Assessing the Quality of Upper-secondary Vocational Education and Training: Evidence from China

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Abstract

An increasing number of policymakers in developing countries have made the mass expansion of upper-secondary vocational education and training (VET) a top priority. The goal of this study is to examine whether VET fulfills the objectove of building skills and abilities along multiple dimensions and further identify which school-level factors help vocational students build these skills and abilities. To fulfill this goal, we analyzed representative, longitudinal data that we collected on more than 12,000 students from 118 schools in once province of central China. First, descriptive analysis shows approximately 90% of VET students do not make any gains in vocational or general skills. In addition, negative behaviors (misbehavior in the classroom, anti-social behavior, and other risky behaviors) are highly prevalent among VET students. A nontrivial proportion of student internships also fail to meet minimum government requirements for student safety and well-being. Perhaps as a result of these outcomes, more than 60% of students express dissatisfaction with their VET programs, as evidenced by eitehr self-reports or dropping out. Finally, using a multi-level model, we find that school inputs (such as school size, teacher qualifications, and per pupil expenditure) are not correlated with vocational and general skill at the end of the school year, or student dropout in the academic year.

Keywords: Vocational education, Skill learning, Developing Countries, Achievement, China

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1. Introduction

In an attempt to provide future generations of students with useful skills and abilities, an increasing number of policymakers in developing countries have made the mass expansion of upper-secondary vocational education and training (VET) a top priority. Countries in the Asia-Pacific region, such as Indonesia, Vietnam, and Thailand, have experienced rapid increases in enrollments in VET since the early 2000s (Ministry of National Education of Indonesia, 2006; Government of Vietnam, 2009; Ministry of Education of Thailand, 2012). The development of VET is one of eight priority areas put forward in the plan of action for the African Union's Second Decade of Education (2006-2015—UNESCO office in Dakar, 2015). International organizations, such as the Organization for Economic Cooperation and Development (OECD), the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and the Asian Development Bank (ADB), have also promoted the large-scale expansion of VET in developing countries with the understanding that VET builds human capital and leads to economic growth (ADB, 2008; Field et al., 2009; UNESCO, 2012).

Education should build human capital, broadly defined as knowledge, skills, competencies and attributes that facilitate personal, social and economic wellbeing by OECD (Keeley, 2007). As noted by Heckman (2000), human capital not only includes cognitive skills but also non-cognitive skills. Cognitive skills are usually measured by

achievement tests. Non-cognitive skills such as grit and mindset are reflected in attitudes and behaviors that can also be measured (Heckman, 2000).

In the same vein, the purpose of vocational schooling is to help students acquire a diverse range of cognitive and non-cognitive competencies that will help them thrive and that will contribute to economic growth and social stability (Clayton et al., 2003; Field et al., 2009; UNESCO, 2012). First, students should learn vocational skills that improve their employability and job competence (Field et al., 2009). Second, students in developed and upper middle income countries (like China) should learn general skills such as math, language, science that are broadly useful in most jobs and that are critical for adapting to changing labor markets (Chiswick, Lee, and Miller, 2003; Field et al., 2009). Third, students should be given the chance to cultivate positive attitudes and behaviors that are associated with personal success, social good, and effective citizenship (Field et al., 2009; Fontaine, 2006& 2007; Mayer, 1995; UNESCO, 2012; MoE, 2014). Fourth, students should be given internship (defined as work placement training [1]) opportunities that enable them to develop their cognitive and non-cognitive skills in the real world of work (Field et al., 2009; King, 2011).

Although policymakers have great expectations for VET, there is little rigorous empirical research on whether VET actually helps students develop this

[1] Field, Simon, Kathrin Hoeckel, Viktoria Kis, and Malgorzata Kuczera. 2009. "Learning for jobs: OECD policy review of vocational education and training: initial report."

broad set of skills and abilities. A number of studies have estimated the economic returns to VET versus general schooling (Hu, Lee and Stromsdorfer, 1971; Psacharopoulos, 1994; EI-Hamidi, 2006; Horowitz and Schenzler, 1999; Moenjak and Worswick, 2003; Kahyarara and Teal, 2008; Li, Liu and Zhang, 2012; Hirshleifer et al., 2014). However, this research base offers no conclusive evidence on the effectiveness of VET. Specifically, these studies provide only mixed results on the economic returns of VET schooling and offer little or no evidence on the contribution of VET to the development of skills and abilities. We are only aware of two studies that look at the impacts of attending VET on improving skills (Loyalka et al, 2016; Chen, 2009). Few, if any, studies examine whether VET fulfills the objectives of building skills and abilities along multiple dimensions.

Perhaps even more fundamentally, the literature does not identify which school-level factors help vocational students build skills and abilities. We begin our analysis in this paper by drawing from the theory of education production. Education production analysis has been a prominent part of the literature since the U.S. government commissioned a study called Equality of Educational Opportunity, or, as it is more commonly referred to, the "Coleman Report" (Coleman et al. 1966). This theory starts with the underlying assumption that schools are factories of student learning. The schools use a certain set of inputs (teachers, facilities, per pupil spending). When these inputs are used in schools, student outcomes (cognitive and non-cognitive outcomes) are produced by the school system (Hanushek, 1986&2003).

Many scholars have made use of the education production function approach in order to analyze which policy choices (which types of investments) are likely to result in the best educational outcomes (for example, Hanushek, 1986&2003; Hedges, Laine and Greenwald, 1994; Aaronson, Barrow and Sander, 2007; Goldhaber and Brewer, 2000). However, these types of studies are conspicuously absent in the context of VET (ADB, 2008 & 2014). To the best of our knowledge, no published study has rigorously examined the relationship between school-level factors and the skills and abilities of vocational students in developing countries. In the absence of such evidence, it is difficult for policymakers to determine which school-level factors need to be strengthened to improve the quality of VET.

