Measuring Results of the Mongolia I Compact Vocational Education (VET) Project

Activity 5: Improvement of Learning Environments Activity
Sub-Activity: Equipment Upgrade

Prepared by Innovations for Poverty Action

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List of Terms and Abbreviations

2SLS	Two-Stage Least Squares
ADB	Asian Development Bank
AVET	Agency for Vocational Education and Training
CAPI	Computer Assisted Personal Interview
CBT	Competency Based Training
DQM	Data Quality Monitoring
GFU	Graduate Follow Up
GIZ	Gesellschaft fuer Internationale Zusammenarbeit
GoM	Government of Mongolia
IPA	Innovations for Poverty Action
M&E	Monitoring and Evaluation
MCA-M	Millennium Challenge Account - Mongolia
MCA-M M&E	Millennium Challenge Account - Mongolia Monitoring and Evaluation
MCC	Millennium Challenge Corporation
MECS	Ministry of Education, Culture, and Science
MMCG	Mongolian Marketing and Consulting Group
MNT	Mongolian Tugrik (Mongolia's currency)
NCVET	National Council of Vocational Education and Training
NLRC	National Learning Resource Center
NVQF	National Vocational Qualification Framework
OLS	Ordinary Least Squares
PAPI	Paper and Pencil Input
USD	United States Dollar
TVET	Technical Vocational Education and Training
VET	Vocational Education and Training

Aimag	Province
Soum	District
Tugrik	Mongolia's currency

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Executive Summary

A. Overview of Compact and Interventions

The Vocational Education and Training (VET) Project was one of the five overarching Millennium Challenge Account Mongolia (MCA-M) projects funded by the Millennium Challenge Corporation (MCC). The stated goal of the VET Project was "to reduce unemployment and poverty through increased employment and income among unemployed and marginally-employed Mongolians"[1]. MCA-M planned to achieve this goal by providing students with access to high quality training in modern industrial skills.

The VET Project saw a significant increase in funding through a reallocation of MCC investments in 2009, almost doubling its original budget[2]. The expansion increased the scope of the VET Project, resulting in five main components:

1. Policy and Operational Framework Reform;
2. Creation of Skills Standards and Competencies System Activities;
3. Competency-based Training Systems Activity;
4. Career Guidance and Labor Market Information Systems Development; and
5. Improvement of Learning Environment.

In keeping with MCC's commitment to carefully track the results of its projects, Innovations for Poverty Action (IPA) was contracted to design and conduct an impact evaluation of the equipment upgrades provided to the schools as sub-activity 5.1 of the fifth component. 28 vocational schools in 16 provinces benefited from these upgrades. Selected schools received modern training equipment for trades such as heating, plumbing, electricity and electronics, heavy machinery operation and lathing. IPA conducted a rigorous impact evaluation of the project in 10 Technical and Vocational Education Training (TVET) schools. This evaluation report serves three main purposes:

1. To describe the project's implementation, evaluation design and collection of baseline, follow-up and administrative data between 2010 and 2015;
2. To present descriptive characteristics of applicants in the 2010, 2011, and 2012 cohorts to the 10 TVET schools which participated in the impact evaluation; and
3. To evaluate the impact of exposure to upgraded equipment in TVET schools on measures of employment and earnings of young Mongolians.

B. Evaluation Questions, Type, and Methodology

While all components of the VET Project were considered, only the equipment upgrades component was identified as a candidate for rigorous evaluation. Thus, the main question that this evaluation is designed to answer is: **What is the effect of providing schools with upgraded equipment on graduates' employability and wages?**

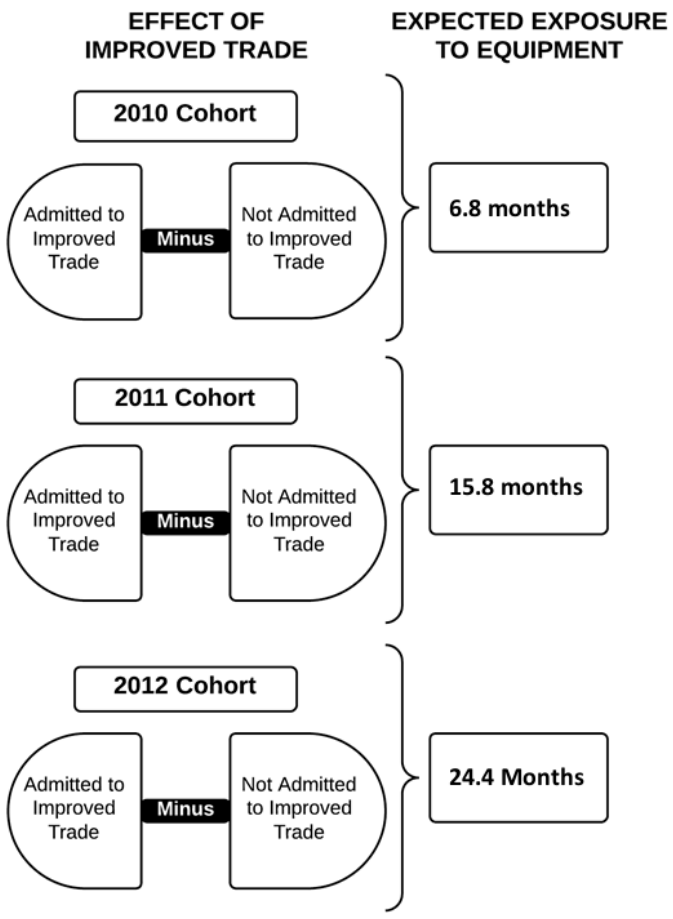
The impact evaluation sought to estimate the causal impact of exposure to equipment upgrades on subsequent outcomes by using a quasi-experimental difference-in-differences methodology. Insofar as we were not able to randomly assign upgraded equipment across schools or trades, we could not estimate the impact of exposure to equipment upgrades directly. However, the gradual rollout of equipment

[1] MCA-M VET Project information pamphlet
[2] MCC, 2009

upgrades to TVET schools over time implied that individuals in later cohorts studying trades affected by equipment upgrades were exposed to these upgrades for longer than individuals in earlier cohorts.

We proceeded to estimate the impact of exposure to upgraded equipment in three steps: First, we recruited students who applied to the 10 TVET evaluations schools in 2010, 2011, and 2012. We identified all trades that received the upgraded equipment and refer to them collectively as "improved trades" or "upgraded trades". Second, in cases where students applied to trades were oversubscribed (i.e. they received more applications than could be accommodated), we conducted lotteries to determine which students would be admitted.[3] This enabled us to estimate the impact of admission to trades affected by equipment upgrades for the 2010, 2011, and 2012 admission cohorts. Third, we compared the impact of admission to trades affected by upgrades on outcomes in earlier and later cohorts to estimate the impact of exposure to upgrades. Specifically, we compare the average outcomes of students who were admitted to improved trades with those of students who were admitted to non-improved trades in earlier cohorts vs. later cohorts. Figure ES1 reproduces a graphical representation of our empirical strategy from the main report.

