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Abstract: We examine the returns to test scores from the 2009 Vietnamese National Entrance Examination to University (NEEU) of individuals born in 1991. We investigate their labor outcomes in terms of hourly wage measured in 2018 or 2020. We find that a one standard deviation increase in the standardized test score on the NEEU is associated with a 7–9 percent increase in wage rate 9–11 years later. The results also suggest that mathematics test scores have a significant correlation with wage rate in the long run.

Keywords: Test scores; Cognitive skills; Returns to education; Vietnam
JEL classification: J24, I26, J23

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I. Introduction

Private spending on education in East Asian economies tends to be high during periods of high economic growth. Spending on education by Chinese urban households has continuously increased in recent years, due mainly to private tutoring (Yuan and Zhang, 2015). The share of education-related expenses in household expenditures increased from just above 5 percent to 7–8 percent in Japan during the period 1970–1995.[1] The amount of spending on private tutoring by South Korean households continuously increased from 0.54 percent of the country's GDP in 1985 to 2.79 percent in 2006 (Kim and Lee, 2010).

One explanation for these changes is the continuous competition for admission to elite schools and universities. The winners can expect high returns. Jia and Li (2021) found the returns to education at elite schools and universities included 5.2–9.7 percent higher wages at a first job in China. Similarly, Sekhri (2020) found that elite Indian public colleges were associated with higher wages 5–9 years after the graduation. Moreover, test scores are well correlated across different grades. De Hoyos et al. (2021) showed that test scores in grade 6 were good predictors of test performance in grades 9 and 12 in Mexico.

Most students competing for spots at elite schools will lose out, regardless of their investment in private tutoring. Yet, in preparing for the examination, these students will study many test subjects, ranging from literature to chemistry, mathematics, and physics, that they might not continue to study in college. Therefore, a key question for these students who lose out is whether the test scores are associated with any returns in the future.

The test scores might be representative of cognitive skills, which also provide returns. In the United States, a one standard deviation (SD) decrease in a state's test score was associated with a 3 percent decrease in the wage rate of new workers during 1970–1990 (Murphy and Peltzman, 2004). Lindqvist and Vestman (2011) found that cognitive skills are an important predictor of wages among Swedish skilled workers. In particular, the returns to cognitive ability increased with experience (Lin et al., 2018). Employers in the United States adjust wages to be in line with real cognitive skills as employers can better judge one's cognitive skills with time (Altonji and Pierret, 2001; Lange, 2007). However, the direct evidence for returns to cognitive skills or test scores is scarce in developing countries.

Therefore, we investigated whether test scores at the end of grade 12 significantly affect labor market outcomes using a unique Vietnamese dataset. Specifically, we regressed the wage

[1] Source: Figure III-2-5 from https://www.mext.go.jp/component/english/__icsFiles/afieldfile/2011/03/07/1303013_007.pdf.

rate measured at the ages of 27–29 years on the test scores of the 1991-born individuals when they took the Vietnamese National Entrance Examinations to Universities (NEEU) in 2009 (at around the age of 18 years). We found that a one SD increase in the test score was associated with a 7–9 percent increase in wage rate. The returns to mathematic test scores were the most significant. Our results are robust across the specifications and tests suggested by Oster (2019).

Our paper makes some important contributions. First, it provides evidence from a close to nationally representative sample in a developing country, which to date has been rare. Second, our evidence on the returns was 9–11 years after the examination and 5–7 years after university graduation for students born in the same year. Previous research has often examined labor outcomes closer to graduation or in different age cohorts, which potentially makes the (standardized) test scores not comparable. Third, we provide estimates of the returns to eight specific test scores.

II. Data

We obtained data of 569 individuals by matching two data sources: the 2009 NEEU and the 2018 and 2020 Household Living Standard Survey (VHLSS).[2] The 2009 NEEU was a nationally administered examination for placement of students in universities. It was conducted in July 2009 by the Ministry of Education and Training. The examination was held on the same date at the same time for all candidates in each of 11 testing group.[3] In total, 0.98 million students took the examination in 2009 (Vu, in press). We used data from the four main testing groups: A (mathematics, physics, and chemistry), B (biology, mathematics, and chemistry), C (literature, history, and geography), and D (literature, mathematics, and English), which covered about 96% of all test takers. We limited the dataset to students born in 1991 who finished grade 12 in 2009. We standardized the sum of 3 test scores within each testing group to form the main explanatory variable (*zscore*). We assumed that the *zscore* best measures the cognitive skills of the individuals.

