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Abstract

This paper uses a large sample of Chinese cross-section firm-level data with comprehensive information about labour quality to investigate the relationship between labour quality and FDI distribution in China. Using parametric, IV-GMM and non-parametric techniques, the author finds that labour quality measured by education level plays an important role on deciding the distribution of FDI but labour quality measured by working certificates lose their significance. The author also finds that labour quality has a more significant impact on other foreign investments than HMT invested firms and the impacts of labour quality on FDI is strongly uneven across industries and provinces.

Key words: education, foreign direct investment, labour quality

JEI codes: F21, O18, O53

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I. Introduction

This paper sets out an answer to the question: does labour quality have an important role in attracting foreign direct investment (FDI) in China? Economists want to know the answer to this question because they want to know whether labour quality is important to economic growth in China. The past three decades have witnessed an unprecedented expansion in inward FDI in China and it is clear that FDI has played a decisive role in China's rapid economic growth.

The evidence of past studies about this question is mixed. Earlier studies such as Cheng and Kwan (2000a, b) use Chinese regional level data to examine the determinants of the location of FDI in China over the period 1983–1995 and find that labour quality, in a variety of measures, is insignificant in explaining the regional distribution of FDI, whereas Gao (2005) uses Chinese provincial FDI by source economy and finds that labour quality plays a significant and positive role in attracting FDI. More recently, Hong (2008) uses 11 year city-level panel data and finds that the impact of labour quality on the location of China's inward-FDI is insignificant.[1] All these studies use regional, provincial or city-level data to investigate the relationship. However, investment relates to firm-level, and aggregated data may bias the results.

To our knowledge, this paper is the first to use Chinese manufacturing firm-level data with comprehensive information about labour quality to investigate the relationship between labour quality and the distribution of FDI in China.[2] In this paper, the author uses a range of education levels and working certificates as a proxy

[1] Kang and Lee (2007) find that for South Korean multinational companies, labour quality had a significant influence on the choice of location for FDI.

[2] Chinese inward FDI dominates in manufacturing. In 2004, China attracted 60.63 billion US dollars, of which, 43.02 billion was in manufacturing (70%). Source: National Bureau of Statistics of China. Website: http://www.stats.gov.cn/tjgb/ndtjgb/qgndtjgb/t20050228_402231854 htm.

for labour quality, and uses both labour quality dummies and labour quality density variables to study the effect of labour quality on FDI.

In Chinese foreign-invested firms, different countries of origin behave quite differently. Most of the Hong Kong, Macao and Taiwan (HMT) affiliates are labour-intensive and the affiliates of western countries are much more technology-intensive. Firms from HMT are export-oriented and tend to use cheap labour in main-land China, while firms from other counties like the USA, EU and Japan tend to focus on the Chinese domestic market(Huang, 2004; Branstetter & Foley, 2007).

In this paper, the author tests the relationship between labour quality and HMT investments and other foreign investment separately. The endogeneity of labour quality is examined using non-parametric matching techniques and IV-GMM methods to double check the impacts of labour quality on FDI distribution. In addition, the author analyses the relationship in key industries and coastal provinces. Through an extensive search, the author finds that: (i) labour quality measured by education level plays an important role in attracting FDI in China, but labour quality measured by working certificates is less significant; (ii) labour quality is more important to other foreign investments than HMT capital; (iii), the roles of labour quality on China's inward FDI are strongly uneven across the industries and provinces.

The structure of the paper is as follows: Section 2 talks about the data and specification. The author will show the results of labour quality's role in attracting FDI in section 3. Section 4 discusses the relationship between labour quality and FDI at industry and province levels. Section 5 is the conclusion.

II. Data and Specification

1. Data

The sample of data used in this paper comes from rich firm-level data focusing on manufacturing industry in 2004. It is based on the First National Economic Census in 2004 conducted by the National Bureau of Statistics of China (NBSC). The Census provides comprehensive information of labour quality including various education levels from junior middle school to graduates and working expertise certificates reflecting working experience. In addition, each firm has variables of firm's characteristics including HMT-invested value and other foreign countries invested value, a rich source of information for the analysis of the relationship between labour quality and FDI.

We focus our study on 29 manufacturing industries with foreign-invested capital. Although this data set contains valuable detailed information, a few samples in the data set are noisy and misleading, due in large part to mis-reporting by some firms (See Holz, 2004, for a discussion about possible problems of using China's data). [3] The author drops the observations with following problems: (a) the firm starts business after 2004 or missing; (b) any of the following are not bigger than zero: the gross value, wage, employment or firm income.

The data set provides 53,415 foreign invested firms, 28,291 HMT-invested firms, 24,588 other foreign firms and 536 firms with both HMT and other foreign investment. In Table 1 and Table 2, the author shows the number of foreign-invested firms in every industry and every province respectively. We can see that industries 17, 18 and 40 are the industries with the highest proportion of foreign capital invested and

[3] For example, some firms report negative export volume and zero employment, and some firms are surveyed twice in the same year.

provinces Guangdong, Shanghai, Jiangsu and Zhejiang are the main destinations of FDI.