Figure ES1: Evaluation Strategy



Thus, the proposed research design seeks to identify the effects of the equipment upgrades by exploiting both random assignment of students to trades and the fact that the upgrades were rolled out over time to a subset of schools. The research design involves estimating two levels of differences: (1) comparing students randomly assigned to study an improved trade to those not assigned to an improved trade, and (2) comparing the difference in student performance by assignment to improved trades across cohorts. Note that, while students were effectively randomized across trades, the comparison across cohorts depends on the assumption that the effects of exposure to different trades would remain constant in the absence of the upgraded equipment. Any change in labor market opportunities across cohorts that differentially affects students exposed to "improved trades" could potentially confound our estimates.

[3] This is common practice in settings where slots are oversubscribed. For example, in the United States, slots at oversubscribed publicly-funded charter schools are regularly assigned by lottery while some public housing units have been allocated by lottery when demand exceeded supply.

C. Implementation Summary

Through sub-activity 5.1 of the VET Project, "Improvement of learning environment", 62 equipment upgrades were delivered to 24 schools between 2010 and 2013. MCA-Mongolia provided IPA with administrative data on the date each school received the upgrades. Not all outputs and outcomes associated with the delivery of equipment upgrades were monitored directly. We do not possess systematically gathered data on whether equipment upgrades were delivered and installed on time, whether teachers of trades that received upgrades used them sufficiently, effectively or both. Additionally, we lack data on whether training on these particular upgrades resulted in students learning skills in demand by employers. These factors were not monitored directly because they were not explicit parts of the project logic and the evaluation's focus shifted to equipment only in 2014, after they had been installed and any teaching staff training completed.

For the 10 TVET Evaluation schools, we estimate that a student from the 2010 cohort admitted to a trade singled out for equipment upgrades could expect 8.7 months of exposure if she studied the trade. A student admitted to the same program in 2012 could expect an average of 24.4 months of exposure to new equipment, or almost three times as long as someone from the 2010 cohort.

A total of 2,852 applicants were admitted to a trade through the lottery that was eventually affected by equipment upgrades. 5,830 were admitted to trades that were not. However, students could be exposed to equipment upgrades even though not admitted to a trade affected by them. They could have changed trades or studied at a different school that received upgrades. Being admitted to a trade was also not a guarantee of exposure to upgraded equipment since students may have dropped out or changed trades. 2,330 students ended up exposed to trades with equipment upgrades. 1,817 of them, or 77.8 percent, had been admitted to trades affected by upgrades.

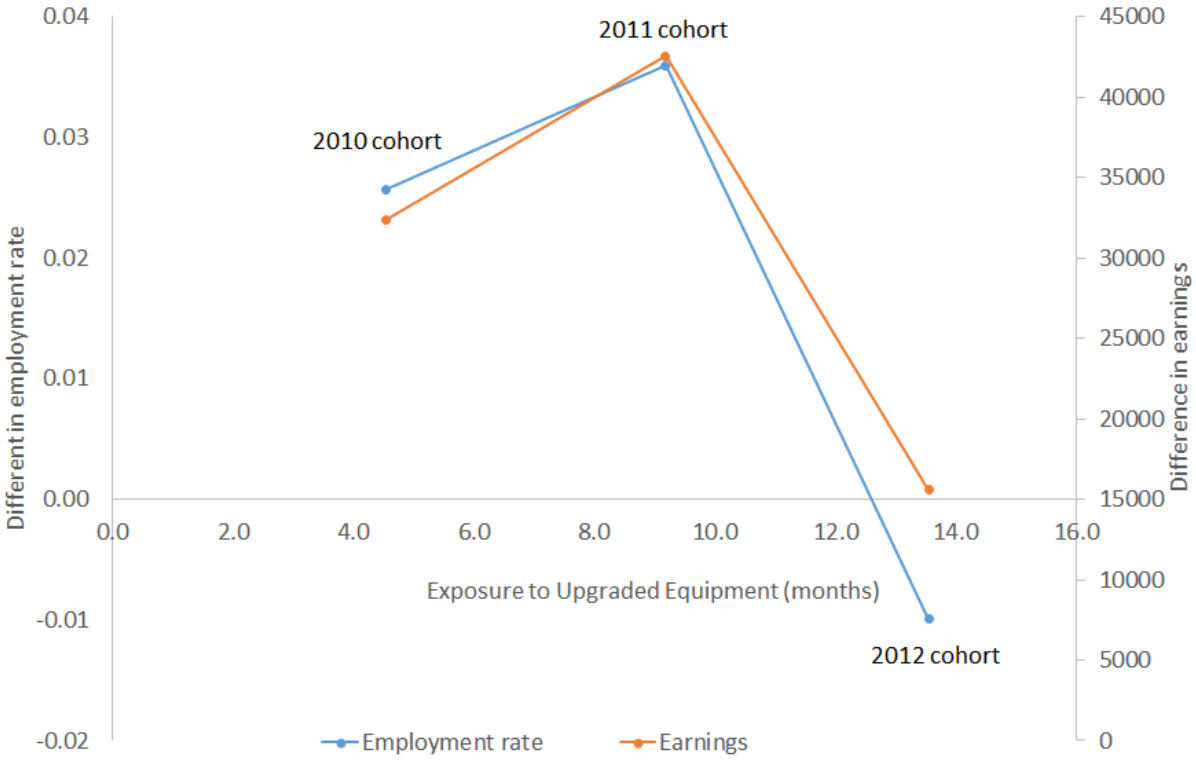
D. Findings

We evaluated the impact of exposure to upgraded equipment in TVET schools on education, employment, earnings, as well as intermediate and other outcomes. The gradual rollout of equipment upgrades over time implies that students in later cohorts studying trades affected by equipment upgrades were exposed to these upgrades for longer than students in earlier cohorts. Indeed, we find that compared to students who were admitted to trades without equipment upgrades, those students who were admitted to improved trades in the 2010 cohort were exposed to upgraded equipment for only 4.5 more months on average, whereas students admitted to improved trades in the 2011 and 2012 cohort were exposed to upgraded equipment for 9.2 and 13.6 more months respectively. These differences in exposure are all highly significant (although smaller than the expected differences in exposure from Figure ES1 because not all students admitted to improved trades were exposed to upgraded equipment and vice versa).

However, the large increases in exposure to upgraded equipment across cohorts were not accompanied by significant or consistent increases in employment or earnings. Students from the 2010 cohort who were admitted to trades with equipment upgrades did have higher employment rates and earnings than students who were not admitted to such trades. But, as explained earlier, these differences are also likely to reflect inherent disparities in labor market opportunities across trades. When we estimate the differences in employment rate and earnings between improved and non-improved trades for the 2011 cohort, they are larger than those for the 2010 cohort but not statistically significantly so. Moreover, the differences in the employment rate and earnings between improved and non-improved trades decline markedly from the 2011 cohort to the 2012 cohort, despite the continued increase in exposure to

upgraded equipment in improved trades. These broad patterns are similar for alternative measures of employment and earnings. This can be seen graphically below over the full sample for our preferred measures of (ever in paid) employment and (average monthly) earnings:

Figure ES2: Difference in employment and earnings between improved and non-improved trades



We estimate the impact of exposure to equipment upgrades on employment and earnings more formally using an econometric model that embeds a generalized difference-in-difference specification within a two-stage least squares (2SLS) framework. We find no significant impacts of exposure to upgraded equipment on various measures of employment and earnings for either men or women.