The VHLSS is a nationally representative survey conducted every two years by the General Statistics Office of Vietnam. The VHLSS provides data on annual income from salary and other employment-related compensation (in cash and in kind) and working hours (working hours per day and working days per year). We used the information to construct a measure of labor outcomes, namely, the logarithm of hourly wage. The VHLSS also provided other

[2] We used district codes, date of birth, gender, completion of general education (12 grades), and other individually identifying information available in the datasets for matching.
[3] See Vu (In press) for the examination regulations and procedure for university placement.

information on educational attainment ($college$ [3 years] and $university$ [4 years or more]) and job details (37 job types, 6 ownership types of businesses, 59 industries).

The similarity of proportions in the NEEU overall and the selected sample suggest that the matching quality is good and that the sample may be close to the nationally representative sample. In the selected sample, the proportions of test takers in testing groups A, B, C, and D are 50, 27.01, 7.38, and 15.60 percent, respectively. Meanwhile, the corresponding proportions in the NEEU were 50.07, 26.38, 7.50, and 16.06 percent. The proportion of female test takers was 53.52 percent in the selected sample and 59.28 percent in the NEEU. The distribution of test takers by province was also similar between the two sets of data (see Appendix 2).

III. Methods

First, we examined the returns to test scores by using the Mincer equation:

$$\ln(wage_i) = \beta_1 zscore_i + \beta_2 Sex_i + \beta_{3j} Province_j + t + \varepsilon_i. \quad (1)$$

Here, t is a dummy for year ($t = 1$ if year=2020, 0 otherwise). *Sex* is a gender dummy (*Sex*=1 if female, 0 otherwise). $Province_j$ is a set of provincial dummies to capture the time invariant factors that influenced the labor outcomes within provinces. We added educational attainment $Educ$ ($college$ and $university$), other controls X for jobs details (37 job types, 6 ownership types of businesses, 59 industries):

$$\ln(wage_i) = \beta_1 zscore_i + \beta_2 Sex_i + \beta_{3k} Educ_k + \beta_{4lm} X_{lm} + \beta_{5n} Province_j + t + \omega_i. \quad (2)$$

Moreover, we replaced $zscore$ with the raw scores for each subject.

Second, we investigated the linear probability of being employed using

$$Employed_i = \alpha_1 zscore_i + \alpha_2 Sex_i + \alpha_{3k} Educ_k + \alpha_{4n} Province_j + t + \varphi_i. \quad (3)$$

Third, we recognized that the $zscore$ would be endogenous, so we applied the procedure proposed by Oster (2019) to test for the stability of $zscore$ with the inclusion of controls.

III. Results

First, we found that the returns to test scores are statistically significant in explaining the logarithm of wage rate. A one SD increase in $zscore$ is associated with a 9 percent increase

in wage rate (Table 1, column (2)). The results are robust across specifications (1)–(4) of Table 1. However, the $zscore$ was unable to explain the probability of employment while completion of a university degree was able to do so (Table 1, column 5). Compared with the $zscore$, completion of a degree would have been a better signal to employers.

TABLE 1 ORDINARY LEAST SQUARED ESTIMATIONS

VARIABLES	(1) Ln(wage)	(2) Ln(wage)	(3) Ln(wage)	(4) Ln(wage)	(5) Employed
Zscore	0.1167***	0.0937***	0.0969***	0.1005***	0.0460
	(0.0305)	(0.0269)	(0.0270)	(0.0251)	(0.0303)
College		0.1656**		0.0664	0.0768
		(0.0802)		(0.0943)	(0.0552)
University		0.1543		–0.0770	0.2348***
		(0.1136)		(0.0781)	(0.0700)
Sex	–0.1081	–0.1047	–0.0563	–0.0654	–0.0191
	(0.0668)	(0.0651)	(0.0940)	(0.0946)	(0.0417)
Job type dummies			Yes	Yes	
Industry dummies			Yes	Yes	
Business ownership dummies			Yes	Yes	
Time dummy	Yes	Yes	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	469	469	469	469	596
R-squared	0.335	0.350	0.676	0.680	0.224

Note: Robust province clustered standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

Second, we further investigated the quality of control using the tests proposed by Oster (2019). As shown in Table 2, the inclusion of controls led to slightly changes in the coefficients of $zscore$ but the R-squared increased from 0.05 to 0.35. The delta value was larger than 1. Looking at the bias-adjusted treatment effect, β^* was positive and statistically significant. The bounds of the set $[\tilde{\beta}, \beta^*(R_{max}, 1)]$ did not include zero. This result suggests that the impact of $zscore$ was robust and less likely to be rendered invalid by omitted variables.