Table 1 Foreign-invested firm in each industry

Industry	Numbers	Ratio
Manufacture of Foods（14）	1247	2.33
Manufacture of Beverages (15)	561	1.05
Manufacture of Tobacco (16)	6	0.01
Manufacture of Textile (17)	5190	9.72
Clothing &Other Fibre Products Manufacturing (18)	5013	9.39
Manufacture of Leather, Fur, & Feather (19)	2472	4.63
Processing of Timber, Manufacture of Wood, Bamboo, Rattan, Palm & Straw Products (20)	909	1.70
Manufacture of Furniture (21)	1017	1.90
Manufacture of Paper & Paper Products (22)	1206	2.26
Printing, Reproduction of Recording Media (23)	676	1.27
Manufacture of Articles for Culture, Education &Sport Activities (24)	1544	2.89
Processing of Petroleum, Coking (25)	162	0.30
Manufacture of Raw Chemical Materials & Chemical Products (26)	3002	5.62
Manufacture of Medicines (27)	867	1.62
Manufacture of Chemical Fibers (28)	304	0.57
Manufacture of Rubber (29)	777	1.45
Manufacture of Plastics (30)	3367	6.30
Manufacture of Non-metallic Mineral Products (31)	2389	4.47
Smelting & Pressing of Ferrous Metals (32)	528	0.99
Smelting & Pressing of Non-ferrous Metals (33)	657	1.23
Manufacture of Metal Products (34)	2759	5.17
Manufacture of General Purpose Machinery (35)	3052	5.71
Manufacture of Special Purpose Machinery (36)	2057	3.85
Manufacture of Transport Equipment (37)	1989	3.72
Arms & Ammunition Manufacturing (39)	3861	7.23
Electrical Machinery & Equipment Manufacturing (40)	4619	8.65
Electronic & Communication Equipment Manufacturing (41)	1282	2.40
Instrumentation Computers, Office Machinery (42)	1804	3.38
Other Manufactures (43)	98	0.18

Table 2 Foreign-invested firms in each province

Province	Number	Province	Number	Province	Number
Beijing(11)	1319	Zhejiang(33)	6700	Hainan(46)	70
Tianjin(12)	1322	Anhui(34)	414	Chongqing(50)	171
Hebei(13)	849	Fujian(35)	4549	Sichuan(51)	405
Shanxi[1](14)	119	Jiangxi(36)	357	Guizhou(52)	99
Inner Mongolia(15)	87	Shandong(37)	3780	Yunnan(53)	159
Liaoning(21)	1925	Henan(41)	346	Tibet(54)	2
Jilin(22)	246	Hubei(42)	486	Shanxi[2](61)	162
Heilongjiang(23)	167	Hunan(43)	374	Gansu(62)	34
Shanghai(31)	5499	Guangdong(44)	14499	Qinghai(63)	13
Jiangsu(32)	8889	Guangxi(45)	285	Ningxia(64)	37
				Xinjiang(65)	51

Note: province code in parentheses.

2. Specification

In order to test the relationship between FDI and labour quality, the author uses the following specification:

$$Ln(FDI) = \alpha + \beta Labourquality + cControl + \varepsilon \qquad (1)$$

where FDI is the dependent variable. Here the author will use three dimensions to measure the FDI, aggregated FDI, HMT-invested capital and other foreign-invested capital.

The key explanatory variable that we are most interested is labour quality. In this paper the author uses two indicators to measure labour quality: the employee's education level, and the employee's working expertise level. For the education level, we have five categories: junior middle school, high middle school, college, undergraduate and postgraduate.[4]

We use $Djunmidd$, $Dhigmidd$, $Dcollege$, $Dundergra$, and $Dgraduate$ to denote the dummies of whether the firms have employees of various education levels

[4] Here, college means students graduated after three-year study and undergraduate means graduated after four-year study in college or university.

(education dummy). If the firm has, the dummy equals unity otherwise zero. We use *Junmidd* , *Higmidd* , *College* , *Undergra* , and *Graduate* to denote the number of employees of various education levels (education density). For the working expertise levels, there are three certification levels: high, middle and preliminary,[5] which reflect workers' employed working experience. We use *Dhigh* , *Dmiddle* , *Dpre* lim to denote the dummies of whether the firms have employees of various certificates(working expertise dummy) and variables *High* , *Middle* , Pr *e* lim to denote the number of employees with a range of working certificates (expertise density). Control variables include: gross capital per capita, income per capita, firm age, computer used per capita, wage per capita, tax per capita, industry dummies and province dummies. The basic descriptive statistics of main variables are provided in Table 3.

Table 3 Descriptive statistics (basics)

variables	mean	standard deviation	min	max
FDI	8.70	1.60	0	15.94
HMT	8.68	1.52	0	15.93
Foreign	8.69	1.71	0	15.94
Capital	4.73	1.33	-0.70	12.95
Income	4.89	1.18	-1.62	13.55
Wage	2.26	0.70	-1.61	9.84
Taxes	1.05	1.84	-7.87	11.72
Computer	-2.95	1.26	-8.48	6.63
Firm-age	1.61	0.82	0	4.69
Junmidd	4.69	1.53	0	10.69
Higmidd	4.09	1.41	0	11.40
College	2.63	1.29	0	9.71
Undergra	2.03	1.35	0	9.86
Graduate	0.99	1.05	0	8.96
High	1.20	1.10	0	8.85

[5] In Chinese firms, there are usually three levels of certificate reflecting employees' expertise: preliminary middle and high. For the preliminary level, one can get this after one year work for undergraduates, and for those employees under the college educational level, they need more years to get the preliminary certificate. For middle level, usually four to five years after the preliminary level and for high level, usually four to five years after the middle level.

Middle	1.80	1.23	0	9.38
Prelim	2.25	1.34	0	9.60

Note: All the variables are the log values.

Table 4 Descriptive statistics (correlations)

Variables	Capital	Income	Wage	Taxes	Computer	Age
Junmidd	-0.19	-0.13	-0.15	-0.10	-0.25	0.02
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Higmidd	-0.03	-0.06	-0.03	-0.04	-0.04	0.03
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
College	0.14	-0.01	0.08	0.00	0.17	0.06
	(0.00)	(0.00)	(0.00)	(0.86)	(0.00)	(0.00)
Undergra	0.25	0.06	0.17	0.06	0.31	0.07
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Graduate	0.25	0.13	0.21	0.12	0.30	0.05
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
High	0.23	0.06	0.12	0.09	0.21	0.11
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Middle	0.18	0.02	0.08	0.06	0.14	0.12
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Prelim	0.10	-0.03	0.05	0.03	0.06	0.13
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Note: P-values are in the brackets.