In accordance with the project logic (more on which in Section II.B), we investigated the impact of exposure to upgraded equipment on a number of intermediate outcomes (e.g. trade-related knowledge, work intensity, type of employment) using the same empirical methodology. However, we did not see any significant impacts on intermediate outcomes such as trade-related knowledge and work intensity. We also investigated the impact of exposure to upgraded equipment on other outcomes (e.g. future expectations, assets, and expenditures) but did not find any significant effects.

E. Next Steps/Future Analysis

We do not find evidence for positive impacts of exposure to upgraded equipment on employment or earnings. Moreover, we can rule out fairly modest impacts on employment and earnings. There is also no evidence for impacts on intermediate or other outcomes. Why do we not find positive impacts from exposure to upgraded equipment? One explanation is that students' exposure to upgraded equipment

did not improve skills that were valued by employers. Indeed, we do not observe any significant increases in scores on tests measuring trade-related knowledge (although it is possible that our tests did not capture all the skills learned from upgraded as compared to older equipment). We have strong evidence that schools received equipment upgrades. But we do not have systematical data on whether teachers used equipment upgrades effectively or whether students learned skills that were useful to employers. Future designs of TVET evaluations should consider including more detailed classroom observations and the possibility of surveying employers directly.

An alternative explanation is that labor market opportunities for those who studied upgraded or improved trades deteriorated relative to those who studied other trades. There is some evidence for a general deterioration of labor market opportunities for individuals admitted to TVET schools in the 2012 cohort. Estimates for the effect of exposure to equipment upgrades that only use data from the 2010 and 2011 cohort are generally insignificant. However, since we were not able to randomly assign upgraded equipment across schools or trades, we cannot rule out this alternative explanation for the absence of positive impacts. Future evaluations should heed the challenges inherent in research designs that do not rely solely on random assignment.

In addition to enabling this evaluation, the resulting data collection effort also provides significant information about Mongolian TVET schools more generally. This is a rich data set that can be used to investigate other questions of interest to the Government of Mongolia and to researchers studying Mongolia. Several aspects of the data should be of interest to the TVET schools themselves. For example, the data we collected could be used to correlate student characteristics with various outcomes, such as the likelihood that students complete the program or their chances of finding a job, in order to better target admissions policies. Finally, the data can be used to build on the growing body of research into the effects of vocational training.

I. Introduction

A landlocked country of 1.56 million square kilometers situated between China and Russia, Mongolia lost economic support from the Soviet Union and abruptly transitioned to democracy and a market economy in the early 1990s. The country's limited, aging transportation infrastructure and young institutions have been shown to be significant constraints to economic growth and development. Today, nearly half of the country's three million people live in Ulaanbaatar, the capital.[4,5]

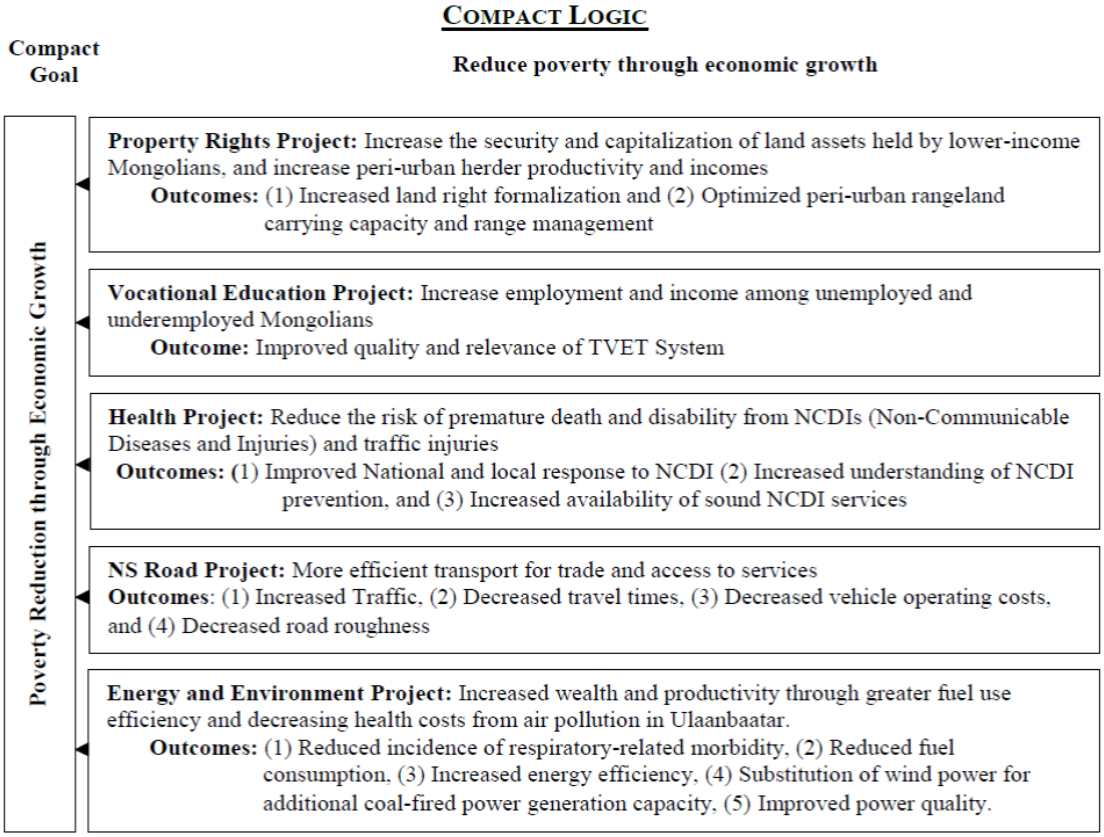
In October 2007, the governments of the United States and Mongolia signed a five-year, $285 million US Dollar Compact. Amended in 2009, the Compact's goal was to reduce poverty in Mongolia by promoting economic growth through five objectives:

(1) Increase the security and capitalization of land assets held by lower-income Mongolians, and to increase peri-urban herder productivity and incomes, through the Property Rights Project;
(2) Increase employment and income among unemployed and marginally employed Mongolians through the VET Project;
(3) Increase the adoption of behaviors that reduce non-communicable diseases and injuries that have the greatest impact on mortality ("NCDIs") among target populations and improve medical treatment and control of NCDIs through the Health Project;
(4) More efficient transport for trade and access to services through the **North-South Road Project;**
(5) Increased savings and productivity through greater fuel-use efficiency and decreased pollution-related health costs in Ulaanbaatar through the Energy and Environment Project.[6]

The Millennium Challenge Corporation (MCC) ultimately financed and implemented projects in five areas in pursuit of these goals, shown in the Compact Logic in Figure 1 below:

[4] Millennium Challenge Corporation, 2014
[5] The World Factbook, 2016.
[6] Millennium Challenge Corporation, 2007

Figure 1. Mongolia Compact Logic (MCC, 2013)



The projects aimed to reduce poverty and increase growth opportunities and the productive capacity of the Mongolian population and economy. By the end of the Compact in September 2013, the Mongolian government and MCC had spent 94 percent of available funds. Two million Mongolians are expected to benefit from the investment over a 20-year period.[7] The full post-Compact Monitoring and Evaluation plan can be found here.

The report that follows covers the background, implementation and evaluation of MCC's Vocational Education and Training Project.

