Risk Premium, Climate Premium and Pollution Premium in Taiwan's Labor Market

Nan Zhang, Daigee Shaw, Chien-Hao Lan, Chuan-Yao Lin

Xian Jiaotong University; Institute of Economics, Academia Sinica; National Chengchi University; Research Center for Environmental Changes, Academia Sinica

Contents

- Introduction
- Literature
- Contributions of the paper
- Data
- Results
- Conclusion

Air Quality around the World, 2015

Annual mean PM10 (ug/m3)
- <20
- 20–29
- 30–49
- 50–99
- 100–149
- ≥150
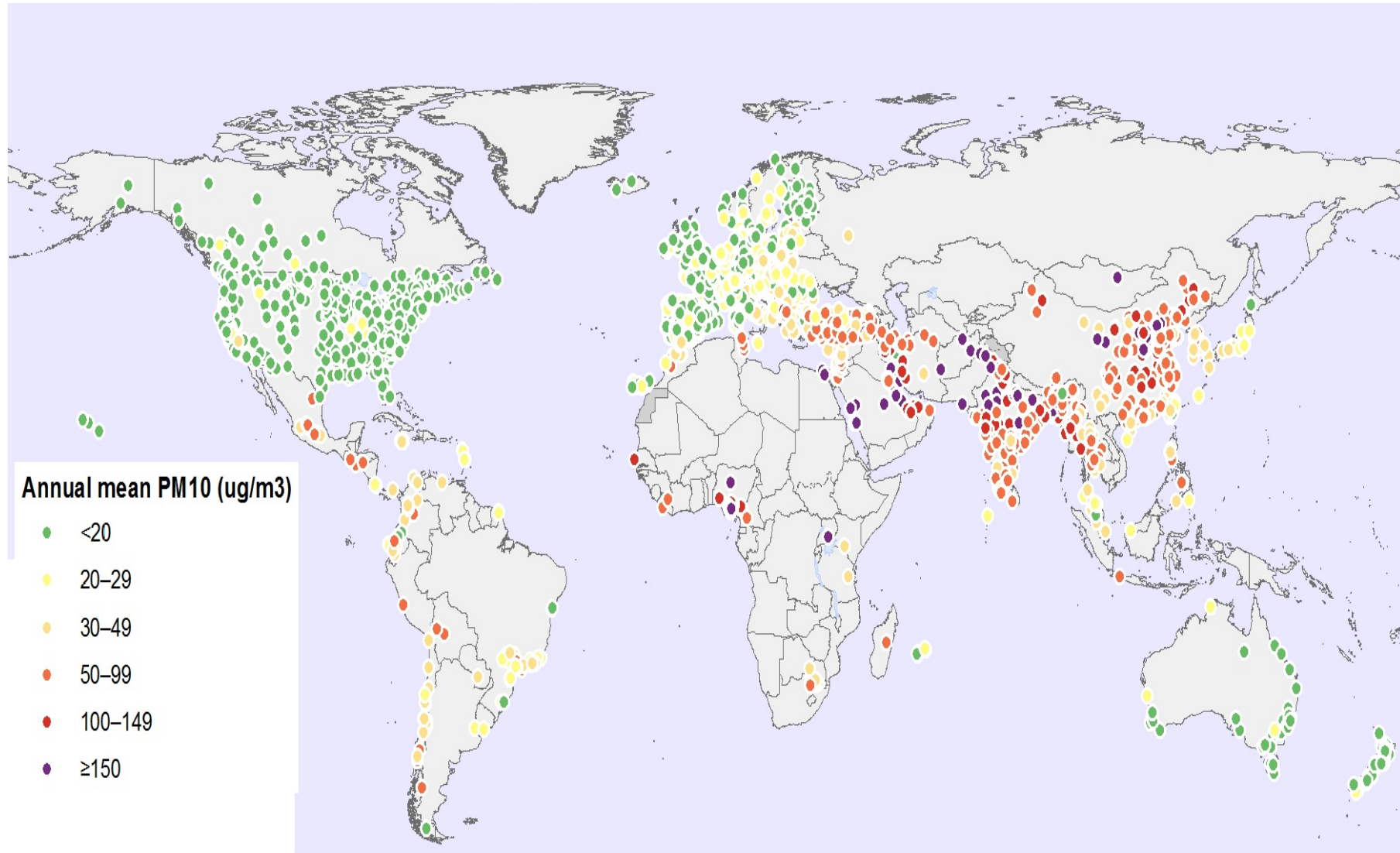
Sources: WHO (2016)