Table 5 Descriptive statistics (correlations cont.)

Variables	Junmidd	Highmidd	College	Undergra	Graduate
High	-0.05	0.05	0.24	0.42	0.36
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Middle	-0.01	0.10	0.34	0.39	0.22
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Prelim	0.06	0.12	0.24	0.24	0.14
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)

Note: P-values are in the brackets.

Tables 4 and 5 report the correlations between explanatory variables, in particular between the key labour quality variables. Table 4 shows the correlation between labour quality variables and other control variables. Generally the correlations are very small values and there is no significant multicollinearity problem between key

variables and control variables. Table 5 displays the correlation between key variables, that is, labour quality by education level and labour quality by working experience. The correlation values between two labour quality indicators are also small, generally less than 0.30. Only four values are bigger than 0.30, the highest one is 0.42, so these values suggest that there is no significant multicollinearity problem in labour quality variables. From the above analysis, we can conclude that in our explanatory variables, there is no significant multicollinearity problem and multicollinearity will not impact significantly on our results, especially on efficiency, because multicollinearity will have no effect on bias or consistency.

III. Inward-FDI and Labour Quality

1. Basic Results

In this section, the author shows the results for the impact of labour quality on China's inward-FDI flows at firm level. First, the author shows the labour structure of foreign-invested firms in Table 6 (FDI=HMT + Foreign).

Table 6 Labour structure in foreign-invested firms

	Education Level				
	Graduates	Undergraduates	College	High school	≤Middle school
FDI	79,351	960,241	1,845,518	9,347,761	15,436,014
Ratio	0.29	3.47	6.67	33.78	55.79
HMT	35,066	435,931	928,831	4,782,495	8,961,956
Ratio	0.23	2.88	6.13	31.58	59.18
Foreign	45,985	554,035	972,397	4,763,847	6,692,695
Ratio	0.35	4.25	7.46	36.56	51.37
	Working Certificates				
	High	Middle	Preliminary	No Certificate	
FDI	141,093	515,980	1,016,074	2.60E+07	
Ratio	0.51	1.86	3.67	93.96	
HMT	73,863	256,555	537,358	1.42E+07	
Ratio	0.49	1.70	3.56	94.25	
Foreign	73,111	276,481	513,406	1.21E+07	
Ratio	0.56	2.13	3.95	93.36	

From the table, it can be seen that in foreign-invested firms, over 50% employees have junior middle school education or below and for HMT the ratio is about 60%. The higher the education level, the lower the number of employees. For example, there are just 0.29% graduates and 3.47% undergraduates for foreign-invested firms. With regard to the working experience, more than 90% employees have no working certificate and are classed as inexperienced.

However, above the junior middle school level, the proportion of employees of various with various education levels in other foreign-invested firms is greater than HMT-invested firms, and the same is true for working experience. Therefore, compared with HMT, other foreign investors have higher labour quality owing to the

different origin advantages and motivations to invest in mainland China as we mentioned above.[6]

Table 7 reports the number of firms with various labour qualities. In foreign-invested firms (FDI), more than 90% of the firms have employees with college education level and about 70% of firms with undergraduate employees and only one fifth firms have graduates. The number of other foreign-invested firms with higher educational employees is more than HMT investors. About 60% of firms have employees with preliminary and middle certificates and 30% firms have employees with high certificates in all foreign-invested firms. The number of other foreign-invested firms with higher working certificates employees is more than HMT-invested firms. This confirms the above finding that other foreign investors have higher labour quality than HMT investors.

Table 7 Number of firms with various labour qualities

	Education Level				
	Graduates	Undergraduates	College	High school	≤Middle school
FDI	10,396	37,200	49,242	52,207	49,135
Ratio	19.46	69.64	92.19	97.74	91.99
HMT	4,965	19,195	26,365	28,221	27,042
Ratio	17.22	66.59	91.46	97.90	93.81
Foreign	5,617	18,463	23,390	24,514	22,596
Ratio	22.36	73.49	93.10	97.57	89.94
	Working Certificates				
	High	Middle	Preliminary	No Certificates	
FDI	15,313	29,424	31,856	15,962	
Ratio	28.67	55.09	59.64	29.88	
HMT	7,785	15,381	17,214	8,795	
Ratio	27.01	53.36	59.71	30.51	
Foreign	7,807	14,451	15,045	7,249	
Ratio	31.07	57.52	59.88	28.85	

Using this information about the labour structure of foreign-invested firms, the author uses the labour quality dummy as the explanatory variable, using aggregated FDI, HMT investments and other foreign investments as the dependent variable to run

[6] We cannot distinguish US, EU and Japan investors from other foreign investors, because this group also includes other Asian developing countries, so we can expect for US, EU and Japanese technology intensive firms in China, labour quality could be even higher.

the regression. Tables 8 to10 report the estimates of different specifications. Table 8 shows the results with aggregated FDI as the dependent variable, Table 9 with HMT investments as the dependent variable, and Table 10 is other foreign capital as the left- hand-side variable.