A. Vocational Education - Project Context

During the socialist era, Mongolia had a robust Technical Vocational and Education Training (TVET) program fashioned after the Soviet model and supported by the Soviet Union. The Mongolian TVET sector had the capacity to produce sufficient skilled labor not only for industries in Mongolia but also for other parts of the Soviet Union[8]. As Mongolia transitioned to a market economy in the 1990s, the TVET sector deteriorated without financial and technical support from Russia. Training equipment became outdated and teachers fell behind the newest developments in their trades. At the same time, the demand for skilled labor grew as Mongolia experienced substantial economic growth due to a booming mining sector.

[7] Figures available at: https://www.mcc.gov/where-we-work/program/mongolia-compact
[8] Personal communication from Stephen Duguun, MCC Consultant on VET Project

With rapid growth, demand for skilled workers in new sectors such as the processing industry, construction, mining and infrastructure emerged rapidly.

The Mongolian government recognized the lack of skilled workers and inadequate capacity of TVET institutions to produce such workers. It set goals to increase TVET school enrollment and improve the quality of TVET education as part of the *Second Education Master Plan 2006-2015*. As the government became more focused on the TVET system and the need for skilled labor became more apparent as the mining sector grew and modernized, a number of international donors began to participate in making Mongolian technical and vocational education more relevant to a rapidly evolving labor market.

The Asian Development Bank (ADB) was the first donor to work with the TVET sector, advising the government on education reform since 1991 and assisting in the formulation of the Second Master Plan. The German *Gesellschaft für Internationale Zusammenarbeit* (GIZ) and the Nordic Development Fund were further early entrants. They partnered with select vocational schools and assisted in the development of vocational education activities during the Second Master Plan.

In 2008, the Millennium Challenge Corporation (MCC) became a major donor in the TVET sector. From 2008 to 2013 MCC, acting through the Millennium Challenge Account-Mongolia (MCA-M) Vocational Education Training (VET) Project, implemented wide-ranging measures to bring Mongolia's TVET sector up to international standards. The VET Project initiated institutional reforms, created competency-based curricula for prioritized trades, retrained teachers, introduced labor market information systems and career counseling and upgraded training equipment and physical infrastructures at select TVET institutions. As of 2013, MCA-M's 52 million USD VET Project was the largest donor investment in Mongolia's TVET sector and is expected to benefit up to 170,000 TVET graduates over 20 years.[9]

Subsequent to MCC's contribution, the Swiss Agency for Development Cooperation, the GIZ and the European Union have been active in areas of curriculum development and teacher training at vocational schools throughout the country. Oyu Tolgoi, a joint venture between the multinational mining corporation Rio Tinto and the Mongolian government that operates the largest mine in the country, is another major contributor to the TVET sector. It invests in mining schools, trains teachers and operates its own apprenticeship programs to train workers for its mining activities.

In order to evaluate the results of its investment in Mongolia's TVET infrastructure, MCC contracted Innovations for Poverty Action (IPA) to design and conduct an impact evaluation using the methodology of a randomized control trial.

As part of this effort, MCA-M conducted a survey of all students who applied for admission to 10 evaluation schools participating in the research project in 2010, 2011 and 2012. The admissions survey provided a basis for the admissions lottery needed for a randomization process and as a baseline survey for IPA's evaluation. IPA then conducted follow-up surveys from 2012 to 2015, covering up to 12,240 students to assess the impact of certain aspects of MCA-M's investments.

The data collected over this five-year period forms the basis of the evaluation. It also provides a unique and comprehensive database of over 12,000 young Mongolians who applied to, studied at and graduated from ten TVET schools that will be available for use by the Mongolian government and other researchers

[9] MCC Mongolia compact. Available at: https://www.mcc.gov/where-we-work/program/mongolia-compact

and organizations. To our knowledge, this is the most complete data on Mongolian TVET students gathered to date.

The following terms are used to refer to different types of schools throughout the report:

1. *VET Project*: MCA-M's vocational schools project
2. *Project school*: Refers to schools that received assistance from the VET Project
3. *Evaluation school*: Refers to the 10 schools that are part of MCA-M's and IPA's randomized admissions impact evaluation
4. *TVET school*: Refers to all vocational schools in Mongolia in general regardless of their project recipient status or evaluation status

B. The TVET School System

Eager to train more skilled workers for a modernizing economy, policymakers have pushed to increase the number of qualified technical and vocational teachers and boost the enrollment levels of TVET schools. Table 1 below shows that overall enrollment ("Students at TVET schools") increased from 2009-2012 and fell and stabilized in 2013-2014. New enrollments showed an increasing trend throughout 2009-2014.

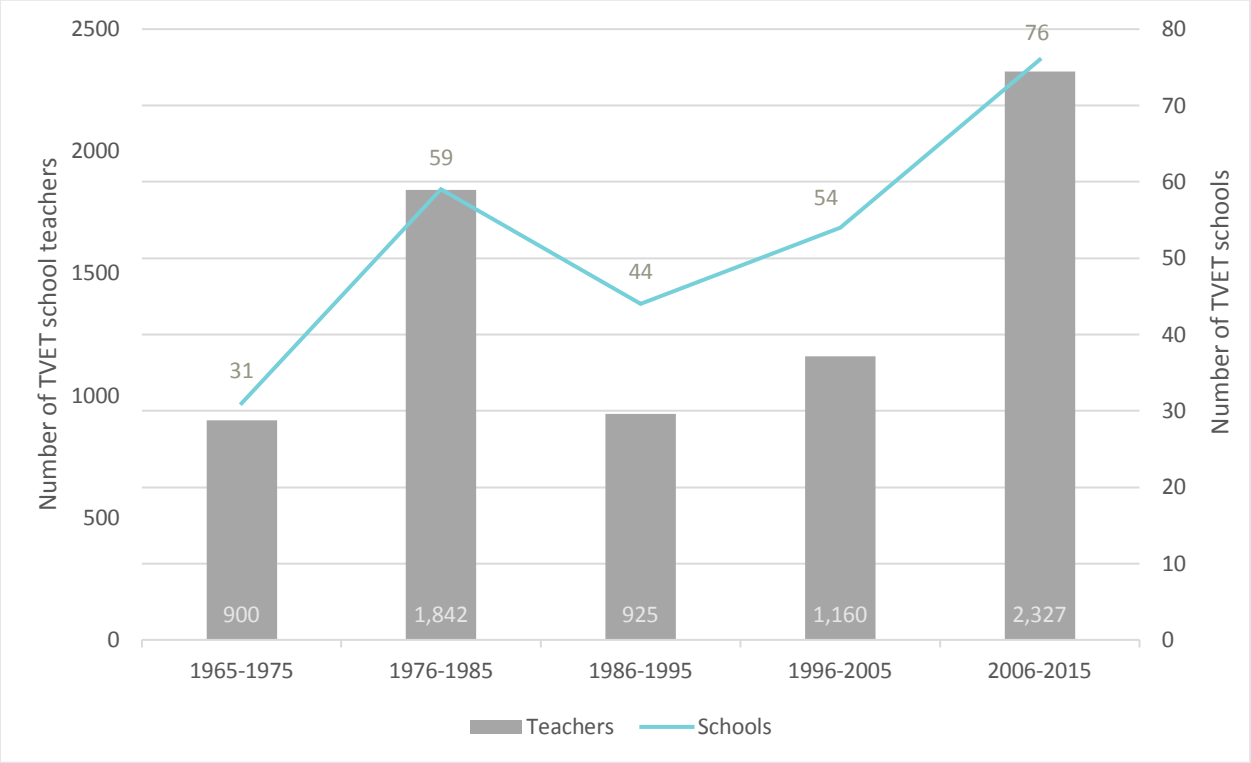
Table 1. TVET student enrollment by academic year, 2009 – 2015[10]

