Ekoloji 28(107): 1659-1663 (2019)

The Theory on the Environmental Emission Trading under the Concept of Two-Tired Earning

Xinxin Pan [1], Wanhao Zhang [2], Lichen Chou [3*]

[1] College of Economics & Management, Southwest University, Chongqing 400715, CHINA

[2] King's Russia Institute, King's College London, London WC2R 2LS, UK

[3] Department of Economics, Wenzhou Business College, Wenzhou 325035, CHINA

[*] Corresponding author: zlc@wzbc.edu.cn

Abstract

In this study we apply the concept of two-tired earning to discuss the possible dispersion problem in the emission trading market. There're always price dispersion, whether it's a product market or labor market as the trades began. The operation in the labor market reflects the degree of market competition, in other words, this phenomenon may also exist in the emission trade market. In this paper we constructed a theory to investigate the impacts that price variation caused by insufficient information, then applies the theory to estimate the condition of information holding between the buyers and the sellers.

Keywords: emission trading, information processing

Pan X, Zhang W, Chou L (2019) The Theory on the Environmental Emission Trading under the Concept of Two-Tired Earning. Ekoloji 28(107): 1659-1663.

INTRODUCTION

With the severity of climate warming, international restrictions on greenhouse gas emissions are increasingly being taken seriously. The Third Conference of the Parties to the United Nations Framework Convention on Climate Change in 1997 adopted the legally binding Kyoto Protocol. Subsequently, the Seventh Meeting of the States Parties to the United Nations Framework Convention on Climate Change in 2001 adopted a series of decision documents implementing the Kyoto Protocol mechanism and established relevant mechanisms for emissions trading. However, so far, emissions trading has not been successfully implemented, and trading trials have only been reached in some regions.

From an economic point of view, Coase theorem believes that under certain conditions, the externalities or inefficiencies of the economy can be corrected through negotiation by the parties to maximize social benefits. However, in the process of trading in reality, we will face problems such as information asymmetry and inconsistent negotiation of bilateral trading. Based on this aspect, this paper attempts to apply the concept of two-tired earning in labor economics, and constructs a model theory to discuss uyer's and seller's ignorance in emissions trading.

LITERATURE REVIEW

The model we apply mainly derived from the labor economics issue that called wage dispersion. Wage variation between the public and the private sectors was widely discussed among literature which firstly analyzed by Smith (1976, 1981). Chen (2007) found that the higher the worker's skill is, the lower his salary premium is in the public sector. The author drew this conclusion by analyzing the salary premium data of Taiwan's public sector from 1980 to 2006 with quantile regression. Unlike the ones in medium or high position, male workers in low position are facing more and more serious problems of salary premium nowadays. Gomes (2015) builds a dynamic stochastic general equilibrium model with search and matching frictions calibrated to U.S. data and shows that high public sector wages induce too many unemployed to apply for public sector jobs and raise unemployment.

The concept of the earnings frontier, originally used in the analysis of production efficiency (Aigner et al. 1977). It was first used in a labor economics context by Hofler and Polachek (1985) in order to examine the extent to which young persons attain the earnings potential of their human capital investment in the process of assimilation in the labor market. The estimated gap between the earnings which are actually observed and potential earnings (also called maximum attainable earnings or frontier earnings) for a given

 Received: 20 Mar 2018 / Accepted: 14 Oct 2018

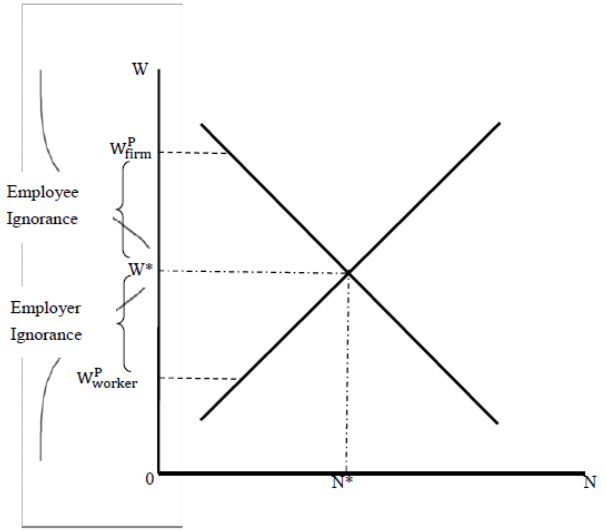

Fig. 1. The employee ignorance and the employer ignorance

human capital endowment, can be conceived as "earnings inefficiency". In the studies of labor issues, studies on wage variation with stochastic frontier approach may have search theory accompanied. All these works focused on the level of the gap, so the model used is always called earning frontier function.