Table 8 Labour quality dummy variable coefficients estimates with aggregated FDI

	(1)	(2)	(3)	(4)
Dgraduate	0.674***	0.657***	0.646***	0.628***
	(0.0206)	(0.0203)	(0.0203)	(0.0200)
Dundergra	0.460***	0.467***	0.442***	0.452***
	(0.0159)	(0.0152)	(0.0159)	(0.0151)
Dcollege	0.428***	0.405***	0.412***	0.395***
	(0.0249)	(0.0233)	(0.0248)	(0.0233)
Dhigmidd	0.527***	0.461***	0.533***	0.473***
	(0.0471)	(0.0459)	(0.0472)	(0.0461)
Djunmidd	0.331***	0.278***	0.351***	0.300***
	(0.0279)	(0.0278)	(0.0276)	(0.0275)
Dhigh	-0.0496***	-0.0145	-0.0331*	-0.00350
	(0.0182)	(0.0177)	(0.0181)	(0.0176)
Dmiddle	-0.125***	-0.0665***	-0.116***	-0.0613***
	(0.0169)	(0.0163)	(0.0167)	(0.0162)
Dprelim	-0.0749***	-0.0206	-0.0672***	-0.0172
	(0.0158)	(0.0154)	(0.0157)	(0.0153)
lnfirmage	0.184***	0.117***	0.184***	0.120***
	(0.00833)	(0.00830)	(0.00826)	(0.00822)
lnpertax	-0.163***	-0.129***	-0.150***	-0.119***
	(0.00516)	(0.00507)	(0.00513)	(0.00505)
lnpercomputer	-0.108***	-0.151***	-0.105***	-0.143***
	(0.00786)	(0.00766)	(0.00826)	(0.00802)
lnperwage	0.141***	0.111***	0.158***	0.130***
	(0.0141)	(0.0140)	(0.0142)	(0.0141)
lnpergrosscapital	0.843***	0.890***	0.857***	0.902***
	(0.0100)	(0.00978)	(0.0103)	(0.0100)
lnperincome	-0.289***	-0.296***	-0.284***	-0.290***
	(0.0114)	(0.0110)	(0.0114)	(0.0111)
Provinces Dummies	no	yes	no	yes
Industry Dummies	no	no	yes	yes
Observations	39,251	39,251	39,251	39,251
R-squared	0.324	0.370	0.345	0.388

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9 Labour quality dummy variable coefficients estimates with HMT FDI

	(1)	(2)	(3)	(4)
Dgraduate	0.631***	0.576***	0.613***	0.556***
	(0.0284)	(0.0279)	(0.0281)	(0.0276)
Dundergra	0.409***	0.411***	0.409***	0.411***
	(0.0206)	(0.0195)	(0.0205)	(0.0195)
Dcollege	0.446***	0.426***	0.437***	0.424***
	(0.0314)	(0.0291)	(0.0314)	(0.0291)
Dhigmidd	0.449***	0.410***	0.459***	0.425***
	(0.0631)	(0.0603)	(0.0632)	(0.0604)
Djunmidd	0.365***	0.314***	0.381***	0.330***
	(0.0405)	(0.0400)	(0.0403)	(0.0397)
Dhigh	-0.0362	0.00746	-0.0144	0.0231
	(0.0246)	(0.0237)	(0.0244)	(0.0235)
Dmiddle	-0.130***	-0.0696***	-0.124***	-0.0666***
	(0.0220)	(0.0212)	(0.0219)	(0.0210)
Dprelim	-0.0900***	-0.0263	-0.0839***	-0.0251
	(0.0206)	(0.0199)	(0.0204)	(0.0197)
lnfirmage	0.157***	0.0833***	0.154***	0.0831***
	(0.0108)	(0.0107)	(0.0108)	(0.0107)
lnpertax	-0.174***	-0.128***	-0.162***	-0.120***
	(0.00679)	(0.00669)	(0.00682)	(0.00670)
lnpercomputer	-0.0985***	-0.153***	-0.0790***	-0.130***
	(0.0100)	(0.00980)	(0.0106)	(0.0103)
lnperwage	0.117***	0.0403**	0.129***	0.0594***
	(0.0187)	(0.0187)	(0.0189)	(0.0188)
lnpergrosscapital	0.799***	0.863***	0.818***	0.873***
	(0.0130)	(0.0126)	(0.0133)	(0.0129)
lnperincome	-0.313***	-0.322***	-0.310***	-0.320***
	(0.0150)	(0.0144)	(0.0152)	(0.0147)
Provinces Dummies	no	yes	no	yes
Industry Dummies	no	no	yes	yes
Observations	21,511	21,511	21,511	21,511
R-squared	0.290	0.350	0.308	0.365

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 10 Labour quality dummy variable coefficients estimates with other FDI

	(1)	(2)	(3)	(4)
Dgraduate	0.696***	0.671***	0.652***	0.632***
	(0.0297)	(0.0293)	(0.0292)	(0.0288)
Dundergra	0.537***	0.522***	0.498***	0.491***
	(0.0251)	(0.0243)	(0.0249)	(0.0242)
Dcollege	0.420***	0.379***	0.395***	0.361***
	(0.0400)	(0.0384)	(0.0397)	(0.0382)
Dhigmidd	0.627***	0.543***	0.631***	0.553***
	(0.0697)	(0.0689)	(0.0697)	(0.0691)
Djunmidd	0.302***	0.255***	0.325***	0.277***
	(0.0382)	(0.0379)	(0.0375)	(0.0374)
Dhigh	-0.0865***	-0.0498*	-0.0768***	-0.0436*
	(0.0270)	(0.0264)	(0.0267)	(0.0262)
Dmiddle	-0.117***	-0.0671***	-0.103***	-0.0579**
	(0.0261)	(0.0255)	(0.0257)	(0.0251)
Dprelim	-0.0631**	-0.00398	-0.0502**	0.00343
	(0.0246)	(0.0241)	(0.0242)	(0.0238)
lnfirmage	0.184***	0.145***	0.189***	0.152***
	(0.0130)	(0.0129)	(0.0129)	(0.0128)
lnpertax	-0.148***	-0.127***	-0.135***	-0.117***
	(0.00786)	(0.00767)	(0.00774)	(0.00758)
lnpercomputer	-0.130***	-0.160***	-0.145***	-0.168***
	(0.0127)	(0.0123)	(0.0134)	(0.0129)
lnperwage	0.169***	0.155***	0.190***	0.178***
	(0.0212)	(0.0210)	(0.0211)	(0.0210)
lnpergrosscapital	0.880***	0.911***	0.890***	0.921***
	(0.0159)	(0.0156)	(0.0163)	(0.0160)
lnperincome	-0.241***	-0.260***	-0.235***	-0.251***
	(0.0176)	(0.0171)	(0.0175)	(0.0171)
Provinces Dummies	no	yes	no	yes
Industry Dummies	no	no	yes	yes
Observations	18,179	18,179	18,179	18,179
R-squared	0.353	0.390	0.381	0.414