	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Students at TVET schools	44,681	46,071	48,134	45,225	42,798	42,797
Students in urban areas	17,962	18,976	18,720	19,286	18,182	18,404
Students in rural areas	26,719	27,095	29,414	25,939	24,616	24,393
Students at state-owned schools	33,386	34,711	37,227	35,256	33,525	32,896
Students at private schools	11,295	11,360	10,907	9,969	9,273	9,901
New students enrolled per year	19,754	19,358	19,417	19,607	20,921	20,804
9^{th} grade enrollment	13,952	13,186	11,116	10,741	9,944	10,928
11^{th} grade enrollment	3,426	2,865	4,094	4,123	5,738	5,130
Graduates from TVET schools	14,836	18,705	23,120	23,393	18,358	18,978

Figure 2 below shows the number of schools and teachers increased significantly over the last decade, surpassing the high reached in the 1970s and 1980s for the first time since the transition to a market economy. There are currently 76 TVET schools in Mongolia that employ over 2,300 permanent teachers.

[10] Information provided by the Mongolian Ministry of Labor.

Figure 2. Mongolian TVET schools and teachers 1965-2015[11]



TVET schools can be either private or state-owned. State-owned schools were formerly under the authority of the Ministry of Education and the Agency for Technical and Vocational Education and Training. After the parliamentary elections of 2012, vocational education was placed under the Ministry of Labor. The ministry appoints the school directors and deputy directors, in charge of day to day operations. Private schools have their directors appointed by their board members. Private schools generally have the same internal structure as state-owned schools and are subject to most of the same rules, regulations and subsidies as state-owned schools.

In general, there are two types of vocational education training programs available to students who have completed basic education in Mongolia: a 2/2.5-year program for students that have only completed nine years of studies in the national education system and a 1-year program for student who have completed all 11 years of secondary schooling. The 1-year programs concentrate solely on vocational training and students receive a vocational education certificate upon graduation. The 2/2.5-year programs offer a mix of basic academic courses and vocational training, and students receive both a secondary education and a vocational education certificate upon graduation.

[11] Source: Presentation: "Vocational school's teacher development" Altantsetseg.Ch & Mongolian Ministry of Labor.

To make TVET programs more attractive, the government provided a 45,000 MNT (22.6 USD[12]) monthly stipend to all enrolled students under the age of 24 at both state-owned and private TVET schools.[13] Private schools generally charge around 220,000–550,000 MNT (110–275 USD) per year. State-owned TVET schools are free of charge and fully funded by the government. Since 2005, TVET schools offer adult training programs, mainly for re-training unemployed or underemployed adults for new jobs.

There are currently 76 TVET institutions across Mongolia. 24 of them are private and 52 state-owned. Each of the 21 provincial capital hosts at least one state-owned TVET school. The average school hosts 670 students, employs 30 teachers and teaches 14 trades. Most TVET school facilities contain traditional classrooms for teaching theoretical courses and a series of workshop areas where trade-specific activities can be taught and performed. Details on such information as the number of staff and students of the 10 evaluation schools can be found in Appendix A, Table 2.

[12] All dollar figures were converted from Mongolian Tugriks (MNT) using the Mongolian central banks official exchange rate for October 2015. 1 USD = 1993.35 MNT.

[13] The monthly stipend was increased to 70,000 MNT (35.1 USD) for all students in January 1st, 2014, but abolished in January 2016 due to lack of funds.

II. Overview of the Compact and the Interventions Evaluated

A. Overview of the Project and Implementation Plan

The MCA-M VET Project aimed to increase employment and income among unemployed and marginally employed Mongolians. It pursued these goals by ensuring that students at technical and vocational schools receive training in modern industrial skills to prepare them to meet the labor market demands in key developing industries in Mongolia. The project targeted both private and state-owned technical and vocational schools.

The original compact agreement between MCC and the Government of Mongolia included an investment into Mongolia's antiquated freight rail system. In 2010, the Rail Project was withdrawn from the compact and the funds reallocated. The VET Project received a significant increase of funding through this reallocation, close to doubling its original budget[14, 15].

The expansion of the VET project through the reallocation of funds resulted in the following five complementary components and sub-activities:[16, 17]

Component 1: Policy and operational framework reform

This component was designed to strengthen the policy and operational framework, to create an efficient governance and standards system and to secure private sector participation for TVET.

Sub-activity 1.1: Develop a competency based TVET training system responsive to market demand

Sub-activity 1.2: National Competitive Grants were provided to encourage the dissemination of best practices at schools. 28 grants worth a total of $2 million USD were disbursed to 26 recipient schools. Finally, one-year long twinning programs were established between three Mongolian and three Australian vocational schools.

Sub-activity 1.3: In 2009, the government of Mongolia enacted a new law on vocational education and training. It established a new body of oversight staffed equally with public and private sector representatives. 2,500 government officials received training on the new law and policies and over 600 managers from 34 TVET schools attended trainings on improved management skills.

Component 2: Creation of skills standards and competencies system

Sub-activity 2.1: Development and piloting of the "Competency-based" curricula (CBC). This component aimed to establish and implement national skills standards and a competency-based qualification system. 28 new curricula in the mining, construction and health sectors were developed from 2010 to 2011. Over 150 expert workers and 50 employer and industry representatives were involved in identifying the competencies their trades required and integrating these labor market demands in the updated curricula.

[14] Millennium Challenge Corporation, 2009
[15] See Section I.C for more details on the costs of the VET Project
[16] Compact Amendment page 14, "Annex I – Summary of Program – C. Vocational Education Project, 2. Activities"; More information on MCC's activities can also be found at: https://www.mcc.gov/where-we-work/country/mongolia
[17] The overview of activities is sourced from an informational pamphlet produced and distributed by MCA-Mongolia, and MCA-M quarterly progress reports

A total of over 2,300 TVET instructors received training on the use of new equipment, media and technology.

Sub-activity 2.2: A policy document establishing a National Vocational Qualification Framework (NVQF) was developed to guide the future development of a standardized framework.

Sub-activity 2.3: Establish and maintain National Learning Resource Center (NLRC). The Mongolian-Korean College, a TVET school in Ulaanbaatar, was chosen as the host of the NLRC. The NLRC's responsibilities are to develop new instructional material, train teachers and disseminate new knowledge to the TVET sector. The 6 Regional Methodological Centers were established to help the knowledge dissemination process.

Component 3: Competency-based training system

Sub-activity 3.1: Implementation of a Competency-Based Training System in Mongolia through Professional Development Training for Administrators, Instructors and Teachers. The new competency-based training (CBT) system had several aspects. After a successful pilot program in 2009, a competency-based training system was developed for fields in mining and construction to make teaching in these trades groups more relevant to the workplace. 308 administrators, managers and instructors from 50 TVET schools took part in English courses to improve their technical knowledge of the language to help them make more efficient use of the training equipment and other materials provided by MCA-M.