Pollution premium

- In 2014, Panasonic confirmed that it offered a "pollution premium" for those working in China, while media reports revealed Coca Cola was offering an environmental hardship allowance of around 15 per cent for employees moving there. (**Agence France-Presse**, 31 Mar, 2019)

Climate is an important input

- To many household's activities
  - Heating and cooling
  - Clothing
  - Nutritional requirements
  - Health
  - Well-being
- To many production activities
  - Agriculture
  - Manufacture
  - Services
  - Recreation
  - Housing and cities
- Labor supply and labor demand
- Evaluate the amenity value of changes in climate is important

Wage differentials

- In a labor market,
  - On the labor supply side, when an individual chooses his job, he chooses his wage and the workplace pleasantness/unpleasantness at the same time
  - On the labor demand side, firms are forced to provide generous financial offers to offset the concerns of the highly skilled people he wanted to recruit
  - In equilibrium, there are **Wage differentials** (Rosen, 1986)
    - Additional amount of wage that a given worker must be offered in order to motivate them to accept a particular job with unpleasantness, risk, or other undesirable attributes, relative to other jobs that worker could perform
    - The differential can be *negative* for an especially desirable job, relative to other jobs
- In this paper, we would like to know if there exist "climate premium" and "pollution premium," in addition to "risk premium" in Taiwan

Introduction

- The hedonic wage method is the most widely adopted method to study Wage differentials (Thaler and Rosen, 1975)
  - Once other personal characteristics (education, work experience, gender et al.) and job characteristics (like the scale of the firm et al.) are controlled, we can study the relationship between wage and job pleasantness/unpleasantness, and estimate those premiums
- Risk premium is the tradeoff between wage and risk when the fatality rate changes by a small amount
  - It is workers' "willingness to pay for a microrisk reduction" (*WTPμr*)
  - Implicit prices of safety
  - Value of a statistical life (VSL)
    - Assuming (unrealistically) the fatality rate reduces from 1 to 0
  - *VSL = WTPμr/μr*

Literature - Hedonic wage model

- Rosen (1974) first come up with the hedonic price model
  - price of a good is the sum of the prices of all the attributes of this good, and consumers' willingness to pay for one attribute is the implicit price of this attribute
  - Housing market
- Thaler and Rosen (1976) applied this theory to the labor market and developed the hedonic wage model.
  - They estimated risk premiums
- There are a vast of studies on risk premium and VSL using the hedonic wage model
- Viscusi and Aldy (2003)
  - A good review of the literature

Literature - Hedonic wage model in Taiwan

- Hsueh and Wang (1987)

  - The first study

  - The 1984 labor survey in Taiwan

  - Adopt the traditional hedonic wage model

- Liu, Hammitt and Liu (1997)

  - The Heckman two-stage model to correct for selection bias

  - Study the wage-risk tradeoff in Taiwan during 1982-1986

- Liu (2011)

  - OLS regression with labor data of 2002-2006 in Taiwan

  - One percent of risk increase corresponds to a wage increase of 2.6%-4.7%

Literature – climate premium, amenity value of climate

- Rehdanz (2006)
  - Utilizes the house price and wage in 1993 and the climate data during 1961-1990 in the UK
  - Applying both the hedonic price model and hedonic wage model. (Roback, 1982, JPE)
  - Higher January temperature is an amenity, while precipitation is an unwanted attribute

- Chen (2016)
  - Using the house price, wage and climate data in Taiwan
  - Higher January temperature is an amenity and July temperature and pollution are disamenities

Literature – climate premium, amenity value of climate

- Maddiso and Bigano (2003)
  - Using the 1991-1995 wage data in Italy to calculate the implicit price of environmental attributes with hedonic wage model and hedonic price model
  - They find that higher temperature in July and higher precipitation in winter are disamenities
- Koirala and Bohara (2014)
  - Study the willingness to pay for climate amenity with hedonic wage method and hedonic price method.
  - Higher January temperature is an amenity
  - While higher July temperatures and precipitation are both disamenities