The goal of this paper is to examine whether attending VET helps improve student cognitive and non-cognitive skills and abilities across multiple dimensions in a developing country context. Specifically, we seek to understand whether VET enables students to: a) improve vocational and general skills; b) cultivate positive social behaviors; c) have a safe and productive introduction to the world of work through internships; d) have a satisfactory educational experience; and e) stay in school (or drop out). The paper also focuses on understanding which school-level factors are correlated with the vocational and general skills of students at the end of the school year as well as dropout in the academic year.

To fulfill these objectives, we analyze representative, longitudinal data collected on more than 12,000 students from over 180 VET programs (in 118 schools)

in one province of central China. This province is an interesting case study because it is held by the national government as a model for how other provincial systems of VET should be organized. Using vertically-equated, standardized tests instruments, we first measure vocational and general skill gains for students in the first two years of their (three-year) programs. We then use descriptive statistics to document the prevalence of positive and negative social behaviors among students, whether student internships adhere to minimum government requirements for student safety and well-being and student satisfaction with VET. We also present descriptive findings on the dropout rate from VET schools. Finally, we use multi-level modeling to examine what school-level factors are correlated with student skills gains and dropout.

We present two sets of key findings. First, we show that VET programs in China are not fulfilling the goal of building student skills and abilities along multiple dimensions. Approximately 90% of VET students appear not to make any vocational or general skill gains. The students in VET programs are also often exposed to negative behaviors (misbehavior in the classroom, anti-social behavior, and other risky behaviors) from their peers. A non-trivial proportion of student internships fail to meet minimum government requirements for student safety and well-being. Perhaps as a result of these dismal outcomes, more than 60% of students express dissatisfaction with their VET programs either through self-reports or arguably by dropping out of their VET program.

Second, we find that few school-level factors are correlated with student outcomes. Specifically, private school ownership (as compared to public ownership) is positively correlated with vocational skill at the end of the academic year. This result is similar to most studies in the context of general schooling (Hanushek, 1986; Thapa, 2013). However, we find that school inputs (such as school size, teacher qualifications, and per pupil expenditures) are not correlated with either vocational or general skill at the end of the academic year or with student dropout in the academic year.

The rest of this paper is organized as follows. The next section describes our research design. Within this section, we discuss VET within the context of China, our sampling and data collection procedures, and our statistical approach. Section 3 reports the results of our study. Section 4 concludes.

2. Research Design

2.1 Background on VET in China

One of the problems of the VET system in China may be that, like in other countries (Field et al., 2009), the VET system is considered a second-tier education sector by students and the general public in China. At the end of junior high school, students take a high school entrance exam. If they score well on the exam, they qualify for entry into academic high school. If they fail to score well on the exam, their only option is to attend vocational high school (or enter the labor market). VET

is thus perceived, both by policymakers and the public, as a second-best option for individuals that wish to consider their studies after nine years of compulsory schooling (primary and junior high school). Previous research in rural China (e.g., Yi et al., 2015) also demonstrates that at the beginning of junior high school, only 14 percent of students planned to attend vocational high school, while 46 percent planned to attend academic high school (the rest stated that they either had no plans or had plans to enter the labor market).

In the vocational track, students apply for different VET schools and programmes. There are three types of VET schools in China: specialized vocational schools (zhongzhuan), vocational high schools (zhigao), and technical schools (jixiao). The specialized vocational school and vocational high schools are managed the Education Department (ED), and the technical schools are mainly managed by the Human Resources and Social Security Department (HRSSD). In 2013, the new enrollments in ED-managed VET schools accounts for 80% of all new enrollments in VET schools (National Bureau of Statistics of China, 2013). Nearly three quarters (73.5%) of ED-managed VET schools are public schools (National Bureau of Statistics of China, 2013).

In addition to cultivate good citizens that are addressed in all education systems, VET schools take the responsibility to teach students skills and capacities that they need in future economy through a 3-year program. To meet the goal, the curriculum of a typical VET school, according to the policy requirement, is divided

into three parts. One third is allocated to teach general academic skills defined nationally by the ministry of education (Ministry of Education of China, 2009). One third is allocated to teach students vocational skills (Ministry of Education of China, 2009). The last one third (always in the last year of vocational schooling) involves sending students to companies or enterprises to complete internships (defined as workplace training—Ministry of Education of China and Ministry of Finance of China, 2007; Ministry of Education of China, 2009). There are a number of regulations placed on these internships to ensure that the basic rights of vocational students are upheld. These include that first-year students should participate in internships and experienced teachers should be available to provide guidance to students conducting internships (Ministry of Education of China and Ministry of Finance of China, 2007).

Although VET schools are certainly not the first choice of students , policymakers in China have made the development of VET a top priority over the last 15 years. In 2002 and 2005, the State Council highlighted the role of VET in building a skilled labor force that can power China's future growth (Chinese State Council, 2002; 2005). The belief that VET is vital for China's economic growth continues to be a major theme in national education policies today (Xinhua Agency, 2011). In fact, China has committed to building a modern, world-class vocational education system by 2020 (Chinese State Council, 2014). VET is expected to produce "…hundreds of

millions of high quality laborers and skilled technical talent…" in the coming decades (Chinese State Council, 2014).

The government's commitment to VET has resulted in a rapid expansion of enrollments and increased investment in VET programs. According to the government's official statistics, new enrollments in VET increased from 1.6 million in 2003 to 6.7 million in 2013 and now accounts for 45% of all new enrollments in upper secondary school (National Bureau of Statistics of China, 2003 & 2014a). Annual investments in VET quadrupled over the same period, reaching 27 billion USD by 2011 (National Bureau of Statistics of China, 2003 & 2013). Because of these investments, VET schools have been able to meet minimum government benchmarks for facilities, teacher qualifications, and teacher training (Yi et al., 2013).

