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A Dynamic Panel Analysis on Minimum Wage and Gender Difference of Employment

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Abstract: In China, the minimum wages is frequently raised in recent years which has affected the employment in urban units. This study aims to explore the effects of the minimum wage to the gender difference of employment in urban units. By controlling the variables which affect the employment, the study designs a dynamic panel model and empirically studies the dynamic effect of the minimum wage. The empirical results show that: (1) The current effects of relative minimum wage to the Ratios of Female Employment (RFE) in various industries are from -0.16 to 0.07 and the lag effects are from -0.04 to 0.14: (2) There exists crowding-out effect of RMW to female employment in 8 industries and the effect is from 0.01 to 0.16 while the lagged crowding-out effect of RMW only exists in 3 industries, from which the author think that there exists an internal correction mechanism in the effect of RMW to RFE: (3) In the group with lower ratio of female workers or with lower RMW, the current effects of RMW are consistently negative while the lagged effects of RMW are differentiated. The study indicates that the rise of the minimum wage has enlarged the gender difference of employment in urban units.

Key words: Dynamic analysis, minimum wage, gender difference, employment, robust estimation

INTRODUCTION

Recent years, a lot of researches have found that the rise of minimum wage will influence the employment but there still exist disagreements in the study conclusions. With respect to the researches on the macro data, although the mainstream view thinks that the influence of minimum wage on employment is negative (Mincer, 1976; Schaafsma and William, 1983; Neumark and Wascher, 1992; Deere *et al*., 1995; Partridge and Partridge, 1999), there are still quite a few researchers who suggest that the influence be positive or neutral (Card, 1992a; Bell, 1997; Lemos, 2006). As to the studies on the micro data, the variability in reported results is probably most strikingly in American catering industry. Katz and Krueger (1992) concluded that the rise of the minimum wage in Texas in 1990 and 1991 stimulated the increase of the employment in the fast-food industry. Contrarily, Card (1992b) argued that the rise of the minimum wage in New Jersey in 1992 led to the reduce of the employment in the fast-food industry. However, Neumark and Wascher (2000) thought that their researches were all unbelievable. Card and Krueger (2000) compared various kinds of statistical data and gave a neutral suggestion that the total employment of fast-food industry did not decrease while the working hours of the workers reduced lightly. But this conclusion did not get Neumark' s approval. Due to the difficulty of identifying the effect of the minimum wage on the employment, Teulings (2000) called it as the minimum wage paradox.

As a vulnerable group, woman is more likely to be discriminated. The consensus view is that the rise of the minimum wage always brings woman negative effect. Mincer (1976) studied American gender difference of employment in early time of implementing minimum wage system and obtained a few important conclusions. In China, the minimum wage system only has a short history of 19 years and the micro data is lacking, so few literatures have focused on the relation between the gender difference and the minimum wage. Chunling and Shi (2008) thought that the gender discrimination was the main factor of gender income gap during the past 10 years. Jia and Zhang (2012) suggested that, from the perspective of labor supply, the rise of the minimum wage would bring negative effects to China's female employment.

When reviewing the implementation process of China's minimum wage system, the author notices that the rise of the minimum wage is just accompanied with the rapid development of the economy and the rise in labor cost is fully offset by the economic growth. Seemingly,

rising labor costs don't influence the demand in labor market, the total labor demand is still increasing continuously and the unemployment rate is still stable in recent years. However, when inspecting the actual state of employment from the micro perspective, the author can find some disharmonious factors: The shortage of migrant workers, the employment dilemma of college graduates, the gender discrimination and educational background discrimination in the employment, etc. All these factors show that there exit acute structural imbalances in China's employment. Recently the imbalance of gender structure has brought the author's attention.