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

From the coefficients estimated with various specifications, it can be seen that all our education dummies have large significant positive values. Take Column 4 in Table 8 for example, the firms with graduates are attracting 62.8% more FDI than those without graduates; for undergraduates, 45.2% more; for college, 39.5% more and for high school graduates, 47.3% more. In addition, all the coefficients of education levels above junior middle school are much bigger than junior middle

school coefficients in three Tables, which mean that firms with higher educated employees find it easier to attract FDI, and for graduate level employees, the significance is the greatest. This result illustrates that labour quality reflected by education level is significant in attracting FDI in China.

For HMT and other foreign-invested firms, the results also show that firms with more highly educated employees attract more investment easily. However, the results also show some differences: most education level dummies above junior middle in Table 10 are larger than Table 9, which means labour quality, is more important in attracting foreign investments for other foreign-invested firms than HMT-invested firms. The fourth column, for example, shows that foreign-invested firms with graduates' employees are attracting 63.2% more investment, while for HMT-invested firms, is 55.6% more. For employees educated to undergraduate level, other foreign-invested firms attract 49.1% more while 41.1% more for HMT-invested firms; and for high school level employees, other foreign-invested firms, is 55.3% more while for HMT-invested firms, 42.5% more. This confirms the previous finding that compared with other foreign-invested capital, especially with regard to USA, EU and Japanese investors, HMT investments are labour intensive and make use of cheap labour in mainland China to process goods for exporting, so the labour quality's role on attracting HMT investments is smaller than other countries.

Although education plays an important role in attracting FDI in China, however, labour quality indicated by working experience does not show any impacts on the distribution of FDI. All of the coefficients for employees' dummies with various working certificates have negative values and most are significantly negative.

In order to confirm our findings, the author uses the education density and working experience density that is the log of employees with various education levels

and different working certificates to do further study about the relationship between labour quality and inward-FDI flows. Table 11, 12 and 13 show the results.

Table 11 Labour quality density variable coefficients estimates with aggregated FDI

	(1)	(2)	(3)	(4)
Graduate	0.0835***	0.0606**	0.0751***	0.0528**
	(0.0240)	(0.0240)	(0.0240)	(0.0241)
Undergra	0.113***	0.109***	0.117***	0.116***
	(0.0296)	(0.0295)	(0.0298)	(0.0298)
College	0.136***	0.146***	0.118***	0.130***
	(0.0317)	(0.0316)	(0.0318)	(0.0319)
Higmidd	0.387***	0.374***	0.385***	0.375***
	(0.0227)	(0.0231)	(0.0229)	(0.0232)
Junmidd	0.240***	0.231***	0.234***	0.225***
	(0.0162)	(0.0165)	(0.0163)	(0.0167)
High	-0.140***	-0.125***	-0.124***	-0.111***
	(0.0221)	(0.0217)	(0.0220)	(0.0217)
Middle	-0.0109	-0.0192	0.00339	-0.00961
	(0.0273)	(0.0273)	(0.0274)	(0.0274)
Prelim	-0.0129	0.0111	-0.0217	0.00316
	(0.0227)	(0.0225)	(0.0231)	(0.0228)
lnfirmage	-0.0660***	-0.102***	-0.0694***	-0.105***
	(0.0256)	(0.0257)	(0.0256)	(0.0257)
lnpertax	-0.126***	-0.111***	-0.130***	-0.116***
	(0.0153)	(0.0152)	(0.0158)	(0.0157)
lnpercomputer	0.119***	0.0847***	0.149***	0.118***
	(0.0272)	(0.0268)	(0.0286)	(0.0281)
lnperwage	0.333***	0.273***	0.353***	0.289***
	(0.0391)	(0.0395)	(0.0397)	(0.0401)
lnpergrosscapital	0.902***	0.925***	0.885***	0.904***
	(0.0295)	(0.0297)	(0.0309)	(0.0310)
lnperincome	-0.106***	-0.107***	-0.103***	-0.104***
	(0.0313)	(0.0312)	(0.0337)	(0.0335)
Provinces Dummies	no	yes	no	yes
Industry Dummies	no	no	yes	yes
Observations	3,906	3,906	3,906	3,906
R-squared	0.585	0.602	0.593	0.608

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 12 Labour quality density variable coefficients estimates with HMT FDI