A substantial proportion of the investments into VET have been earmarked for improving quality. For example, between 2010 and 2013, education officials invested approximately 1.7 billion USD to establish one thousand "model" VET schools (*shifan xiao*) across the country (MoE, 2010a; 2010b).[2] During the Twelfth Five-Year

[2] When the policy was launched, VET schools were invited to apply for designation as model schools. Only schools that meet a list of criteria demonstrating high schooling quality were allowed to apply. Criteria considered include the extent to which this school was compliant with official education policy, the size of the campus, the value of existing school equipment, the student-teacher ratio, subjective evaluation of schooling quality, and the student employment rate, among other factors (MoE, 2010b). The 1000 schools determined by official evaluators to have the highest schooling quality were selected to become model schools and given a one-time transfer of approximately 1.7 billion USD, ostensibly to allow the school to further increase schooling quality. However, a most recent study (Li et al., 2015) finds that there are no significant benefits of attending model VET schools on cognitive or non-cognitive student outcomes although model VET schools have higher levels of resources per student than non-model VET schools.

plan (2011-2015), the government also invested heavily in efforts to improve the quantity and quality of VET teachers (MoE&MoF, 2011). Further, the government has promised to take a series of actions between 2014 and 2020 to develop a modern, world-class vocational education system. These actions include promoting project-oriented courses, raising the share of schooling devoted to participating in an internship, reconciling VET curriculum with career standards, and providing more teacher training (Chinese State Council, 2014; MoE, 2015a & 2015b).

Despite the increased attention to quality, little is known about how effective the current VET system is at building human capital. Only one study documents student skill gains from attending VET.[3] Loyalka et al. (2016) show that students in the first year of VET make negligible gain in vocational skill and negative gain (i.e. losses) in general skill. However, the generalizability of this finding is limited by the fact that it only reflects skill gains in the first, transitional year of vocational high school, rather than examining skill gains over the first two years when students are taking vocational and general classes.[4] Notably, no study has measured whether students are building the broad range of cognitive and non-cognitive skills and abilities that the government believes are important for national development. Finally,

[3] Most published studies (Kuczera and Field, 2012; Guo, Xiang and Pang, 2012; Yi et al., 2013; Ran and Shi, 2014) and government-led assessment activities (National Education Supervision Group of China, 2011) concerning VET mainly focus on the quantity of inputs that are being invested into VET.

[4] Students typically make few, if any, achievement gains in the first transitional year between junior high school and high school, even in academic schooling in developed countries such as the United States (Alspaugh, 1998; Reyes et al., 2000).

few, if any, studies on China's VET system examine what school-level factors may help students build skills and abilities.

2.2 Sampling

We chose Henan province—in Central China—as the site of our research. There are three main reasons for choosing Henan. First, Henan is one of the nation's nationally-designated pilot provinces for VET development and reform in China. In other words, national-level policymakers look to the achievements and lessons learned in Henan's VET system to revise VET policy across China (Ministry of Education of China, 2014). Second, Henan has a very large population of 94 million persons. If Henan was a country, it would rank as the 14th largest country in the world. Third, because of its large population, Henan is an important source of labor for all of China. Although it is one out of 31 provinces, it produces eight percent of the nation's VET graduates (Henan Provincial Government, 2014; National Bureau of Statistics of China, 2015; World Bank, 2015).

In the second step of our sampling procedure, we obtained a comprehensive list of all upper secondary VET schools in seven representative prefectures from the provincial government (590 schools in total). From this list, we then limited our sample to those VET schools with the two most popular programs in the province (and China), applied computing (henceforth, computing) and digital control. In 2013 these two programs comprised 22% of all VET school student enrollment in the sample province and 31% of student enrollment nationally (National Bureau of

Statistics of China, 2014a & 2014b). After limiting the list in this way, we were left with 219 VET schools (Figure 1). Our sample was then further reduced to 132 schools by focusing on VET schools that had at least 30 students in each grade in at least one of the two selected programs. We found that 14 of schools with a low number of students (less than 30) had been closed during the year before sample selection and did not want to risk having one of our sample schools close during the study period. Therefore, the final analytical sample included students and principals in 118 schools and 185 programs.

Next, we sampled classes of students in each school. Specifically, in each sample school, we randomly sampled one first year and one second year class in each program.[5] In the subset of schools that had only one of our sample programs (52 out of 118 schools), we only sampled one first-year class and one second-year class in that particular program (either computing or digital control). After randomly sampling the classes, we surveyed all students in the class. Altogether, we sampled 12,071 students across 345 classes in 185 programs in 118 schools (Figure 1).

Appendix Table 1 presents descriptive statistics on student background and school characteristics. In our sample, 89 percent of students were between 15 and 18 years old; 87 percent of students came from rural areas in Henan province. When

[5] In China, VET at the upper secondary level is a three-year program. Government policies suggest that students should take vocational and general skill classes in their first two years (MoE, 2009). Half of the classes are meant to cover vocational or major-specific skills such as computing, accounting, and engineering, whereas the other half of the classes are meant to cover general skills such as math, language, and English (MoE, 2009).

comparing the characteristics of their parents (using our data) with descriptive statistics that used data on a population of 15 to 18 years old individuals from rural China (using data from the 2012 China Family Panel Studies (Xie and Hu, 2014)), we see that the parents of students in our sample are more likely to have graduated from at least high school (23% vs 17%), and are less likely to be in their home villages, instead of working as a migrant outside of their home village (62% vs 70%). Based on these findings, we can tentatively conclude that the VET students in our sample, in fact, are not the most vulnerable group in China. Those students whose parents have lower levels of education and are living and working in their village (most likely being engaged in farming) appear to have stopped their schooling before they entered VET.

2.3 Data Collection

In October 2013 (at the beginning of the academic year) we conducted a baseline survey among our sample students and their school principals. The survey of principals included a series of questions about the basic characteristics of the school. Specifically, the survey asked about whether the school was public or private; whether the school was directly administered by the province's Department of Education (DoE) or by the province's Department of Human Resources and Social Security (DoHRSS); whether the school was a model school; the total number of students enrolled in the school; the ratio of students to teachers; and the share of

teachers that graduated from four-year universities or had advanced graduate degrees, per student expenditure in the previous year.

