[3]

Table S1. Effect of skilled employment growth and labour unrest on employment in offshoring industries

	Women		Men	
	(1) Covered firms in offshoring industry X = 1	(2) Uncovered firms in offshoring industry X = 2	(3) Covered firms in offshoring industry X = 1	(4) Uncovered in offshoring industry X = 2
Offshoring industry x skilled worker x labour unrest	0.00001 (0.000001)***	0.0002 (0.000201)***	0.0001 (0.00001)***	0.0006 (0.00004)***
Lagrange Multiplier	85417(0.0001)***		75586(0.0001)***	
Likelihood Ratio	88732(0.0001)***		85187(0.0001)***	
Wald test	25984(0.0001)***		27992(0.0001)***	
Number of observations	187695		181589	
Offshoring industry x skilled worker x labour unrest x covered firm (1)-(2) or (3)-(4)	(5) -0.0002 (0.00001)***		(6) -0.0005 (0.0001)***	
Offshoring industry x skilled worker x labour unrest x covered firm x gender (5)-(6)		(7) 0.0003 (0.0001)***		

Source: MUS 2008-2017
* < 0.05, ** < 0.01, *** < 0.005, **** < 0.001
Values are probability values, and those in parenthesis are standard errors.
Values in parenthesis are of LM (Lagrange multiplier), LR (likelihood ratio), and Wald test Pr > ChiSq.
Notes:

(1) Cell values in Columns (1) to (4) are the probability of employment calculated from Equation 1, the coefficients estimated are for Covered vs Uncovered firms in offshoring industries and are reported in Columns (1) to (4) as part of Equation 2.

Columns (1) and (3) are calculated from Prob.[$SW_{ijt} = 1$ and $HLUI_t = 1$ when $X = 1$] − Prob.[$SW_{ijt} = 0$ and $HLUI_t = 0$ when $X = 1$].
Columns (2) and (4) calculated from Prob.[$SW_{ijt} = 1$ and $HLUI_t = 1$ when $X = 2$] - Prob.[$SW_{ijt} = 0$ and $HLUI_t = 0$ when $X = 2$].

(2) Based on Equation 2, Columns (5) – (6) report results of DDDD estimates from Covered firms minus Uncovered firms in offshoring industries. E.g., Column (5) = Column (1) – (2). Column (6) = Column (2) – (3).

(3) Column 7 reports values of women minus men from (5) – (6).

Table S2 Effect of skilled employment growth and labour unrest on wages in offshoring industries

	Women	**Men**
	(1)	(2)
Offshoring industry x labour unrest	0.082 (0.021)***	0.015 (0.027)
Offshoring industry x skilled worker x labour unrest	-0.061 (0.017)***	-0.034 (0.023)*
Offshoring industry x covered firm x skilled worker x labour unrest	0.110 (0.035)***	0.103 (0.046)**
λ^x	8.63 (0.212)***	5.48 (0.162)***
Adjusted R square	0.5007	0.5079
F value	983	1223
Number of observations	94,046	113,652
	(3)	
Othe ffshoring industry x covered firm x skilled worker x labour unrest x gender women – men	0.007 (0.121)	

Source: MUS 2008 – 2017
* < 0.05, ** < 0.01, *** < 0.005, **** < 0.001
a. Based on equation 4 (Dependent variable = log value of monthly wage)
b. Standard errors are presented in parentheses.
c. Column 3 shows result of the model with women minus men from (1) – (2).

Notes

1. Endogeneity problems occurred when productive firms attracted SW during industrial peace.
2. The first part in Equation 2 is DDD of the Covered firm (Prob.[$SW_{ijt} = 1$ and $HLUI_t = 1$ when $X = 1$] − Prob.[$SW_{ijt} = 0$ and $HLUI_t = 0$ when $X = 1$]), and the second part is DDD of the Uncovered firm (Prob.[$SW_{ijt} = 1$ and $HLUI_t = 1$ when $X = 2$] - Prob. [$SW_{ijt} = 0$ and $HLUI_t = 0$ when $X = 2$]).
3. We ran OLS and regressed squared residuals from OLS against a constant term and the reciprocal of the working population. We used the square root of the inverse of the predicted value from the second step as weights.

References

Kan K and Lin YL (2011) The effects of employment protection on labour turnover: Empirical evidence from Taiwan. *Economic Inquiry* 49(2): 398-433.

Lai YC and Sarkar S (2013) Labour market effects of work-sharing arrangements in Taiwan, ROC. *International Journal of Manpower* 34(6): 635–657.

Lai YC and Sarkar S (2016) Effects of Paid Parental Leave allowance on labour market outcomes in Taiwan. *International Journal of Information and Management Science* 27(4): 379–403.

Lai YC and Sarkar S (2017) Gender equality legislation and foreign direct investment. *International Journal of Manpower* 38(2): 160–179.

Lai YC (2019) Effect of Participation of Foreign Migrant Workers in Labour Market on Native Workers: Evidence Based on Change Noticed in College Premium in Taiwan ROC. *Global Economic Review* 48(1): 88-110.

Rosenzweig MR and Wolpin KI (1986) Evaluating the effects of optimally distributed public programs: Child health and family planning interventions. *American Economic Review* 76(3): 470–482.

Zveglich, Jr J E and Rodgers YVDM. (2003) The impact of protective measures for female workers. *Journal of Labor Economics* 21(3): 533-555.

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