Currently, there is no defined standard to help us judge whether or not China's gender ratio of employment is reasonable. However, by comparing with world's major developed or developing countries, the author finds that the ratio of female employment in China is obviously lower than the ratios of those countries (Liu and Tong, 2012). This study will, from a micro perspective, explore the effect of minimum wage to the gender difference (or gender structure) of employment in China's urban units. The author attempt to explore how much the minimum wage affects the gender difference of employment and to provide some reasonable policy proposals for the adjustment of minimum wage in future. This research bases on the hypothesis: Without the influence of external interference, the gender ratio of the employment in urban units will keep stable. Once the change of gender ratio is observed significantly, can the author deduce that the side that the employment ratio has dropped is crowded out from the unit which is partly because the rise of minimum wage leads to the increase of labor cost and, hence, causes the strengthening of gender discrimination.

The main contributions of this study are as follows: Firstly, the author inspects the inertia of the gender difference of employment (namely, the lag effect of the gender ratio of employment). Secondly, the author notices the relative changes of the employment gender while most of the literatures only notice the absolute changes. Thirdly, the author uses the dynamic panel analysis and more accurate and robust estimation methods in the regression estimation. Finally, the author pays more attentions to the effects of the minimum wage in 10 industries of urban units a relative micro perspective. And the author also takes notice of the relationship between the minimum wage and the average wage of industry.

MATERIALS AND METHODS

To analyze the effect of minimum wage on gender difference, the author chooses 10 industries from China's urban units:

$$I_1, I_2, I_3, I_4, I_5, I_6, I_7, I_8, I_9, I_{10}$$

Where:

- I_1 denotes agriculture, forestry, husbandry and fishery
- I_2 denotes mining
- I_3 denotes manufacturing
- I_4 denotes production and supply of electric power, gas and water
- I_5 denotes construction
- I_6 denotes transportation, storage and postal service;
- I_7 denotes wholesale, retail, accommodation and catering
- I_8 denotes finance and insurance
- I_9 denotes real estate
- I_{10} denotes water conservancy and environment protection

The author uses MATLAB 9.0 to perform the data-processing and use Stata 11.0 to perform the dynamic panel analysis of the model.

Theoretical model: The author design a dynamic panel model as follows:

$$RATIO_{i,t,p} = \sum_{j=1}^{k} \beta_j RATIO_{i,t-j,p} + \gamma RMW_{i,t,p} + \lambda RMW_{i,t-1,p} + \eta x_{i,t,p} + v y_{i,t,p} + \mu_{i,p} + \varepsilon_{i,t,p}$$

Where, i = 1, 2, ..., 30 denotes 30 regions (Tibet is not included due to the lack of statistic data) t = 1996, 1997, ...2010, p = 1, 2, ..., 10 denotes 10 industries. The coefficient raw vectors, denoted as η and v are 9 dimensions and 10 dimensions respectively. The errors of the model are formed by μ_i and $\varepsilon_{i,t}$ where μ_i is the unobservable difference of region feature and $\varepsilon_{i,t}$ is the random error. The column vectors x and y are expressed as:

$$x = (RH, RE, LABOR, RFDI, RTRADE, LPGDP, LD, UR, LPC)^T$$

$$Y = (YEAR1996, YEAR1997, ..., YEAR2010)^T$$

Statistical description of the variables: Table 1 lists the statistical description of the variables. The data are derived from the official statistical data of 30 regions of China from 1996 to 2010.

The author also compares the mean of RFE and RMW respectively among 10 industries: for RFE, $I_5>I_2>I_6>I_4>I_{10}>I_9>I_1>I_3>I_8>I_7$ and for RMW, $I_1>I_7>I_5>I_3>I_9>I_2>I_{10}>I_6>I_4>I_8$. Thus, the author can divide 10 industries into 2 groups: The group with higher ratio of female workers including the industries of I_5, I_2, I_6, I_4 and I_{10} and the group with lower ratio including the industries of I_9, I_1, I_3, I_8 and I_7. The author can also divide 10

Table 1: Definitions and descriptive statistics for variables in the research models