The baseline survey of students included two blocks. The first block gathered data about student vocational and general skills. Specifically, students took two standardized exams, one to test their skill in their program area, computing or digital control, and one to test their skill in math. The content of each of the exams was based on curricular standards established by the DoE and the DoHRSS (and more generally by the Ministry of Education and the Ministry of Human Resources and Social Security). A multi-step procedure was used to ensure that the tests represented the types of skills that students are expected to acquire in VET schools in China. Once the content of questions was decided upon, we designed vertically-scaled (equated) baseline and endline exams. Placing the baseline and endline exam scores on a common scale allows us to measure absolute gains in learning from the start until the end of an academic year. The exams were timed and closely proctored by enumerators. Appendix 1 contains further details about how the exams were constructed.

The second block gathered basic information about student background characteristics. We asked students to report their gender, age, whether they completed junior high school, the educational attainment of their parents, whether their parents had ever migrated in the past year. Students were also asked to fill out a checklist of household durable assets. We used principal components analysis, adjusting for the fact that the variables are dichotomous and not continuous, to calculate a single metric

of *socioeconomic status* for each student (see Kolenikov and Angeles, 2009).[6]

In April 2014 (near the end of the academic year) we returned to our sample schools and conducted an endline survey. In addition to testing student vocational and general skills, we added three additional blocks to the endline student survey. In the first block, we asked students whether during the previous week they had seen their classmates engage in negative behaviors. Specifically, we asked students whether they had seen classmates cheat on tests, skip class, copy homework, or talk back to his/her teacher. We also asked students if they had ever seen classmates engage in anti-social behaviors such as fighting, extortion, or bullying. Another set of questions sought to identify the prevalence of risky behaviors among peers, such as drinking alcohol or smoking. Finally, we collected data from students on the amount of time they used their computer or cellphone every day and, specifically, on how long they used computer or cellphone for entertainment (such as playing games, chatting, or watching movies) during the previous week.

In the second block, we collected detailed information about student internship experiences. We asked students whether they had participated in one or more internships at some point in time during the last academic year. If they had, students

[6] We conduct standard robustness tests to see whether the use of polychoric PCA results in a viable socioeconomic status metric (Kolenikov and Angeles, 2009). First, we find that the first principal component explains a large proportion of the variance in the household asset variables. The second and remaining principal components explain little of the variance. This indicates that the metric reflects a common relationship underlying the resources (wealth). Second, the scoring coefficients on the first principal component for each asset indicator all run in the anticipated directions. This means that the possession of assets indicates a higher first principal component score (wealth). Third, we find no evidence of clumping or truncation in the socioeconomic status metric.

were asked about the details of their most recent internship experience. Specifically, the questions in this block of the survey asked students when they participated in the internship, whether they were accompanied by teachers during their internships, whether internship work was related to the program they studied, and whether he/she would be willing to recommend this internship program to other students in the same program.

The third block asked students about their attitudes toward VET schools. Specifically, we asked students to report the extent to which they were satisfied with their learning experiences in VET schools. Students were given four options for this question: "1=very satisfied", "2= a little satisfied", "3=a little dissatisfied", and "4=very dissatisfied." We created a binary variable equal to 1 if students reported being "1=very satisfied" or "2= a little satisfied" and 0 otherwise.

Finally, to assess dropout rates, our enumerators filled in a student-tracking form for each class during both the baseline and endline surveys to assess dropout rates. This form contained a list of all the students that had completed the baseline survey. During the endline survey our enumerators asked class monitors whether each student on the baseline list was present, temporarily absent, transferred to another school, completing an internship, or dropped out. If there was any question as to the status of an individual student, we verified the information with multiple classmates, the homeroom teacher, and by calling the student and/or his/her parents.

We should note that the attrition rate in our analytical sample was high for three general reasons: high rates of dropout (which is an important outcome of the study); due to the fact that some students were participating in internships, and were not at school, during the endline survey; or the students had either transferred or were temporarily absent such as sick leave. Out of 12,071 students, 4,004 (33%) students did not complete the survey or take the standardized tests at endline (April 2014). Therefore 33% of students were not included in most of our analyses (other than the analysis of dropout rates). In terms of the breakdown of reasons for attrition, 1,469 students dropped out of school, 1,584 students were away on internships, 28 students transferred to other schools, and 923 students were temporarily absent (Figure 1).

Because of these high attrition rates, we examined whether there were significant differences in baseline characteristics between attrited and non-attrited students (Appendix Table 2). Attrited students were likely to be older (Row 2, significant at 1% level), male (Row 3, significant at 10% level), and junior high dropouts (Row 4, significant at 1% level). Attrited students also had lower vocational and general skills at baseline (Row 5, significant at the 5%, and Row 6, significant at the 1% level). Although there is imbalance between attrited students and non-attrited students, it is likely that the attrited students had even worse endline outcomes than the non-attrited students (Loyalka et al., 2016). As such, results that rely on the sample of non-attrited students in most cases provide a liberal estimate of the quality of VET.

2.4 Statistical Approach

We use a two-step procedure to examine whether the vocational and general skills of individual students showed significant improvement from baseline to endline. First, we calculate each student's absolute gains in both general and vocational skills by taking the difference between his/her vertically scaled scores at the endline and at the baseline.[7] Second, we scaled the absolute gains by the standard error of measurement, a statistic produced during the estimation of the common scale between the baseline and endline tests. The scaled gains follow an asymptotic standard normal distribution (mean = 0, standard deviation (SD) = 1). Using a simple approximation of the properties of the normal distribution, all values that fall outside the range of (-2, 2) indicate a statistically significant positive or negative gain. For example, if the scaled gain is larger than 2, then a student has shown significant progress from baseline to endline. When the scaled gain falls between -2 and 2, the gain is not significant and we find no evidence of progress or regress.