Sub-activity 3.2: instructional media equipment was procured and multimedia content developed for the implementation of the CBT.

Component 4: Career guidance system and labor market information systems development

Sub-activity 4.1: Labor Market Information System. A labor market survey was carried out in 2010 to determine the current and future state of labor market demand in Mongolia. The data served as the basis for the Labor Market Information System and Career Guidance System, both developed in 2012. The Career Guidance System is online, accessible under http://www.hzzm.mn.[18]

Component 5: Improvement of learning environment

Sub-activity 5.1: Equipment upgrades. 28 vocational schools in 16 provinces benefited from this sub-activity. 24 schools received modern training equipment for trades such as heating, plumbing, electricity and electronics, heavy machinery operation and lathing[19]. They were also equipped with modern multimedia labs and equipment.

Sub-activity 5.2: Construction and Rehabilitation activities. 20 new workshops for applied classes were built in 5 schools and 44 workshop spaces modernized in 12 schools.

Some of the components focused directly on increasing student productivity while others were meant to increase school-level productivity as measured by sustained private-public partnerships and non-governmental funding for the TVET sector. Increases in school-level productivity were meant to increase employability and wages of TVET school graduates as schools produce graduates more suited to the demands of the workplace. Activities in the first project component area, *Reforms to TVET policy and*

[18] At the time of writing, the Career Guidance System webpage was not accessible online.
[19] See Table 46 for the list of trades affected by MCC-sponsored equipment upgrades

operational framework activities, were designed to increase the management capacity of TVET schools, which should improve school management. This improvement, with an increase in partnerships between training institutions and employers as promoted by the National Competitive Grant Program, was intended to increase private funding and eventually lead to sustained private-public partnerships. Development of competency-based curricula standards and training teachers and administrators were meant to improve the quality of instruction at TVET institutions.

Improved instruction and improved learning environment—outcomes of equipment upgrades and the construction and rehabilitation of facilities—were intended to enhance the learning outcomes of graduates and make them more suited to the demands of employers. The improved match between the skills of graduates and the needs of employers should in turn increase graduates' employability and wages. See Section II.B for the project logic associated with Sub-activity 5.1, equipment upgrades, which this evaluation focuses on. The Labor Market Information System and career counseling should reduce the possible mismatch between the skills students acquire and the employment opportunities sought by graduates. The expected key student-level outcomes for the VET project are increases in employment and productivity as measured by their wages.

1. Project Participants

The VET project was national in scope and its activities aimed to reach all of Mongolia's vocational students and staff. TVET policy reforms, for example, affected all TVET institutions, albeit to different extents depending on whether they were private or public and the kinds of trades they offered. Other activities were focused on sectors such as mining, which affected schools that offer trades most relevant to that sector more than those that focused on other areas. The curriculum update and equipment upgrade components of the project focused on implementing their activities in priority sectors, with the result that the various trades taught at vocational schools did not experience the same intensity of intervention. Although 28 competency-based curricula were developed for use by teachers in any TVET institution in Mongolia, these 28 curricula pertained to trades in seven priority sectors: construction, agriculture, mining, food and light industry, energy, information technology, and transportation. Similarly, upgraded equipment and renovated facilities focused on nine priority trades: heavy machinery operator, welding, plumbing, electricity and electronics, lathe-milling, heating and air conditioning technician, mining, health, and construction.

2. Geographic coverage

Institutional reforms, curriculum development and teacher training activities were implemented nationwide. The VET Project's material investments in improving learning environment included 20 of Mongolia's 21 provinces. Equipment upgrades affected schools across 15 provinces and schools in 15 provinces participated in the National Competitive Grants Program. Regional Methodological Centers were established in four provinces to serve as hubs for the northern, southern, eastern and western regions of the country[20]. Three Centers of Excellence were created in two provinces with the aim to make them model schools with practices for other TVET institutions to emulate[21][22].

[20] Two of the Regional Methodological Centers are also Evaluation schools: Dornod Phased VTPC and Orkhon VTPC
[21] None of the Centers of Excellence is also an Evaluation school
[22] See Table 44 in Appendix A for the list of Regional Methodological Centers and Centers of Excellence

Between 2008 and 2013, 57 private and public schools in urban and rural areas benefitted from some type of MCA-M assistance. 26 schools were part of the competitive grant initiative, and training activities were conducted in 51 schools. Training activities included English language lessons for school staff, industry-specific instructor trainings and a professional development training for administrative and teaching staff. The full table of the 72 schools in Mongolia at the time of MCA-M's intervention and the type of assistance they had received as of 2012 if reproduced in Table 2 below.

Table 2. Mongolia's 72 TVET Schools: Total Number of Students, Teachers, and Trades (2011-2012). TVET evaluation schools highlighted in blue[23]

Category	School Name	# of Students	# of Teachers	# of Trades	MCA Intervention			
					Grant	Training	Equipment	Infrastructure
State-Owned VTPC	Arkhangai VTPC	764	46	24	√	√	√	√
	Bayan-Ulgii VTPC	1218	56	18		√	√	√
	Bayankhongor VTPC	1681	56	29		√		
	Bulgan VTPC	527	39	15	√			
	Gobi - Altai VTPC	893	54	23		√	√	√
	Dornogobi VTPC	743	40	-	√	√		
	Dornod VTPC	493	34	18			√	
	Dornod Phased VTPC	1046	45	27	√	√	√	√
	Dundgobi VTPC	862	41	30	√	√	√	√
	Zavkhan VTPC	914	47	25		√		
	Umnu Gobi VTPC	809	40	31	√	√	√	√
	Selenge VTPC	370	20	10			√	√
	Selenge Shaamar VTPC	326	22	16				
	Tuv VTPC	557	25	14		√	√	√
	Tuv Shaamar VTPC	405	18	12				
	Khuvsgul VTPC	929	38	27	√			
	Khentii VTPC	832	37	31	√			
	Orkhon VTPC	1027	44	32	√	√	√	√
	Darkhan VTPC	1229	59	19	√	√	√	√
	Darkhan Urguu VTPC	1380	51	32	√	√		
	Nalaikh VTPC	1066	49	19	√	√	√	√
	Gobisumber VTPC	697	32	15		√	√	√
	Selenge Zuunkharaa VTPC	557	27	9				
	Art and Production VTPC	1574	81	41				
	Tumur zam VTPC	607	16	10				
	Tuv Erdeme Soum VTPC	300	13	9				
	Selenge Sant VTPC	211	25	8				
	Bulgan Agricultural VTPC	100	12	-				
Private VTPC	Donbosco VTPC	315	24	10				
	Abuka VTPC	396	21	7				
	Arkhangai Bulgan VTPC	493	13	13				
	Bayankhongor Ulziit VTPC	437	9	5				
	Anima VTPC	39	4	3				
	Amidrakh Ukhaan VTPC	183	10	7	√			
	Khamag Mongol VTPC	740	17	11				
	USI VTPC	50	6	3	√			
	Baz School VTPC	739	21	9				
	INI VTPC	37	9	2				
	Dornogobi Tumurzam VTPC	155	10	4				
	Altangorkhi VTPC	60	4	2				
State-Owned College	Music and Dance College	197	84	7				
	Zavkhan Music and Dance	76	27	6				
	Mongol Korean College	1968	77	27	√	√	√`	
	Mongol Korean College in	448	36	11	√			