Polachek and Yoon (1987) structured two-tiered earnings frontier estimation analyzed the information-sufficiency-degree of the management and the labor with data from dynamic tracking survey in 1981. The final results taught people the potential employees would get 28.8% more and the potential employers might pay 40% less than that when people in the labor market with information symmetry. This method could distinguish between the depth of information the supplier got and that of the demander got in the market, which provided a lot of possibilities in the research of the price or salary difference there.

In other related studies, Chuang (2006) discussed the effect of minimum wage on youth employment and unemployment in Taiwan; Gangopadhyay and Shankar (2015) applied the modify stochastic frontier analysis to investigate the labor mobility in the urban and peri-urban labor markets in Bangladesh. Recently, Tsionas (2012), Park et al. (2015), Das and Polachek (2017) and Parmeter (2018) propose in the literature nonparametric and semi-parametric approaches where no parametric assumption on the functional form of production relationship is made.

METHODOLOGY

Assuming the labor market is competitive and has information symmetry, such as in the **Fig. 1**, abscissa presents the amount of people employed and ordinate presents the level of their salary. Because the labor isn't able to know the maximum salary the employer wants to offer (W^P_{firm}, the reservation wage of the employer) and the employer can't get what is the minimum salary the labor is willing to accept (W^P_{worker}, the reservation wage of the employee), there will reach a salary supply-demand balance $W=W^\star$.To be honest, given the information in the labor market could be insufficient and asymmetry, the employer, and the labor are more likely to form various compensation contents when fixing the salary and contract. Supposing a large sample obeys the normal distribution and the minimum salary labor is willing to accept is W^P_{worker}, the employer will not be able to know it because of the information asymmetry or insufficient. What's more, every worker in the labor market has different human capital in the reality. The employer could only judge the productive force or the ideal salary level of workers with information like educational background, age, gender and so on. If the minimum salary that the potential employee's willing to get is less than the salary supply-demand balance, there will be a gap which we can call it $W^\star$-W^P_{worker}. Previous studies defined this exceeded salary that the company owners paid as employer ignorance (Polachek and Yoon 1987, Murphy and Strobl 2008). Similarly, job-hunters would also lose their abilities to get the idea of the maximum salary their potential employers' willing to give due to the information asymmetry. However, if the salary, in reality, is less than the one during the information symmetry in the labor market, workers will get less because of insufficient information (the gap W^P_{firm}-$W^\star$), and this phenomenon called employee ignorance. All these matters lead to a wage dispersion in the labor market and form various levels of salary. When considering salary issues in the labor market, it's appropriate and necessary to estimate and measure the information asymmetry in the labor market.

The problem of the aforementioned salary distribution does not only exist in the labor market. There are similar problems in the transaction process of real estate buyers and sellers, the negotiation of commodity purchases or other industries. For example, we are facing the environmental industry. With the emphasis on the issue of greenhouse warming, the buyers and sellers of emissions trading also have a dilemma that trading information is not sufficient.

Therefore, we apply the concept of two-tired earning which mentioned above to construct an emission trading theory to discuss trading information in the market. Supposed a situation of demand and supply of one emission trading market could be expressed as follows:

$$L^D = f(X^D, w) - e^D, \frac{\partial f}{\partial w} < 0 \quad (1)$$

$$L^S = g(X^S, w) - e^S, \frac{\partial g}{\partial w} > 0 \quad (2)$$

w represents the level of salary, while XD and XS means other explanatory variables besides emission trading, which could influence the demand and supply of that market. eD and eS are two nonnegative random variables and represent the effect both of the sides in the market get because of the information asymmetry. When both of eD and eS equal 0, the trading market is in information symmetry and both sides there could get sufficient information. When both of eD and eS are larger than 0, the trading market is in information asymmetry in some degree. The lager eD or eS get, the bigger the gap is between the two sides there. And trades might decrease while the gap grows.

When there's a balance in emission trading market, LD=LS, define the relationship equation of the excess demand as H(X,w)= eD-eS.

$$H(X, w) = e^D - e^S = f(X^D, w) - g(X^S, w) \quad (3)$$

Apply Taylor expansion to H(X,w) at (x0,w0) and we can get the relationship equation of dependent variable:

$$W = (\partial H/\partial w)^{-1} \times \{[(\partial H/\partial w)w_0 + (\partial H/\partial x')x_0 - H(x_0, w_0)] - (\partial H/\partial x')x + (e^D - e^S)\} + R \quad (4)$$