We calculated the sample means to describe whether VET school students: a) exhibited behavior that would be conducive to learning and social stability; b) engaged in internships that would enable them to gain experience and learn valuable job skills; c) self-reported being satisfied with their VET schools; and d) stayed in school (or dropped out of school).

[7] Our exam scores are on a logit scale that contains fractional and negative values. For the ease of interpretation, we transformed the scores to a 1000-point scale, which is common practice in the educational assessment literature (Cook and Eignor, 1991; Baker, 2004).

To examine whether differences in student outcomes are related to differences in school-level factors, we conduct a multi-level regression analysis. In particular, we use hierarchical linear modeling (HLM) to identify the school-level correlates of student performance (Raudenbush and Bryk, 2001). HLM is an extension of ordinary least squares (OLS) regression analysis that takes into account hierarchically structured data (Raudenbush and Bryk, 1986; Woltman et al., 2012). Hierarchically structured data are data where individual units are nested within institutions or groups, such as students within schools. The nested structure of the data violates the independence assumption of ordinary least squares regression (Woltman et al., 2012). HLM is widely used by educational researchers to analyze school-level determinants of student outcomes (Lee, 2000; Woltman et al., 2012).

Within the HLM framework, we use the random intercept model as the basic specification for our analysis:

$$Y_{ij} = \gamma_{00} + \gamma_{10}X_{ij} + \gamma_{01}S_j + U_{0j} + r_{ij} \qquad (1)$$

where Y_{ij} represents the outcome variable of interest. In this paper, Y_{ij} could alternatively represent endline measures of vocational skill, general skill, or dropout. The term X_{ij} is a vector of student characteristics (level-1 predictors). Student characteristics include baseline measures of skills, demographic information (age, gender), educational background (a dummy variable equaling one if student did not complete junior high school), and family characteristics (dummy variables for at least one parent received at least a high school education, no parents migrated in the past

year, and whether or not the family is in the bottom tercile of the socioeconomic index). The term, S_j, is a vector of school characteristics (level-2 predictors). These characteristics include whether the school is public or private, whether the school is directly administered by the DoE or DoHRSS, total enrollment, student-teacher ratio, the share of teachers with university degrees, and per student expenditures. The first part of the model ($\gamma_{00} + \gamma_{10}X_{ij} + \gamma_{01}S_j$) refers to the overall expected effect of student and school-level characteristics on student performance. The term U_{0j} represents a random school-level error term that quantifies the variation between schools. Finally, r_{ij} is random error term associated with student i in school j. The descriptive statistics of the variables are listed in Appendix Table 3.

3. Results

3.1 Does Attending VET Improve Student Outcomes?

3.1.1 Vocational and General Skills

Table 1 reports the vocational and general skill gains of students in our sample. The average vocational skill gain over one academic year is 10.6 points (Row 5, Column 1, Table 1), which only accounts for around 1.1% of the total number of points (= 1000).[8] Furthermore, only 10.1% of students made significant progress in

[8] We could not measure the gains in vocational skill among first year digital control students. Different from computing, students almost have no opportunities to learn skills about digital control before they go to vocational schools. We did not test their digital control skill of first year students at baseline survey because they are supposed to know nothing about this. Instead, in the baseline the first year computing test was administered to first year digital control students. The same kids were given a digital control test in the endline. Thus the first year digital control kids did not have a comparable digital control score from baseline to endline.

vocational skill over one academic year (whether it was the first or second academic year—Row 5, Column 5, Table 1). In other words, approximately 90% of students did not make any significant vocational skill gain in their VET programs.

Students also made negligible gains in the case of general skills (Columns 3 and 4 of Table 1). Specifically, students made an average absolute gain of only 5.0 points in general skill over one academic year (Row 5, Column 3, Table 1), which accounts for less than 0.5% of the total number of points (= 1000). As in the case of vocation skill gains, the share of students that made gains in general skill was also small. According to the results, only 8.9% of students made significant progress in general skill over one academic year (again, whether it was the first or second academic year—Row 5, Column 4, Table 1). Therefore, 91.1% of VET school students did not significantly improve, or even regressed, in their general skill.

When we look at student gain in vocational skill by grade, we find that students in both grades made limited progress in vocational skill. Although the absolute gain of second year computing students are 2.3 points higher than that of first year computing students (Rows 1 and 2, Column 1, Table 1), the share of students that made significant progress is almost same (10.0% versus 10.3%, Rows 1 and 2, Column 2, Table 1). This result indicates that in the first two years of in-school, on-campus learning, few students make any gain in vocational skill.

In addition, our results show that students in both programs were gradually losing general skills. The results show that the share of second year computing

students that made significant progress in general skill is less than first year computing students by 2.1 percentage point (or 20%, Rows 1 and 2, Column 4, Table 1). In comparison with first year digital control students, the share of second year digital control students that made significant progress in general skill declined by 3.2 percentage points (or 35.2%, Rows 3 and 4, Column 4, Table 1). Overall, our results suggest that the education provided by VET programs does not result in students learning skills: students are not learning any vocational or general skills.

3.1.2 Internship Experiences of VET Students

Table 2 describes the internship experiences of VET students. Nearly one-third of students in our sample completed an internship in their first or second year of VET schooling. Specifically, among the 12,071 students included in the baseline survey, 1,584 students were on internships on the day of endline survey (Row 5, Column 2, Table 2), and an additional 1,791 students reported that they had participated in an internship since the time of the baseline survey (Row 5, Column 3, Table 2). Altogether, 28.0% of VET students in our sample had participated in internships during their first two years of VET (Row 5, Column 4, Table 2).[9] This indicates that it is common for first or second year vocational students to participate in internships, although these internships are supposed to be completed in the third year of vocational schooling.