Variables	Definition	Mean	Standard deviation	Maximum	Minimum
Explained variable					
RFE	Gender difference: Ratio of female employment to total employment	33.56	4.7	063.16	6.61
RFE(-i)	RFE, lagged i years, I = 1, 2, 3				
Observed variables					
RMW	Ratio of absolute minimum wage (AMW) to average wage (AW)	31.93	7.4	109.8	6.41
RMW(-1)	RMW, lagged one year				
Education					
RH	Ratio of workers with high school education or above to total workers	19.13	11.66	064.6	5.50
RE	Ratio of education fund to GDP	4.44	1.18	008.6	2.48
Labor supply					
LABOR	Ratio of population of 15 to 64 years to total population	68.94	4.41	082.67	55.08
Economic opening					
RFDI	Relative FDI: Ratio of FDI to GDP	2.86	2.87	016.84	0.00
RTRADE	Ratio of total export-import volume to GDP	30.15	35.79	166.8	4.05
Economic growth					
LPGDP	Logarithm of per capita GDP	8.53	0.70	010.22	6.87
LD	Logarithm of total number of labor dispute cases	8.32	1.32	011.92	3.47
Employment environment					
UR	Unemployment rate	3.57	0.89	007.4	0.60
LPC	Logarithm of per capita consumption	8.78	0.45	010.05	7.93

industries into 2 groups: the group with higher wage including the industries of I_2, I_{10}, I_6, I_4 and I_8 and the group with lower wage including the industries of I_1, I_7, I_5, I_3 and I_9.

By selecting the Ratio of Female Employment to total employment (RFE) as explained variable, the author can easily judge whether or not the female workers are crowded out from a certain industry according to the change of RFE. Yet, the author can not distinguish the crowding-out effect from the change of the absolute quantity of female employment. In addition, although the study has controlled 10 variables associated with the gender difference of employment it is inevitable that some of the important variables are omitted. After all, the gender difference is influenced by numerous factors. To solve the problem, the author introduce lagged RFE to the study and the optimal lag number is determined by Arellano-bond AR test (Arellano and Bond, 1991).

The main observation variable is Relative Minimum Wage (RMW) and lagged RMW of one year (RMW(-1)). If:

$$\frac{\partial(\mathrm{REF})}{\partial(\mathrm{AMW}/\mathrm{AW})}=\frac{\partial(\mathrm{REF})}{\mathrm{AW}.\partial(\mathrm{AMW})-\mathrm{AWM}.\partial}\bullet(\mathrm{AW})^2>0$$

Then:

$$\frac{\partial(\mathrm{REF})/(\mathrm{REF})}{\partial(\mathrm{AMW}/\mathrm{AW})}>\frac{\partial(\mathrm{REF})/(\mathrm{REF})}{\partial(\mathrm{AW})/(\mathrm{AW})}$$

and vice versa. Here AMW is the absolute minimum wage and AW is the average wage. Hence, from the regression coefficient of RMW the study can get: The positive coefficient indicates that the elasticity of female employment to AMW is greater than the elasticity to AW and vice versa.

So far, few literatures have researched the lag effect of minimum wage. But some researchers have noticed the importance of the lag effect. Neumark and Wasche (1992, 1994) found that the effect of minimum wage will upward bias if the lagged minimum wage was omitted. Therefore, the author introduces the lagged RMW into the model in order to inspect the lag effects of minimum wage in various industries. China's minimum wage system rules that the minimum wage should be adjusted once in two years. The author determines the optimal lag number of RMW being one in order that the study can distinguish the lag effect of minimum wage from the effect of newly-adjusted minimum wage.

In this study, the author also controls lots of variables that probably influence the explained variable RFE: Firstly, the author uses RH and RE to control the education difference of various regions. Secondly, the author uses LABOR to control the labor supply difference. Thirdly, the author uses RFDI and RTRADE to control the difference of economic opening level. Fourthly, the author uses LPGDP to control the difference of economic development. Lastly, the author uses LD, UR and LPC to control the difference of employment environment. In addition, as the author introduces RFE(-i) into the model, the author uses the Generalized Method of Moments (GMM) to estimate the dynamic panel model. In general, there is correlation of various cross-sections in dynamic panel GMM estimation. To solve the problem, the author introduces the dummy variables of year 1996 to 2010 into the model.