We take β as the remainder term of Equation (4) after Taylor expansion and transfer Equation (4) as a linear model as below:

$$w = \beta' X + u + v + \gamma \quad (5)$$

in which

$$\beta = (\partial H/\partial w)^{-1} \times \{[(\partial H/\partial w)w_0 + (\partial H/\partial x')x_0 - H(x_0, w_0)], \partial H/\partial x'\},$$

$$v = (\partial H/\partial w)^{-1} \times e^D \leq 0,$$

$$\gamma = (\partial H/\partial w)^{-1} \times e^S \geq 0,$$

β, v and z represents the coefficient of, X, the explanatory variable, the degree of insufficient information of the demander and the supplier in the emission trading market. Take the mathematical expectation to v and γ so that we can get E(v)=-μv<0 as well as E(γ) =μγ >0. μv represents the gap between the maximum price the buyer's willing to give and the seller actually gets under the mathematical expectation, which is called buyer's ignorance. μγ represents the gap between the minimum price the seller's willing to accept and the buyer actually gives, which is call seller's ignorance. We rewrite the Equation (5) as follow:

$$w = \beta' X + \varepsilon, \varepsilon = u + v + \gamma \quad (6)$$

ε contains three error terms as the error term of the regression estimation, buyer's and seller's ignorance. $u_i \in (-\infty, \infty), v_i \in (-\infty, 0), \gamma_i \in (0, \infty)$. In case of large-sample allocation, suppossed ui obeys the normal distribution which has the mean of 0 and the variation of σ_u^2. vi and γ i are exponential distribution models of means μ_v and μ_γ. Splitting these three error terms and adding marginal probability density function as:

$$\begin{aligned} g(\varepsilon) = \frac{1}{\mu_v + \mu_\gamma} \times exp\left(\frac{\varepsilon}{\mu_v} + \frac{\sigma_u^2}{2\mu_v^2}\right) \\ \times \left\{1 - \Phi\left(\frac{\varepsilon}{\mu_u} + \frac{\sigma_u}{\mu_v}\right)\right. \\ + \left(1 - \Phi\left(\frac{-\varepsilon}{\mu_u} + \frac{\sigma_u}{\mu_\gamma}\right)\right) \\ \times exp\left[\frac{-1}{2}\left(\frac{2\varepsilon}{\mu_u} + \sigma_u\left(\frac{1}{\mu_v} - \frac{1}{\mu_\gamma}\right)\right)\sigma_u\left(\frac{1}{\mu_v}\right.\right. \\ \left.\left. + \frac{1}{\mu_\gamma}\right)\right]\Bigg\} \end{aligned} \quad (7)^{1}$$

Φ is a cumulative density function which obeys the standard normal distribution. So we can estimate the buyer's and seller's ignorance which are studied in Equation (6) and Equation (7) with maximum likelihood estimation (MLE). Equation (8) is a likelihood function while Equation (9) is a log likelihood function:

$$\begin{aligned} L(w|\beta, \sigma_u, \mu_v, \mu_\gamma) &= \prod g(\varepsilon) \\ &= \prod g(w_i - \beta' x_i) \end{aligned} \quad (8)$$

$$\begin{aligned} logL = nlog\left(\frac{\theta_u \theta_v \theta_\gamma}{\theta_v + \theta_\gamma}\right) + \left[\theta_u \theta_v \sum_i \varepsilon_i + (\frac{n}{2})\theta_v^2\right] \\ + \sum_i log\left\{1 - \Phi(\theta_u \varepsilon_i + \theta_v)\right. \\ + [1 \\ - \Phi(-\theta_u \varepsilon_i \\ + \theta_\gamma)]exp\left[-(\frac{1}{2})(2\theta_u \varepsilon_i + \theta_v\right. \\ \left.\left. - \theta_\gamma)(\theta_v + \theta_\gamma)\right]\right\} \end{aligned} \quad (9)$$

The parameter $\theta_u, \theta_v, \theta_\gamma$ in the Equation (9) can be defined like this: $\theta_u = 1/\sigma_u, \theta_v = \sigma_u/\mu_v, \theta_\gamma = \sigma_u/\mu_\gamma$.

[1] The prove of the marginal probability density function g(ε) can refer Polachek and Yoon (1985, 1987) and Murphy and Strobl (2008).

We already know that μv and μγ represent the ignorance between the buyer's and seller's in the emission trading market while θ_v and θ_γ show the depth of them. Compared with the traditional one-tiered earnings frontier estimation or the traditional stochastic frontier approach, when evaluating the productivity, the traditional ways could only estimate the level of the deficiency of one market or a whole industry but can't tell which the department or group caused it. Two-tiered earnings frontier estimation may draw a picture of the level of the deficiency of the market as well as whose ignorance is deeper and analyze the deficiency of the operation in that particular market.