[23] Source: MCA-Mongolia

Category	School Name	# of Students	# of Teachers	# of Trades	MCA Intervention			
					Grant	Training	Equipment	Infrastructure
	Ulaangom College	1515	72	35	√	√	√	√
	Khovd Politechnical College	1499	68	35			√	√
Private College	Mongol Farming College	220	12	7	√			
	Khangai College	510	11	13				
	Construction Technological	1088	31	12	√			
	Technical and Technological	1864	54	31	√	√	√	√
State-Owned	Culture Institute	33	4	1				
	Tumur zam Institute	654	-	7				
Private Institute	New Civilization Institute	328	17	5				
	Mongol Business Institute	160	10	3				
	Technology Institute	2534	90	20				
	Monos Institute	65	10	1				
	Enerel Institute	285	16	-				
State-Owned University	MUST- Uvurkhangai Technology	1487	51	27	√			
	MUST- Sukhbaatar Technology	593	19	27				
	MUST- Technology University	138	11	4				
	MUST- MIS University	621	17	9				
	MUST- UDTS University	105	2	1				
	MUST- Ulaanbaatar Politechnic	1833	71	20			√	√
	MUST- Darkhan Politechnical	632	22	20				
	MUST- Bor- Undur VTPC	333	12	7				
	Agirultural University- Darkhan	51	8	1				
	Agirultural University- Orkhon	440	23	8				
	NUM- Food University	240	10	7				
	Health- Gobi-Altai University	671	-	6				
	Health- Dornogobi University	299	-	5				
	Health- Darkhan University	1277	-	7				
Private	Ikh Zasag University	209	13	2				

B. Focus of the Evaluation and Project Logic

While all aspects of the VET Project described above were considered, the equipment upgrades component was identified as the only candidate for rigorous evaluation. Some of the project components directly affected, or were at least available to, all schools. Others, such as providing computers for administrative purposes, were deemed unlikely to have a direct effect on students' academic or job market performance The equipment upgrades were provided to specific trades and implementation was rolled out over a three-year period. Variation in timing and the selection of schools that received equipment upgrades as well as the supposed direct benefit that students would receive from training on modern equipment made the equipment upgrade component a good candidate for evaluation. See Table 5 for the dates equipment upgrades were delivered to this study's Evaluation schools and Table 46 in Appendix A for the list of trades affected by each type of upgrade.

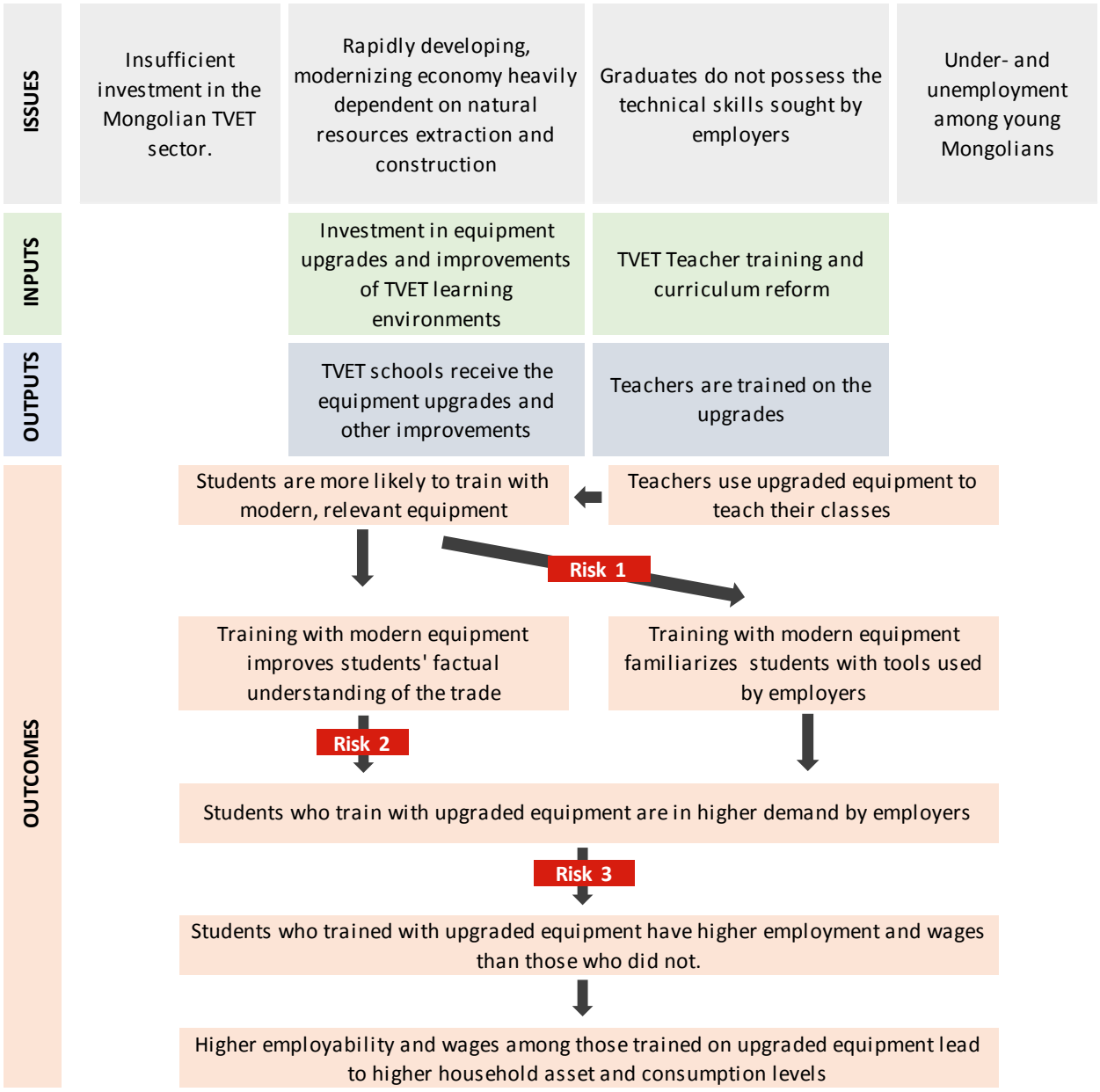
The project logic prepared by Innovations for Poverty Action is shown in Figure 6 below. Following the material investments, teacher training and curriculum reforms should have been received by schools, and teachers expected to teach using the upgraded equipment. Students in classes that received equipment upgrades should be more likely to train with modern, relevant equipment. The combination of a better factual understanding of trades and familiarity with tools used by employers is hypothesized to make

students more attractive to employers, leading to higher wages and higher rates of employment compared with students who did not train using upgraded equipment.[24]

Figure 3. Equipment upgrades project logic (Innovations for Poverty Action)

[24] Economic theory predicts that, under the assumption of perfect competition, workers should be paid their marginal product; i.e. what they contribute to the production process. So if workers are more productive because of their training, they should earn more accordingly. Employers may be able to appropriate the returns to training if such training is specific to their firm or if the employer can prevent other firms from "poaching" the workers. However, to the extent that the training received is more general and useful to many firms in a given industry, it is unlikely that employers can appropriate much of the returns to training.