[9] The shares of second-year computing students (42.5%, row 2 and column 4) and digital control students (55.0%, row 4 and column 4) that completed an internship within the last school year are about three times as high as the share of first-year students (rows 2 and 4, column 4).

We also collected detailed information about the internship experiences of students (if they were at school on the day of endline survey—Row 5, Columns 5 to 8, Table 2). While internships are supposed to be part of the educational process, our data show us that VET schools are not abiding by the policy edicts from the government regarding the conduct and purpose of internships. For example, of the first-year students that took part in an internship (which itself, as reported above, is not part of the official VET education process), 13.5% of computing students and 15.1% of digital control students were underage (under 16 years old) at the time of the internship (Rows 1 and 3, Column 5, Table 2). Even in the second year, a small share (one percent) of computing and digital control students were under 16 years of age at the time they participated in their most recent internship.

In addition to minimum age limits for participating in offsite internships, VET student-intern/workers are supposed to be accompanied by a teacher from their school while completing their internship (MoE and MoF of China, 2007). However, according to our data, 38.9% of students had no teacher accompany them on their internship (Row 5, Column 6, Table 2). Interestingly, first-year students (computing: 39.9%; digital control: 35.8%) were less likely to be without a teacher than second-year students (computing: 41.5%; digital control: 37.1%), but the differences are not significant at the 10% level.

Furthermore, most student internships appeared to lack a clear educational purpose. In total, 68.2% of students reported that during their most recent internship

they were working in a job that had nothing to do with their VET program (Row 5, Column 7, Table 2). In fact, during interviews with students, it was clear that in most cases students were being sent to work in low-wage manufacturing jobs. This means, of course, that such internships would have no educational function. Clearly, many schools were not following government regulations designed to protect students and ensure an educational component to the internships.

Given the widespread non-compliance with rules set up to protect students and to make internships educational, it should be no surprise that students were not satisfied with their internship experiences. In response to the question about whether they would recommend their most recent internship to their classmates, students were clear in their responses. More than half of first-year students (54.1% of computing students and 58.8% of digital control students, Rows 1 and 3, Column 8, Table 2) said they would not recommend their internship to students in their same program, even if they were asked to do so (Rows 1 and 3, Column 8, Table 2). The rate for second-year students was even higher (Rows 2 and 4, Column 8, Table 2). Taken together, approximately half of the students (50.1%) were dissatisfied with their internships (Row 5, Column 8, Table 2).

3.1.3 Behavior in China's Vocational Education Programs

In all schools in China, promoting high morals and producing good citizens are important objectives of the educational process (The National People's Congress of China, 2015; MoE, 2014). Policymakers are especially keen to see these aspects

taught in VET schools (MoE, 2014; Xinhua Agency, 2015) However, according to our data, VET programs are falling short of this goal. In addition to neither teaching students vocational or general skills nor adequately providing students with practical or educational internship experiences (see discussion above), VET schools also do not help students develop habits of good behavior.

Our endline survey finds that misbehaving inside and outside of the classroom is a common occurrence among students in VET schools. The forms of misbehavior evaluated in our study include cheating on exams, cutting class, copying homework, and talking back to the teacher. According to our survey, 64.8% of students reported that they had observed their classmates misbehaving in the classroom at some point during the past week (Row 5, Column 1, Table 3). The two most prevalent forms of misbehaving in-class are copying (50%) and cheating on tests (40%).

Even more seriously, a significant share of VET students said that they had observed classmates display anti-social behavior during the previous week, such as engaging in fighting, extortion, or bullying. According to our data, 21.2% of students observed such anti-social behaviors among their classmates in the previous week (Row 5, Column 2, Table 3).

Finally, our survey also revealed that many VET students engage in risky health behaviors. Overall, 45.7% of students said they had observed classmates either drinking alcohol or smoking on campus (Row 5, Column 3, Table 3). The share of first year students (who are 16 years old, on average—Rows 1 and 3, Column 3, Table

3) is about the same as that of second year students (who are 17 years old, on average – Rows 2 and 4, Column 3, Table 3). In short, our research suggests that displays of misbehavior, antisocial behaviors, and risky health behaviors are common among VET students in our sample.

In addition to displaying negative behaviors, VET students also self-reported that they spent a large amount of time on their computers or cellphones for purposes other than learning. Our survey found that, on average, students spend 3.8 hours per day on their computers and cellphones for entertainment, such as playing games, watching television shows or movies, and social chatting (Figure 2). This amount of time spent on electronic devices for entertainment purposes is more than the total time (3.1 hours) that the average high school student in China spends on either a computer or smart phone whether for entertainment or any other purpose such as practical use or learning (China Internet Network Information Center, 2016). The time spent by high school students in OECD countries (2 hours) is even lower (OECD, 2015). This amount of time spent on electronic devices for entertainment purposes accounts for 63.6% of student daily use of electronic devices (regardless of grade or program—see Figure 2).

3.1.4 Self-reported Satisfaction with VET and Dropout

Given negligible gains in skills, poor internship experiences, and the high prevalence of negative behavior, it should be no surprise that more than 60% of

students are dissatisfied with VET schools by either self-reports or dropping out (Figure 3). Among students who completed our baseline survey, 8,067 students (66.8%) completed our endline survey. Of these students, 43.3% reported that they were dissatisfied with their overall learning experience at VET schools. This accounted for 28.9% (=43.3% x 66.8%) of all baseline students (Figure 3). Additionally, 1,469 students (12.2% of the baseline students) arguably expressed their dissatisfaction by dropping out of their VET program during either academic year. Specifically, the dropout rate was 16.3% over the academic year among first-year students and 6.2% over the academic year among second-year student students (12.2%, on average). Moreover, an additional 10.3% of the baseline students dropped out during the vacation period between the two academic years.[10] This means that the cumulative dropout rate in the first two academic years was 31.2% (=16.3%+10.3%+ (100%-16.3%-10.3%)×6.2%) (Figure 3). Hence, in total, 60.1% (=31.2%+28.9%) of students expressed their dissatisfaction with the quality of their VET schooling experience by either stating so during the endline survey or by dropping out of their VET program.