RESULTS AND DISCUSSION

The author uses the DIF-GMM method (Arellano and Bond, 1991) to estimate the dynamic model and use the Small-sample Correction method (Windmeijer, 2005) to correct the deviation in the DIFF-GMM estimation. The author uses MATLAB 9.0 to

Table 2: Regression results of the dynamic panel model in 10 industries

	I_1	I_2	I_3	I_4	I_5	I_6	I_7	I_8	I_9	I_{10}
RFE(-1)	0.44***	0.55***	0.72***	0.60***	0.58***	0.47***	0.45***	0.50***	0.47***	0.45***
Corrected s.d.	-0.06	-0.11	-0.09	-0.05	-0.09	-0.08	-0.11	-0.06	-0.07	-0.08
RFE(-2)	0.44***	0.37***	0.23***	0.22***	0.30***	0.30***	0.23*	0.20***		0.18***
Corrected s.d.	-0.05	-0.09	-0.08	-0.06	-0.09	-0.03	-0.12	-0.07		-0.04
RFE(-3)							0.26**	0.13**		
Corrected s.d.						-0.12	-0.06			
RMW	0.06*	-0.14**	0.07*	-0.01	-0.04	-0.01	-0.05*	-0.04	-0.16*	-0.05
Corrected s.d.	-0.04	-0.06	-0.03	-0.04	-0.05	-0.02	-0.03	-0.07	-0.09	-0.06
RMW(-1)	-0.04	0.14*	-0.04	0.05	0.04	-0.01	0.08***	0.02	0.14*	0.14**
Corrected s.d.	-0.03	-0.06	-0.04	-0.05	-0.06	-0.02	-0.03	-0.05	-0.08	-0.07
AR(1) test	-2.84	-3.09	-3.98	-3.3	-3.97	-2.95	-2.39	-3.94	-2.95	-3.59
Probability	0	0	0	0	0	0	-0.02	0	0	0
AR(2) test	1.81	-1.85	-1.34	-0.34	0.17	-1.71	-0.96	-0.01	-0.29	-0.65
Probability	-0.07	-0.06	-0.18	-0.73	-0.87	-0.09	-0.34	-1	-0.77	-0.51
Sargan test	206.66	181.43	315.36	234.52	165.26	292.36	130.54	254.04	210.31	331.06
Prob.	-0.9	-0.09	-0.06	-0.12	-0.08	-0.37	-0.42	-0.16	-1	-0.5
Obs. value	390	390	390	390	390	390	360	360	420	390

In Table 2, I_1 denotes agriculture, forestry, husbandry and fishery; I_2 denotes mining; I_3 denotes manufacturing; I_4 denotes production and supply of electric power, gas and water; I_5 denotes construction; I_6 denotes transportation, storage and postal service; I_7 denotes wholesale, retail, accommodation and catering; I_8 denotes finance and insurance; I_9 denotes real estate; I_{10} denotes water conservancy and environment protection. Corrected s.d. denotes corrected standard deviation; RFE denotes ratio of female employment to total employment; RMW denotes ratio of absolute minimum wage to average wage. The number under the regression coefficient is the corrected standard deviation and the number under the statistic value of test is the probability value, ***, ** or * indicates significance at the level of 0.01, 0.05 or 0.10, respectively. Arellano-bond AR(1) and AR (2) test perform the correlation test of the residual error series. Sargan test performs the validity test of the instrumental variables

perform the data-processing and use Stata 11.0 to perform the dynamic panel analysis of the model. The estimation results are listed in Table 2 (the results of control variables are not listed).