Literature - the endogeneity problem

- Self-selection bias
  - Viscusi (1978) points out that the wealth effect would affect people's job risk choice through the error term, and make the estimation biased

- Missing unobservable variables
  - Brown (1980)
    - important but missing unobservable variables, for example, ability, could make the estimation biased.
  - Garen (1988)
    - some unobserved personal characteristics like cool-headedness could cause the risk premium to differ in different risk levels and makes the 2SLS/3SLS inconsistent.
    - To solve this problem, he suggests using a weighted 2SLS approach, and he proves this two-step approach (Garen's approach) could give unbiased and consistent estimation results

- Using the fixed effect model (FE) with panel data has distinct advantages in dealing with missing time-invariant unobservable variables, thus greatly relieve the endogeneity problem
  - Brown (1980), Hintermann et al. (2010), Kniesner et al. (2012)

Contributions of the paper

- We examine the relationship between wage and their attributes, especially risk, climate and air quality in Taiwan, using the hedonic wage model with panel data

DATA

The Panel Survey of Family Dynamics (PSFD)

- Research Center for Humanities and Social Science, Academia Sinica
- Conducted in Taiwan and three east provinces (cities) in mainland China since 1999.
- We use the Taiwan part. Data were collected every year except 2013.
- Job features like the wage, job industries, occupations and so on.
- Worker's characteristics like education, gender, marital status, health, education of parents, et al.
- Workers in agricultural, and those who work for themself instead of haired by others, together with those who are not currently employed, are excluded from our sample
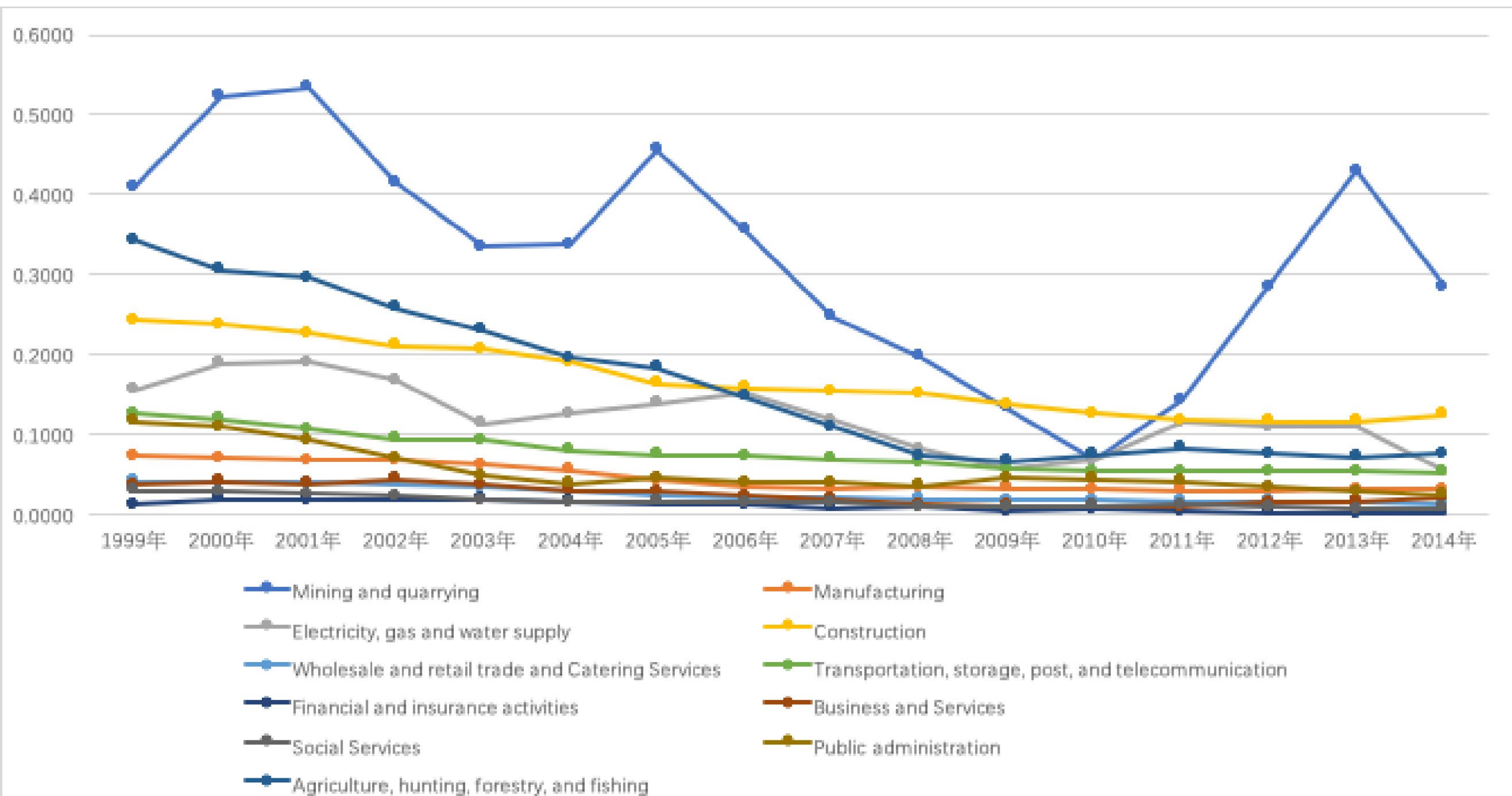 - Valid observations: 13,180