TABLE 2 THE OSTER (2019) TEST

	(1) Baseline effect (S.E) [R^2]	(2) Control effect (S.E) [R^2]	(3) Biased adjusted β^* (Bootstrapped S.E)	(4) $\tilde{\delta}$ for $\beta = 0$
$Zscore$	0.1249***	0.0937***	0.0740**	2.643
	(0.0311) [0.05]	(0.0269) [0.350]	(0.0325)	

Notes: *** p<0.01, ** p<0.05, * p<0.1. $R_{max} = 1.3R = 0.455$. Bootstrap replications = 1000 using the specification in (2) of Table 1 for control effect. See Oster (2019) for detailed procedure.

Our estimated return is higher than that estimated by Lindqvist and Vestman (2011) using Swedish data (5–8 percent increase) and by Nordin (2008). However, both of those studies used samples of male test takers who enlisted in the Swedish military. Our results agree with those of de Hoyos et al. (2021) in which the returns to the grade 12 test score were about 6

percent. However, de Hoyos et al. (2021) analyzed 1020 Mexican high school graduates only 2 years after graduation. Our results were consistent with those of Altonji and Pierret (2001) and Lange (2007) (8–11 percent) but lower than that of Lin et al. (2018) (14–24 percent increase in lifetime income) in the United States. However, Lin et al. (2018) used the scores of some people over 18 years of age. In contrast, our *zcores* were free from measurement errors arising from the contribution of higher education and work experience to the test scores.

TABLE 3 RETURNS TO SPECIFIC TEST SCORES

	(1)	(2)	(3)
VARIABLES	Ln(wage)	Ln(wage)	Ln(wage)
Mathematics (A)	0.0480*	0.0450***	0.0319*
	(0.0255)	(0.0137)	(0.0163)
Physics (A)	0.0144		
	(0.0311)		
Chemistry (A)	0.0217		
	(0.0202)		
Biology (B)	0.0088		
	(0.0302)		
Mathematics (B)	0.0346	0.0352**	0.0219
	(0.0225)	(0.0165)	(0.0189)
Chemistry (B)	0.0301		
	(0.0294)		
Literature (C)	0.0586		
	(0.0760)		
History (C)	–0.0011		
	(0.0454)		
Geography (C)	0.0148		
	(0.0763)		
Literature (D)	0.0303		
	(0.0520)		
Mathematics (D)	0.0518*	0.0736***	0.0577***
	(0.0296)	(0.0209)	(0.0184)
English (D)	0.0356		
	(0.0456)		
College			Yes
University			Yes
Sex	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes
Province fixed effects	Yes	Yes	Yes
Observations	469	469	469
R-squared	0.347	0.330	0.346

Notes: Same as Table 1. (A), (B), (C), and (D) stand for the testing group.

Third, we found that a 1 point increase in the raw mathematics test score (max score=10 points) were associated with a 3–6 percent increase in wage rate in testing groups A and D (Table 3, column (1)-(3)). This result suggests that cognitive skills represented in mathematics

could have a long-lasting influence on income. However, the nexus was minimal for test takers in Group B.

V. Conclusions

We found that returns to test scores were an approximately 7–9 percent increase in wage rate per one SD increase. We also found mathematic test scores had a long-term connection with wage rate.

We acknowledge several limitations of this work. First, we captured the returns of only non-movers who resided in their districts during 2009–2020. Second, we were unable to disentangle between endowments and investment in education throughout the period up to grade 12. Third, the returns to test scores may be valid for only relatively highly skilled workers given that the selected sample contained graduates with more than 12 years of education.

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APPENDIX 1 DESCRIPTIVE STATISTICS

Variable	Obs	Mean	Std. Dev.	Min	Max
Ln(wage)	469	3.595	0.511	2.197	6.606
$Zscore$	596	–0.141	0.894	–1.572	2.761
College	596	0.391	0.488	0	1
University	596	0.273	0.446	0	1
Sex (=1 if female, 0 otherwise)	596	0.535	0.499	0	1
t (=1 if year=2020)	596	0.512	0.500	0	1
Employed (=1 if employed, 0 otherwise)	596	0.787	0.410	0	1
Mathematics (A)	298	2.693	1.474	0	7.5
Physics (A)	298	5.477	1.510	2.5	9.5
Chemistry (A)	298	3.440	1.281	1.25	8.5
Biology (B)	161	5.087	1.208	2.75	8.75
Mathematics (B)	161	2.851	1.800	0.5	8.5
Chemistry (B)	161	4.025	1.402	1.5	8.75
Literature (C)	44	4.886	1.229	2	7
History (C)	44	2.784	1.854	0	7.75
Geography (C)	44	5.284	1.420	2.5	8.25
Literature (D)	93	4.489	1.245	1.75	7.5
Mathematics (D)	93	2.806	1.903	0	9.75
English (D)	93	3.820	1.407	1.75	8.5

Note: (A), (B), (C), and (D) stand for the testing group.

APPENDIX 2 DISTRIBUTION OF TEST TAKERS BY PROVINCE NAME