	(1)	(2)	(3)	(4)
Graduate	0.0936***	0.0250	0.0902**	0.0206
	(0.0358)	(0.0354)	(0.0357)	(0.0356)
Undergra	0.0601	0.0580	0.0661	0.0694*
	(0.0421)	(0.0403)	(0.0422)	(0.0404)
College	0.153***	0.184***	0.127***	0.159***
	(0.0473)	(0.0447)	(0.0477)	(0.0454)
Higmidd	0.313***	0.302***	0.308***	0.301***
	(0.0337)	(0.0335)	(0.0341)	(0.0336)
Junmidd	0.279***	0.246***	0.276***	0.244***
	(0.0244)	(0.0242)	(0.0247)	(0.0245)
High	-0.0933***	-0.0409	-0.0870***	-0.0380
	(0.0322)	(0.0302)	(0.0321)	(0.0302)
Middle	-0.00567	-0.0337	0.0130	-0.0222
	(0.0390)	(0.0377)	(0.0396)	(0.0383)
Prelim	-0.0188	0.0337	-0.0254	0.0294
	(0.0320)	(0.0315)	(0.0326)	(0.0319)
lnfirmage	-0.138***	-0.188***	-0.142***	-0.194***
	(0.0376)	(0.0369)	(0.0376)	(0.0371)
lnpertax	-0.155***	-0.131***	-0.155***	-0.132***
	(0.0217)	(0.0217)	(0.0228)	(0.0226)
lnpercomputer	0.129***	0.0467	0.161***	0.0824**
	(0.0372)	(0.0352)	(0.0387)	(0.0366)
lnperwage	0.307***	0.166***	0.340***	0.193***
	(0.0545)	(0.0534)	(0.0566)	(0.0547)
lnpergrosscapital	0.879***	0.922***	0.867***	0.900***
	(0.0419)	(0.0421)	(0.0430)	(0.0434)
lnperincome	-0.114**	-0.118***	-0.118**	-0.128***
	(0.0453)	(0.0444)	(0.0489)	(0.0480)
Provinces Dummies	no	yes	no	yes
Industry Dummies	no	no	yes	yes
Observations	1,921	1,921	1,921	1,921
R-squared	0.543	0.598	0.555	0.608

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 13 Labour quality density variable coefficients estimates with other FDI

	(1)	(2)	(3)	(4)
Graduate	0.0871***	0.0812**	0.0806**	0.0741**
	(0.0332)	(0.0331)	(0.0334)	(0.0334)
Undergra	0.142***	0.122***	0.153***	0.136***
	(0.0433)	(0.0435)	(0.0435)	(0.0441)
College	0.146***	0.146***	0.121***	0.125***
	(0.0447)	(0.0449)	(0.0446)	(0.0452)
Higmidd	0.420***	0.410***	0.415***	0.406***
	(0.0314)	(0.0324)	(0.0319)	(0.0328)
Junmidd	0.203***	0.214***	0.191***	0.199***
	(0.0219)	(0.0226)	(0.0224)	(0.0232)
High	-0.193***	-0.186***	-0.167***	-0.161***
	(0.0316)	(0.0316)	(0.0314)	(0.0317)
Middle	-0.00556	-0.0195	-0.000455	-0.0147
	(0.0393)	(0.0396)	(0.0393)	(0.0398)
Prelim	-0.0383	-0.0127	-0.0430	-0.0193
	(0.0334)	(0.0332)	(0.0338)	(0.0336)
lnfirmage	-0.0427	-0.0691*	-0.0439	-0.0716*
	(0.0360)	(0.0369)	(0.0355)	(0.0366)
lnpertax	-0.113***	-0.0976***	-0.117***	-0.104***
	(0.0218)	(0.0219)	(0.0223)	(0.0223)
lnpercomputer	0.114***	0.101**	0.138***	0.124***
	(0.0400)	(0.0406)	(0.0427)	(0.0430)
lnperwage	0.377***	0.347***	0.389***	0.358***
	(0.0558)	(0.0564)	(0.0567)	(0.0572)
lnpergrosscapital	0.913***	0.920***	0.886***	0.895***
	(0.0414)	(0.0415)	(0.0444)	(0.0441)
lnperincome	-0.111***	-0.113***	-0.101**	-0.104**
	(0.0423)	(0.0429)	(0.0457)	(0.0460)
Provinces Dummies	no	yes	no	yes
Industry Dummies	no	no	yes	yes
Observations	2,100	2,100	2,100	2,100
R-squared	0.578	0.592	0.591	0.603

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The coefficients in Tables 11 to 13 are elasticises. From Table 11 to 13, it can be found that the education density variables are significantly positive for aggregated FDI, HMT investments and for other foreign investments, which shows that labour quality measured by education levels is an important factor determining the distribution of FDI. However, for the working experience variables, most of the estimates are either significant negative values or lose their significance, meaning that

the labour quality as measured by working experience is not very important in attracting FDI in China.

It has already been found that firms with higher education levels are attracting more FDI and for other foreign investors, the effect is even more significant, as shown in Table 9 and 10. In Table 12 and 13, it can also be found that with higher educated employees, the elasticity effects of other foreign investments are more significant than for HMT investors, especially for graduates, undergraduates and high schools; this again reflects the different ownership advantages of FDI.

2. Endogeneity

In our studies of the relationship between labour quality and inward FDI, the basic results show that labour quality as measured by education plays an important role in inward FDI, but the labour quality as measured by working experience loses its significance and labour quality is more important for other foreign investments than HMT investment. However, there are some possible endogeneity problems in our analysis, and we will address this issue with IV-GMM and non-parametric matching methods to double check the significance of the roles of education.

There are three likely endogeneity issues. The first is that the education dummy is likely representing other factors – unobserved by the researcher – that influence firm FDI but are omitted. These omitted variables may bias the coefficient estimates. Second, it is quite possible that more educated employees may prefer to work in foreign-invested companies,[7] which is the simultaneity in econometrics. Third, the measurement error of variables may bias the results. So we need to address these possible endogeneity sources. The most convenient way to control the omitted variable is using panel data; however, it is conditional that the omitted variable is time

[7] The author thanks the anonymous reviewer for pointing this out.

in-variant. And because of the data limitations, we cannot use panel data to control the endogeneity issue. Also we could use an instrument variable to control the above endogeneity sources, but it is not straightforward to find good instruments.