[10] In October 2014, we conducted a phone call follow-up survey over to first year computing program students in a subsample of 16 schools to estimate the dropout rate between the end of the first academic year (April 2014) and the beginning of the second academic year (October 2014). The 16 schools were randomly selected from one of our sampled prefecture (provincial capital). We called all students who were at school at our follow-up survey of April 2014. Each student was listed as present, temporarily absent, transferred to another school, attending an internship, or dropped out, according to information of phone call.

3.2 Correlates of Skill Gains/Losses and Dropout

We find that two school-level factors are correlated with vocational skill at the end of the academic year. First, students from public schools have lower vocational skill at the end of the school year than their counterparts from private schools by 9.1 points (significant at the 5% level, Row 10, Column 1, Table 4). This is consistent with the results of similar studies on general schooling (Hanushek, 1986; Thapa, 2013). One possible explanation might be that principals in private schools may have more power to decide what kind of resources they employ to improve vocational skills (OECD, 2012). Second, students from schools directly administered by the DoE have lower vocational skill at the end of the academic year than students from schools directly administered by the DoHRSS (by 10.1 points, Row 11, Column 1, Table 4). To some extent, this may be explained by the fact that the DoHRSS has a stronger background and tradition in vocational training (Ministry of Human Resources and Social Security of China, 2015). It is important to keep in mind, however, that although there are statistically significant differences between public and private schools and between DoE and DoHRSS schools, the magnitude of the differences is quite small.

Other school-level factors, and almost all school inputs with the exception of student-teacher ratios, are not correlated with vocational skill at the end of the academic year. These school inputs include whether the sample school is a model

school, total enrollment, the share of teachers that graduated from university or above, and per student expenditures (Rows 12, 13, 15 and 16, Column 1, Table 4).

When we examine the association between either general skills or dropout on the one hand and school-level factors on the other, we find almost no associations are statistically significant (Column 3, Table 4). One exception is that the student-teacher ratio is negatively correlated with the dropout in the academic year (significant at 10% level, Row 14, Column 3, Table 4). However, the effect size of student-teacher ratio is negligible (0.1 percentage points).

We also run a robustness check to examine if our results remain constant when we use multiple imputation to account for missing data arising from attrition and missing values for student and school characteristics (Appendix Table 4). One concern might be that our current interpretations about which school-level factors are correlated with vocational or general skills at the end of the school year or dropout in the school year are driven by the nature of our dataset (i.e., sample of observations that did not include the students that attrited between baseline and endline). If we were to include data from the missing students, perhaps our results would change. While multiple imputation cannot fully reconstruct the missing data, we conduct the analysis to determine how sensitive our existing analysis is to missing data under the "missing at random (MAR)" assumption (Carpenter, Kenward and White, 2007).

The tables for this analysis are in the appendix (Appendix Table 4). For the sake of brevity, we omit a thorough discussion of the results from these additional

analyses. In briefest terms, however, when using the larger dataset (constructed by using multiple imputation), the results are similar to and support the results presented above.

4. Discussion

Since VET is often considered the second-best option, it may tempting to attribute the failure of the VET system to low student and parent morale. However, there is little evidence that this is the case. A randomized field experiment on vocational school stereotype threat conducted by Chu et al. (2017) shows that VET students do not internalize negative stereotypes related to VET (such that it affects their cognitive outcomes).

We posit three reasons why the quality of VET is so low in China. First, we point out that models of successful VET systems in the world—those in Germany, Switzerland, and Austria, for example (Kathrin and Schwartz, 2010; Pedró et al., 2009), were developed and improved over centuries with regards to a particular social, political and economic climate. The much larger scale mass expansion of VET in China and other Asian-Pacific countries, by contrast, has occurred in the relatively short span of one or two decades. Developing the right teaching resources and know-how for building a successful VET system in a short amount of time and integrating that system with the constantly evolving needs of industry in a large and rapidly changing economy are each Herculean tasks.

Second, there may be a fundamental absence of understanding—even by policymakers (either regional and/or national)—that VET students do not require focused training in general skills. In many policy documents, the impetus to expand VET in China has been characterized as a movement to help students find a job (Chinese State Council, 2003; MoE, 2005). There is much less rhetoric that pushes educators to emphasize general academic skills. Because of this, VET school principals and teachers may have tended to over focus on the teaching of professional ethics, specific vocational skills, and the ability to find and hold a job (The Central People's Government of China, 2010). Hence, it may be that the gains in general skills are so low because of the absence of any imperative to teach them. However, international experiences have shown that general skills increase the prospect of lifelong learning, and enable students to adapt to the long-term demands of the economy (Chiswick, Lee, and Miller, 2003; Field et al., 2009).

Third, unlike almost every other area of schooling in China, vocational schooling lacks assessment and accountability. The vast majority of students from junior high schools and academic high schools in China participate in high-stakes high school and college entrance exams (Ding and Lehrer, 2007; Li et al., 2015). Students in primary schools participate in high-stakes exams at the regional level as well. Teachers and school administrator incentives and rewards are often tied to how well students perform on these exams (An, 2015; Sina, 2016; Xue and Wang, 2016). By contrast, there is little assessment, and therefore little accountability, in vocational

schooling. Introducing assessment and accountability, both from government and industry, may help improve student outcomes in VET (Field et al., 2009).

The lessons that we have learned in China's VET system may well apply to other countries in the Asia-Pacific region (Stewart, 2015). First, in the case of countries, such as Indonesia and Thailand, there is more or less a shared industrial structure (World Bank, 2016). Due to these similarities, it might be possible to conclude that a VET education would have similar demands for and impacts on human capital in these countries.