The results show that the crowding-out effects exist in the current and lag effect and most of the total effect are positive which is different to the previous studies (Liu and Tong, 2012). The coefficients of RMW except I_1 and I_3 are negative which is consistent with the Neumark's results (Neumark and Wascher, 1992). The coefficients of RMW(-1) except I_1, I_3 and I_6 are positive which proves the upward bias of the lagged minimum wage (Neumark and Wascher, 1992, 1994). Other findings are as follows:

- In each industry, the probability values of Arellrano-Bond AR(2) test and Sargan test are all greater than 0.05 which indicates that the residual error series of the model are unrelated and the instrumental variables used in the estimation of the model are valid
- In I_7 as well as I_8, the lag number of RFE is 3 which indicates that the lag effect of RFE may last a relative long time. While in I_9 the lag effect of RFE can only last one year. In the rest industries the lag effect of RFE all last 2 years. In I_3 the effect of RFE(-1) reaches a significant maximum value 0.721. In I_3 and I_7 the total lag effects of RFE are greater than other industries
- The current effects of RMW in 10 industries are mainly negative. In I_3 the current effect of RFE reaches a positive maximum value 0.066 while in I_9 the current effect of RFE has a negative maximum value -0.160. The lag effects of RMW in 10 industries are mainly positive. In I_{10} and I_3 the lag effect has the positive maximum value 0.144 and the negative maximum value -0.041, respectively. In the industries except I_6 the current effects and lag effects of RMW are all opposite which indicates that there exists an internal correction mechanism to the effect of RMW on RFE. In most industries, the rising effect of AMW is greater than that of AW
- In the group with lower ratio of female workers, including I_5, I_2, I_6, I_4 and I_{10}, the current effects of RMW are consistently negative while in the group with higher ratio, including I_9, I_1, I_3, I_8 and I_7, the current effects of RMW are differentiated. The lag effects of RMW are mainly positive in the two groups but the author doesn't find consistent effect. In the group with lower RMW, including I_8, I_4, I_6, I_{10} and I_2, the author finds that the current effects of RMW are consistently negative while in the group with higher RMW, including I_9, I_3, I_5, I_7 and I_1, the current effects of RMW are differentiated. The lag effects of RMW in the group with lower RMW are mainly positive

CONCLUSION AND SUGGESTION

Using China's statistical data and dynamic panel model, the study empirically explored the effect of RMW to RFE and presented some beneficial conclusions. The

author finds that the current effects of RMW to RFE are from -0.16 to 0.066 and the lag effects are from -0.041 to 0.144. In 8 industries there exists instant crowding-out effect of RMW to female employment and the crowding-out effect is from 0.008 to 0.160. However, the lagged crowding-out effect of RMW only exists in 3 industries. The above results show that there exists an internal correction mechanism to the effect of RMW to RFE.

According to the empirical research and the conclusions above, the authors provide some beneficial suggestions for the adjustment of minimum wage in various regions of China in future:

- As in most industries there exist the internal correction mechanism to the effect of RMW on RFE, the minimum wage should not be frequently adjusted. Otherwise, female employment will suffer from the rising of minimum wage rather than benefit from it
- When regional governments decide how to adjust the minimum wage standard, they should take the local industrial structure as well as the average wage into consideration. The author suggests that the local pillar industries be given some autonomous rights so that they can determine the rise or fall of the minimum wage according to their economic development level, status of labor demand and the employment structure of industry
- When the regional governments adjust the minimum wage, they should make policies matched to the minimum wage in order to eliminate the negative effects caused by the adjustment of minimum wage and keep the continuity and consistence of the policies. Meanwhile, the relevant departments of local government should provide suitable professional train to the female labor so as to improve their comprehensive quality and marginal productivity
- To those industries that absorb a large number of female labors and thus have a high ratio of female employment, the government should give them more policy supports in order to help them eliminate the negative effect caused by the rise of minimum wage. To the industries with higher average wage, the government should pay more attentions to the negative effect of income gap to female employment. As to the industries with higher ratio of female workers, the government should pay close attention to the long-term impact of minimum wage on female employment

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