Nevertheless, we can make use of the non-parametric matching method to find the consistent average treatment effects of education dummy variables on FDI with cross-sectional data for labour quality of various education dummies. The literature on matching econometrics is well established (Abadie and Imbens, 2006, etc.). It is valuable to use matching techniques to study the impacts of labour quality on FDI for the following reasons: first, because of the large data set, we can generate a credible counterfactual FDI flow for an "untreated" matched country pair; second, while parametric techniques have strict specification assumptions, the virtually unlimited potential specifications suggest that matching estimates of treatment effects provide "benchmark" non-parametric estimates of long-run treatment effects. Third, there has been no such study to estimate the impact of labour quality by education on FDI flows. The idea behind this is that we can match the firm having specific educational level employees with other control group firms which do not have specific educational level employees and treat the matched firms as a counterfactual, and then we can estimate the consistent average treatment effects.[8]

Table 14 reports the results of our matching estimators in various educational levels with aggregated FDI, HMT investments and other foreign investments. We can see that labour quality by educational level effects on FDI is still robust and consistent with parametric results presented earlier. The effects of higher education variables on other foreign investments are much higher than on HMT investments, which is also consistent with our above analysis.

[8] See Abadie and Imbens (2006), Baier and Bergstrand (2009) for details about the matching method.

Table 14 Labour quality dummy coefficients matching estimator

Variables	Graduate	Undergra	College	Highmidd	Junmidd
Aggregated FDI	0.577***	0.736***	0.740***	0.504***	0.152***
	(0.0259)	(0.0227)	(0.0358)	(0.0636)	(0.0435)
HMT	0.525***	0.614***	0.724***	0.385***	0.242***
	(0.0343)	(0.0281)	(0.0438)	(0.0801)	(0.0552)
Foreign	0.622***	0.836***	0.796***	0.627***	0.136*
	(0.0366)	(0.0348)	(0.0556)	(0.0960)	(0.0764)

Note: All other variables including region and industry dummies controlled. Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

In addition, we know that labour experience has little effect on FDI location and labour certificates is correlated with education levels variables, although it is hard to find a good instrument variable and labour experience might be a reasonable choice of instrument variable. Because we have five categories of education, in order to avoid a non-identification problem, we use the IV-GMM method and high education variables to do a further test[9] for educational density variables. Table 15 reports the results.

Table 15 Labour quality density IV-GMM estimator

VARIABLES	Aggregated FDI	HMT	Foreign
lneducation	0.748***	0.704***	0.716***
	(0.0140)	(0.0267)	(0.0231)
lnfirmage	-0.0621***	-0.0965***	-0.0716***
	(0.0156)	(0.0235)	(0.0260)
lnpertax	-0.115***	-0.121***	-0.138***
	(0.00983)	(0.0163)	(0.0206)
lnpercomputer	-0.0267*	-0.0661***	-0.0430
	(0.0146)	(0.0254)	(0.0273)
lnperwage	0.208***	0.0385	0.217***
	(0.0262)	(0.0691)	(0.0595)
lnpergrosscapital	0.866***	0.822***	0.846***
	(0.0191)	(0.0408)	(0.0301)
lnperincome	-0.135***	-0.0859	-0.0438
	(0.0208)	(0.0745)	(0.0476)

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

From Table 15, we again find the significant effect on labour quality of

[9] For details about instruments and GMM, see Wooldridge (2002) Chapter 8.

education level and labour quality has a bigger effect on the other foreign investment than on HMT investments.

3. Comparisons

In order to compare our results to the findings in previous studies on this issue about labour quality and FDI flows,[10] Table 16 reports our results about various education levels with Gao's results with province level data (Gao, 2005). The labour quality in Gao's paper is defined as the percentage of employees with various education levels, we use the log number of employees with various education levels. The dependent variable in Gao's paper is the FDI share, while in this paper is the log of real value, so we can compare the coefficients, both of which mean measures of elasticity.

Table 16 Results comparison

Results in this paper(Bench-mark)					
Labour quality	Junmidd	Highmidd	College	Undergra	Graduate
Aggregated FDI	0.225***	0.375***	0.130***	0.116***	0.0528**
Foreign	0.199***	0.406***	0.125***	0.136***	0.0741**
HMT	0.244***	0.301***	0.159***	0.0694*	0.0206
Gao(2005) results					
Labour quality	Primary	Junior	Senior	College	
Aggregated FDI	0.083*	0.080***	0.082***	0.191***	
Developed	0.159***	0.133***	0.165***	0.383***	
Developing	-0.006	0.012	-0.019	-0.070	

*** p<0.01, ** p<0.05, * p<0.1

Generally, our estimates of results are larger and more significant than Gao's results, especially for the HMT and developing countries' FDI. The main reasons behind this are as follows: first, we use firm level data and he uses aggregated provincial data; second, the definition of education level is different-our definition includes more categories of education, for example, our college means that those who

[10] The author thanks the anonymous reviewer for pointing this out.

receive three years of education in college but in Gao's paper, college means the employees receiving education, which includes college, undergraduates and graduates in our definition; third, in this paper, we use FDI from all countries as aggregated FDI and disaggregate the FDI into HMT and other foreign countries, but in Gao's paper, only 14 countries are included, and the developed countries include the USA, Japan and EU members, so our results of other foreign countries are underestimated; fourth, we use data from 2004 but Gao uses data from 1996 to 1999, and the different results imply that labour quality is becoming more and more important in attracting FDI. Because of the improvement of the data quality and definitions of education levels, our results should be more reliable than previous studies.

It can be concluded that, although labour quality as measured by working experience loses its significance in deciding the distribution of FDI inflows, labour quality as measured by education level is an important factor in attracting China's inward FDI, no matter where it comes from. However, higher labour quality is more significant for other foreign investors than HMT investments. In the next section, I will perform further checks on the relationship between labour quality and FDI in some key industry and principal provinces.

IV. Industry Level and Province Level Study

In this section, the author uses a higher education dummy as a measure of labour quality to investigate the role of labour quality on the decision of distribution of FDI at industry and province level. Here the author chooses the key industries 17, 18, 26, 30, 35, 39 40, which cover the main industries with foreign investments like textiles, chemistry, machinery and electronic and coastal provinces dominating China's inward FDI: Guangdong, Jiangsu, Shanghai, Zhejiang, Fujian, Shandong, Liaoning, Beijing and Tianjin. The author controls for other variables including industry dummies or regional dummies respectively. Table 17 and 18 report the results.