Second, other Asia-Pacific countries may also benefit from understanding the experiences of China in how it has been successful (and has not been successful) in being able to use VET to effectively build human capital. The case of China might be especially relevant to developing countries that are trying to rapidly build a VET system in a globalized world. For example, nations, such as Indonesia, Thailand, and Vietnam, have all made concerted efforts to rapidly expand vocational schooling and on a massive scale in the past decade or so (UNESCO-UNEVOC, 2014). Like China, they do not appear to have the requisite resources or know-how for building a thriving VET system in a short time. Adapting the VET system to the rapidly evolving needs of industries in fast-developing emerging economies is also undoubtedly a highly challenging task for policymakers and school administrators in these countries.

Finally, vocational schooling in many Asia-Pacific countries such as in Vietnam, Nepal, and Sri Lanka is also characterized by a lack of assessment and

accountability (ADB, 2014; ADB and Australian Aid, 2014). The China case might raise concerns on the quality of vocational education in these countries.

5. Conclusion

The overall goal of expanding VET in developing countries is to help students increase vocational and general skills, develop positive social behaviors, and increase work experience (Chiswick, Lee and Miller, 2003; Field et al., 2009; Sheldon and Thornthwaite, 2005; UNESCO, 2012). However, to date little research has been conducted to examine to what degree these goals have been achieved. To fill in this gap, we used representative, longitudinal data on over 12,000 students from 118 VET schools in one province of central China to measure student gains in vocational and general skills, the quality of internships available to students, the prevalence of negative behaviors among students, as well as student dissatisfaction with VET.

We find that the VET is not meeting its goals. Around 90% of VET students did not make any improvements in vocational and general skills over one academic year. Students are surrounded by peers that engage in negative social behaviors (misbehavior in the classroom, anti-social behavior, and other risky behaviors). Student internships are also of low quality, often because they do not adhere to basic government requirements established to ensure student safety and well-being. Students also report that they are not learning from internships. On the whole, close to

two thirds of students expressed dissatisfaction with their VET programs or dropped out.

An examination of the correlation between school-level factors and student outcomes provides a modicum of insight for how to improve the quality of VET in China. The type of agency in charge of managing the school (public versus private or DoHRSS versus DoE) explained a small amount of the variation in vocational skill gains. On the other hand, almost none of the observable school inputs could predict skill gains or student dropout.

Taken together, the results tentatively suggest that policymakers interested in improving the quality of VET may need to move beyond increasing resources in VET to introducing and evaluating programs that can improve how VET schools are managed. We further suspect that improving how VET schools are managed may well extend beyond determining which type of agency runs the VET school towards introducing greater assessment and accountability into the VET school system. Indeed, VET school systems in China and elsewhere, unlike general schooling systems are often characterized by an almost complete lack of assessment and accountability. Whether introducing assessment and accountability into the VET school system can improve a wide range of student outcomes is, however, an open empirical question and the subject of future research.

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Appendix 1 Design of Tests

A multi-step procedure was used to construct the tests and ensure that they were valid (represented the types of skills that students are expected to acquire in upper-secondary vocational education and training (VET) schools in China). First, we used national and provincial curricula standards for VET schools to define the content domains for our tests. We then collected a pool of exam items, including 135 math items, 162 computer items, and 164 digital control items. These items mirror these content domains from official textbooks and VET college entrance examinations. To further verify that the items were being covered in actual curricula taught in VET schools, we asked 28 VET schoolteachers to serve as content experts. We asked these content experts to review our test items based on whether the item measures content taught in VET schools, the difficulty of the item, and the time it took students to complete the item. Based on the feedback we received, we selected a subset of items to make up a pilot version of the tests.

To ensure that our tests had good psychometric properties, we conducted a pilot round of tests with over 1,000 VET students in September 2013. We analyzed data from the pilot to filter out items that exhibited poor psychometric properties. We carefully selected the items that strengthened the reliability of the tests while maintaining balanced of test items from different curricular content areas. With the selected items, we created final tests that had a high degree of reliability (person reliability of 0.7 to 0.8).

All examinees were estimated using the Rasch model. Students measures were obtained by the method of maximum likelihood implemented with Winsteps software. As a result three scales were constructed: one scale for Math (from first year baseline, first year endline (same to second year baseline), second year endline tests), one for Computing (from first year baseline, first year endline (same to second year baseline), second year endline tests), and finally one for Digital Control (from first year endline (same to second year baseline) and second year endline tests). Each student

participated in both cycles of assessment on particular test (math, computing and digital control) has got two scores on the test. If a student participated only in one cycle (baseline or endline) he has got only one score.

The estimates – test scores of test takes are on the logit scale and are not appropriate for reporting to test takers and stakeholders since they contain fractional and negative values. The estimates are traditionally transformed from the logit scale to another, more convenient one. To this end, a 1000-point scale was selected, which is widely used in the world testing practice, in particular, in international monitoring assessments.

Transition to the 1000-point scale was performed using a linear transformation that maintains the scale metricity and does not distort intervals between the objects. Scores of all students for each test separately (math, computing and digital control) were transformed from the logit scale to the 1000-point scale with the average value of 500 and standard deviation of 50.

The t-statistics is calculated to test a hypothesis if the difference in endline and baseline measures is significant taking into account the error of measurement. The t-statistics is calculated as

$$t = \frac{measure\_endline - measure\_baseline}{\sqrt{(SEM\_endline)^2 + (SEM\_baseline)^2}}$$

where measure_endline is a student's test score on endline test (at logit scale), measure_baseline is the student's test score on baseline test (at logit scale), SEM_endline and SEM_baseline - accosiated errors of measurement. It has asymptotically normal distribution with mean =0 and SD=1. So all values out of range (-2, 2) say about significant difference between baseline and endline measures. If t>2, then student's progress is significant. If t<-2, then student's regress is significant. And lastly if t has value from (-2,2) then difference in the student's measures is not significant.