Table 1. Data statistics

Category	Variables	Definition	Mean	Std. Dev.
personal characteristics	Health	self-perceived health, from 1- very bad health, to 5-very good health	3.68	0.82
	edu_year	years of education	12.79	3.07
	Marriage	1 if married, 0 otherwise	0.53	0.50
	Wexp	years of work experience	16.63	10.84
	medu_year	mother's education years	5.76	3.91
job features	Wage	yearly wage	515,963	379,811
	past3_risk	the average job fatality rate of the past three years	0.045	0.048
	Female	1 if female, 0 otherwise	0.43	0.50
	scale1	1 if the number of employees lies between 10-49, 0 otherwise	0.28	0.45
	scale2	1 if the number of employees lies between 50-499, 0 otherwise	0.26	0.44
	scale3	1 if the number of employees is more than 500, 0 otherwise	0.24	0.43
Climate and pollution amenities	_1tp_avg	average January temperature of each county	16.2	1.2
	_7tp_avg	average July temperature of each county	29.0	0.6
	pm10	average pm10 concentrations of each county	63.6	12.5

The Job Fatality Rate

- From the Bureau of Labor Insurance, Ministry of Labor, 1999-2014
- Moving average of job fatality rate of past three years
- Fig 1
- The fatality rates show a downward trend, especially in the mining sector

Fig 1. The Industrial Fatality Rate from 1999 to 2014 (‰)

- Mining and quarrying
- Manufacturing
- Electricity, gas and water supply
- Construction
- Wholesale and retail trade and Catering Services
- Transportation, storage, post, and telecommunication
- Financial and insurance activities
- Business and Services
- Social Services
- Public administration
- Agriculture, hunting, forestry, and fishing

Air quality and climate to which the respondents are exposed

- Air quality
  - We analyze the annually mean PM10 concentrations from 2008 to 2011 from 78 monitoring stations of the Taiwan Environmental Protection Administration.
  - The PM10 concentrations are interpolated from these 78 air quality stations to the locations of township governments in where the respondent resided using the Cressman scheme (Cressman G.P., 1959)
- Climate at the locations of township governments where the respondents reside in
  - Interpolated from a 1km-resolution uniform-grids climate dataset over Taiwan.
  - The climate dataset is provided by the Taiwan Climate Change Projection and Information Platform (TCCIP) project.
  - Using a conventional spatial interpolation technique (Weng and Yang, 2012) and multiple data sources (Central Weather Bureau, Water Resources Agency, Irrigation Associations, Taiwan Power Company). More than 300 monitoring stations are used.
  -