Set the empirical estimation with a linear model as follows:

$$W_i = log(w_i) = \beta' X_i + \varepsilon_i, \varepsilon = u + v + \gamma, \quad i=1, 2, n \quad (10)$$

Remove the log(wi), and set exponential distribution and take expectation of Equation (8):

$$E(w_i) = exp(\beta' X_i) \cdot E(e^u) \cdot E(e^v) \cdot E(e^\gamma) \quad (11)$$

E(ev) and E(eγ) in Equation (11) show the depth of the buyer's and seller's ignorance could influence the emission trade expectation. The equation $E(e^v) = 1/(1+\mu_v), E(e^\gamma) = 1/(1-\mu_\gamma)$ carries several economic meanings as below: E(ev) is the percentage of real trading price sellers got in the potential price level of the buyer (when the market is open and in information symmetry) and 1-E(ev) is the depth of the employee ignorance of the sellers. Similarly, E(eγ) is the percentage of real price that buyer paid to the potential price level of the sellers, and E(eγ)-1 shows the depth of the buyer ignorance.

CONCLUSION

This study tries to explore the impacts that emission trade dispersion which influenced by insufficient information. In this paper we constructed a theory to investigate the impacts that price variation caused by insufficient information, then applies the theory to estimate the condition of information holding between the employee and the employer.

For the future studies we hope that the study can furtherly apply environmental research data. With the help of these kinds of data, it is very promising and persuasive to give advice to the government on the implementation of the related environmental policy. We believed it is better to make further studies with long-term tracking materials in the future. On the other hand, we believe that such a theory can also be applied to real estate transactions. Based on this model, we can estimate the housing price volatility in real estate transactions, and further explore issues other than the housing bubble in housing price volatility.

ACKNOWLEDGEMENTS

This paper was supported by Major Project of Humanities and Social Sciences in Colleges and Universities in Zhejiang province during the year 2017-2018 (project no. 2018QN089).

REFERENCES

Aigner A, Lovell CAK, Schmidt P (1977) Formulation and Estimation of Stochastic Frontier Production Function Models. Journal of Econometrics, 6(1): 21-37.

Chen CL (2007) Counterfactual Decomposition of Public-Private Sector Wage Differentials in Taiwan: Evidence from Quantile Regression. Acdemic Economic Paper, 35(4): 473-520.

Chuang YC (2006) The Effect of Minimum Wage on Youth Employment and Unemployment in Taiwan. Hitotsubashi Journal of Economics, 47(2): 155-167.

Das T, Polachek SW (2017) Estimating Labor Force Joiners and Leavers using a Heterogeneity Augmented Two-tier Stochastic Frontier. Journal of Econometrics, 199(2): 156-172.

Gangopadhyay P, Shankar S (2016) Labour (Im) mobility and Monopsonistic Exploitation of Workers in the Urban Informal Sector: Lessons from a Field Study. Urban Studies, 53: 1042-1060.

Gomes P (2015) Optimal Public Sector Wages. The Economic Journal 125(587): 1425-1451.

Hofler RA, Polachek SW (1985) A New Approach to Measuring Wage Ignorance in Labor Market. Journal of Economics and Business, 37(3): 267-276.

Murphy A, Strobl E (2008) Employer and Employee Ignorance in Developing Countries: the Case of Trinidad and Tobago. Review of Development Economics, 12(2): 339-353.

Park BU, Simar L, Zelenyuk V (2015) Categorical Data in Local Maximum Likelihood: Theory and Applications to Productivity Analysis. Journal of Productivity Analysis, 43(2): 199-214.

Parmeter CG (2018) Estimation of the Two-tiered Stochastic Frontier Model with the Scaling Property. Journal of Productivity Analysis, 49(1): 37-47.

Polachek SW, Yoon BJ (1985) Frontier Estimation: a Three-Error Component Generalization. Working Paper.

Polachek SW, Yoon BJ (1987) A Two-Tiered Earnings Frontier Estimation of Employer and Employee Information in the Labor Market. The Review of Economics and Statistics, 69(2): 296-302.

Smith SP (1976) Pay Differentials between Federal Government and Private Sector Workers. Industrial and Labor Relations Review, 29(2): 179-197.

Smith SP (1981) Public/Private Wage Differentials in Metropolitan Areas. in P. Mieszkowski and G. E. Peterson (eds), Public Sector Labor Markets, pp. 81-102, Washington, DC: Urban Institute.

Stedhamn Y, Yamamura JH (2000) Gender and Salary: A Comparative Study of Accountants in the US and Australia. Asia Pacific Journal of Human Resources, 38(3): 104-116.

Tsionas EG (2012) Maximum Likelihood Estimation of Stochastic Frontier Models by the Fourier Transform. Journal of Econometrics, 170(1): 234-248.