Table 17 Labour quality coefficients estimates at industry level

	(1)FDI	(2)HMT	(3)Foreign
Manufacture of Textile (17)	0.629***	0.597***	0.656***
	(0.0595)	(0.0748)	(0.0996)
Observations\ R-squared	3,870\0.395	2,318\0.388	1,589\0.404
Clothing& Other Fibre Products	0.402***	0.427***	0.384***
manufacturing (18)	(0.0505)	(0.0641)	(0.0852)
Observations\ R-squared	3,505\0.289	2,018\0.293	1,506\0.254
Manufacture of Raw Chemical	0.431**	0.305	0.603***
Materials & Chemical Products (26)	(0.172)	(0.248)	(0.222)
Observations\ R-squared	2,363\0.396	1,239\0.381	1,165\0.423
Manufacture of Plastics (30)	0.711***	0.806***	0.494**
	(0.109)	(0.120)	(0.213)
Observations\ R-squared	2,475\0.324	1,454\0.325	1,039\0.351
Manufacture of General Purpose	0.824***	0.677***	0.890***
Machinery (35)	(0.141)	(0.224)	(0.159)
Observations\ R-squared	2,325\0.370	1,072\0.408	1,274\0.369
Arms & Ammunition	0.667***	0.618***	0.701***
Manufacturing (39)	(0.154)	(0.193)	(0.255)
Observations\ R-squared	2,777\0.279	1,583\0.300	1,228\0.303
Electrical Machinery& Equipment	0.958***	1.155***	0.0760
Manufacturing (40)	(0.212)	(0.231)	(0.274)
Observations\ R-squared	3,167\0.312	1,709\0.309	1,503\0.324

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 18 Labour quality coefficients estimates at province level

	(1)FDI	(2)HMT	(3)Foreign
Beijing (11)	0.741**(0.311)	1.541***(0.403)	0.376 (0.342)
Observations\ R-squared	1,125\0.349	334\0.360	809\0.374
Tianjin (12)	0.741*** (0.198)	1.473*** (0.329)	0.463* (0.255)
Observations\ R-squared	975\0.361	195\0.438	786\0.394
Liaoning (21)	0.876*** (0.171)	0.840*** (0.298)	0.799*** (0.213)
Observations\ R-squared	1,444\0.366	381\0.390	1,083\0.373
Shanghai (31)	0.723*** (0.0955)	0.799*** (0.150)	0.566*** (0.113)
Observations\ R-squared	3,832\0.373	2,532\0.377	1,328\0.353
Jiangsu (32)	0.587*** (0.0664)	0.466*** (0.0876)	0.694*** (0.0973)
Observations\ R-squared	6,677\0.412	3,070\0.362	3,668\0.452
Zhejiang (33)	0.531*** (0.054)	0.617*** (0.0708)	0.415*** (0.0843)
Observations\ R-squared	5,285\0.325	2,784\0.295	2,595\0.342
Fujian (35)	0.439*** (0.0594)	0.485*** (0.0646)	0.372*** (0.133)
Observations\ R-squared	3,545\0.357	2,366\0.349	1,203\0.389
Shandong(37)	0.599*** (0.108)	0.444**(0.209)	0.630*** (0.125)
Observations\ R-squared	2,515\0.295	710\0.321	1,852\0.305
Guangdong(44)	0.629***(0.0481)	0.628***(0.0513)	0.506*** (0.130)
Observations\ R-squared	10,126\0.288	7,444\0.274	2,770\0.317

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

From the industry estimates, it can be seen that labour quality is a very important factor in attracting the FDI but the roles of labour quality are quite different across the industries. Taking electrical machinery and equipment manufacturing (40) and clothing (18) for example, firms with higher educated employees are 96% and 40% more FDI intensive than those firms without any higher educated employees in each industry. However, some industries show a different impact of labour quality on HMT capital and other foreign investment. For example, labour quality is more important in HMT investments for industries 18, 30 and 40 while labour quality is more important in other foreign investment for industries 17, 35 and 39.

For the coastal provinces, labour quality has a very important role in attracting FDI and the roles are also quite different across the provinces. In Beijing, Tianjin, Liaoning, Shanghai, Zhejiang, Fujian and Guangdong, labour quality is much more important for HMT but less important for other foreign-invested firms, but for Jiangsu

and Shandong, the labour quality is much more important for other foreign investors than HMT firms.

It can be concluded that labour quality does have an important roles in deciding the FDI distribution in China and firms with higher educated labour find it easier to attract FDI but the impacts are strongly uneven across the industries and provinces, even when considering similar industries and coastal provinces which dominate China’s inward FDI.

V. Conclusions

In this paper, the author uses a large cross-section firm-level data set to study the relationship between labour quality and FDI in China. The data provides comprehensive information about the labour quality of each firm including various educational levels and working experience. Since the firm is the actual entity to be engaged in FDI activities, the estimates should be more reliable than previous studies using provincial and industry-level data.

The author uses labour quality dummy variables to see the differential impact of labour quality premium on FDI and the author also uses labour quality density variables to see the elasticity of labour quality with respect to FDI. The author takes into consideration the different ownership advantages from FDI and disaggregates the FDI into two groups: HMT and other foreign countries. In addition, the author uses IV-GMM and non-parametric matching techniques to consider the possible endogeneity of labour quality with respect to education levels. An extensive search reveals some stories: first, labour quality as measured by education plays an important part in deciding the distribution of FDI in China, but labour working experience is insignificant in attracting FDI in China; second, labour quality is more significant in attracting other foreign investments than for HMT investors, which confirms different ownership advantages and investment motivations; third, the roles of labour quality on China's inward FDI are strongly uneven across the industries and provinces.

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