RESULTS

Table 2. OLS estimation results t-values in parentheses *** p<0.01, ** p<0.05, * p<0.1

	model 1	model 2	model 3
Ln(wage)			
lnpast3_risk	0.0410*** (8.10)	-0.00206 (-0.39)	0.00413 (0.78)
female	-0.288*** (-35.72)	-0.303*** (-38.11)	-0.304*** (-38.91)
medu_year	0.00487*** (3.94)	0.00871*** (7.11)	0.00637*** (5.25)
health	0.0358*** (7.46)	0.0229*** (4.83)	0.0272*** (5.82)
lnedu_year	0.844*** (46.06)	0.880*** (48.75)	0.837*** (46.65)
marry	0.127*** (14.24)	0.115*** (13.12)	0.117*** (13.47)
lnwexp	0.153*** (21.51)	0.148*** (21.12)	0.136*** (19.60)
scale1	0.137*** (12.37)	0.133*** (12.19)	0.123*** (11.43)
scale2	0.225*** (19.68)	0.217*** (19.37)	0.202*** (18.25)
scale3	0.350*** (29.32)	0.341*** (29.09)	0.327*** (28.27)
year		-0.0237*** (-22.55)	-0.0215*** (-20.64)
_1tp_avg			-0.0530*** (-16.06)
_7tp_avg			0.108*** (16.49)
pm10			0.000558* (1.85)
_cons	10.36*** (182.55)	57.77*** (27.47)	51.23*** (24.28)

Table 3. Fixed effect model estimations t-values in parentheses *** p<0.01, ** p<0.05, * p<0.1

	total sample	skilled and unskilled workers	managerial workers
lnpast3_risk	0.0338*** (4.98)	0.0567*** (4.70)	0.0220 (1.29)
Health	0.0111*** (2.61)	0.00824 (1.16)	-0.0000591 (-0.01)
lnedu_year	0.157* (1.86)	0.136 (1.13)	-0.000201 (-0.00)
Marry	0.0493*** (4.76)	0.0419** (2.27)	0.0734*** (2.92)
Lnwexp	0.216*** (13.97)	0.132*** (4.22)	0.236*** (6.18)
scale1	0.0781*** (6.86)	0.0804*** (4.51)	0.0967** (2.46)
scale2	0.123*** (9.14)	0.175*** (7.55)	0.102** (2.44)
scale3	0.157*** (10.43)	0.216*** (7.84)	0.101** (2.28)
Year	-0.0106*** (-7.17)	-0.0135*** (-5.59)	-0.000314 (-0.08)
_1tp_avg	-0.0248*** (-2.59)	-0.0565*** (-2.87)	-0.0151 (-0.64)
_7tp_avg	0.0538*** (3.31)	0.0256 (0.71)	0.0576 (1.56)
pm10	0.00283* (1.70)	-0.00236 (-0.80)	0.00799* (1.72)
_cons	31.99*** (10.77)	39.54*** (8.10)	11.52 (1.52)
N	13180	4867	2504

CONCLUSIONS

Air quality and climate to which the respondents are exposed

- Labors in Taiwan are compensated for work-related fatal risk, especially for skilled and unskilled workers, but for managerial workers, the tradeoff between risk and wage is small and insignificant
- Lower temperature in July and higher temperature in January are preferred
- Lower pollution is also a workplace amenity
- The climate premium and pollution premium between the two groups are different
    - Workers care more about the January temperature, and they are paid less for working in an environment with higher average January temperature
    - Managerial workers care more about the pollution level. They are paid higher for working in regions with higher PM10 concentration

Air quality and climate to which the respondents are exposed

- The VSL we get in our research is 390 million TWD, which is larger than previous hedonic wage studies in Taiwan.

- Our research with panel data analysis has a particular advantage of dealing with time-invariant factors, and effectively reduce the estimation bias in the cross-sectional analysis.

- Worker's willingness to pay for a unit decrease of PM 10 concentration
  - 1460.2 (2014 TWD), which is about 48 USD

Air quality and climate to which the respondents are exposed

- Air quality
  - We analyze the annually mean PM10 concentrations from 2008 to 2011 from 78 monitoring stations of the Taiwan Environmental Protection Administration.
  - The PM10 concentrations are interpolated from these 78 air quality stations to the locations of township governments in where the respondent resided using the Cressman scheme (Cressman G.P., 1959)
- Climate at the locations of township governments where the respondents reside in
  - Interpolated from a 1km-resolution uniform-grids climate dataset over Taiwan.
  - The climate dataset is provided by the Taiwan Climate Change Projection and Information Platform (TCCIP) project.
  - Using a conventional spatial interpolation technique (Weng and Yang, 2012) and multiple data sources (Central Weather Bureau, Water Resources Agency, Irrigation Associations, Taiwan Power Company). More than 300 monitoring stations are used.
  -