Technical and Vocational Education and Training (TVET) Project
Equipment upgrades project logic



In addition to the impact on employment and wages, the intervention might also have effects on graduates' household assets and consumption levels. Higher income would allow graduates to purchase various household assets, increase consumption, and provide general support to the household. However, we do not anticipate strong short-term effects on household assets and consumption. Over time, with demonstrated wage increases and employability of graduates, it may be possible to detect effects on household assets and consumption in longer-term follow-up surveys. For now, we focus on wages and employment as the main outcomes of interest.

As highlighted in Figure 3 above, the project logic includes risks that were not directly monitored:

> Risk 1 refers to the assumption that equipment provided by MCC is the same as that used by potential employers. The VET project did not monitor the characteristics of and possible changes in labor markets during and following the implementation of the equipment upgrades and other improvements in the schools' learning environments.
>
> Risk 2 is closely associated with Risk 1: the assumption that employers value the training on the equipment provided by TVET schools over doing the training themselves.
>
> Risk 3 refers to the assumption that employers can identify students who were trained on upgraded equipment and prefer such students to those who did not.

The assessment of these risks would have benefitted from a labor market survey targeted at employers of vocational school graduates in Mongolia, particularly one directed at sectors the equipment upgrades were aimed at, such as mining and construction. MCA-M contracted Cambridge Education Ltd. (UK) and MEC LLC (Mongolia), two research organizations, to conduct a labor market study from 2009 to 2010. The study helped inform VET project activities but did not explicitly address the assumptions associated with risks 1-3 above.

MCA-M also implemented activities associated with the labor demand side. A public information and outreach campaign was conducted with the aim of raising awareness of the TVET sector among the public and to promote the perception of a demand-driven TVET sector. The campaign was discontinued in 2013, before the end of the first Mongolia Compact. This study's sample of students with the most exposure to equipment upgrades weren't expected to graduate until 2014-2015, at which time awareness of the reforms could have faded or the needs of the labor market changed relative to projections at the time of the investments.

These risks do not affect this evaluation's methodology. The inability to test the assumptions does, however, make it less straightforward to assess at which stage implementation problems may have happened that adversely affected the outcomes associated with the project logic. For the benefit of future evaluations, it is recommended to increase the level of detail in project output that would have led to farther reaching project output monitoring.

MCA-M's project logic associated with equipment upgrades focused on the delivery and installation of the upgrades at the selected schools. For this evaluation in particular, it would have been valuable to include monitoring of aspects that followed the delivery of equipment upgrades to TVET schools. A more detailed project logic at the time of implementation may have led to more monitoring and documentation of the trainings teachers received on the upgrades, whether teachers had the knowledge and capacity to use the upgraded equipment in classrooms and more details on the longevity of the new equipment and availability of fuel and spare parts. This information would have enabled a more thorough assessment of the outputs and outcomes in 4. Section VI.F provides more discussion on how the estimated impacts inform this study's project logic.

C. Link to Economic Rate of Return (EER) and Beneficiary Analysis

Table 3 breaks down the costs of the different components of the VET project. Originally budgeted at USD $25,512,856, the 2009 expansion brought the total disbursed amount to $49,322,727. The original plan allocated the largest portion of funds to competency-based training and skills standards activities. Most

additional funding was allocated to Component 5, Improvement of Learning Environments, which included equipment upgrades as Sub-activity 5.1. Table 3 below shows the final VET project implementation costs by component.

Table 3. VET program costs after the expansion[25]

Component	Cost (USD)
Career Guidance System Activity	$ 1,883,536
Competency-Based Training System Activity	$ 13,837,760
Improvement of Learning Environments Activity	$ 21,795,971
Industry-Led Skills Standards System Activity	$ 3,197,482
Project Administration Costs	$ 3,048,545
TVET National Framework Activity	$ 5,559,434
Total	**$ 49,322,727**

MCC conducted an analysis of the expected Economic Rate of Return (ERR) at compact closure, projecting a total rate of return from all activities of 20 percent[26]. This assumed that the projects would result in a six percent increase in the number of graduates from TVET institutions between 2007 and 2012, an 8.3 percent increase in wages and five percent increase in probability of employment.

As noted in Section II.A and above, the VET Project received a significant increase in funding in 2009. A large portion of the VET Project's additional funding was channeled into the sub-activity this evaluation focuses on: Equipment upgrades at 28 TVET schools, including all 10 evaluation schools. At the time of writing, the last available version of the MCC Economic Rates of Return (ERR) projections for the individual VET Project components dates from 2007, before the project's expansion. Because there are no projected rates of return associated with the equipment upgrades, we are not able to present a meaningful comparison with our findings.

This evaluation focuses on the effects of equipment upgrades on beneficiaries as measured by the marginal impact of training with upgraded equipment on graduates' wages and employment. We are thus not able to assess the accuracy of the overall ERR projections for the full package of projects. We do provide relevant statistics for the equipment upgrades, such as estimates of the difference in the probability of employment, the increase in wages, as well as the probability of working in the professions in which a student is trained. For more information on the evaluation design, please consult the Evaluation Design Report.

D. Implementation Summary

1. Implementation Monitoring

The VET Project's implementation was monitored by MCA-Mongolia and subject to external evaluation. Table 2, shows Mongolia's TVET institutions (at the time of the VET Project's implementation) and which, if any, MCA-M interventions they received. Table 4 below shows the VET Project implementers and contracts they were responsible for.

[25] Source: MCC A&F

[26] Millennium Challenge Corporation, 2013. Estimated benefits also available here: https://www.mcc.gov/where-we-work/program/mongolia-compact#mn-vocational-education-project

Table 4. List of MCA-M VET Project Contractors[27]

Contractor name	Contract
ABU Consult Berlin GmbH	National Vocational Qualifications Framework, Competency Based Curriculum and National Learning Resources Development in support of Demand-driven TVET system in Mongolia
Egel LLC, Chuluutin bagsh LLC, Baldans LLC, Bridge construction LLC, Ochirtaab LLC	Design and Oversight Consultant for New and Rehabilitation of existing TVET Schools and Centers of Excellence
Wagner Asia Equipment LLC, Mongolia	Training of 6 Trainers as Heavy Machinery Service Technicians
Nomin Holding LLC, Inter science LLC, Medimpex LLC, KPM LLC, ED corporation (Korea), MCS electronics LLC, Anun LLC	Supply of training equipment and furniture for 17 TVET schools
Tsagaansumber LLC, Agayin LLC, Uran okhid LLC, Burkhant LLC, Sinchi oil LLC, DCH LLC, Hyasaat Bersum LLC, Ekbis LLC, Naran ord LLC, PGS LLC, Delger construction LLC, Gurban khajinga trade LLC, Sindicat LLC, B Soft LLC, Dugant bar LLC, NAB LLC	Civil works contract for 12 workshop rehabilitations and 5 workshop constructions
Institute of Finance and Economics, Mongolia	Education and Training Contractor for Management Capacity Building Plan
MUST, Mongolia	Multimedla Technical Instructional Content Development
Gopa Consultants, Germany	The implementation of a Competency-Based Training System in Mongolia; Professional Development Training for administrators, instructors and teachers
Arigumedia LLC, Star TV, Mogolia	Public Outreach Program on increasing Public Awareness of the Social Value and Impact of TVET
Holmesglen, Australia; Central Queensland Institute of TAFE	Twinning Program for three TVET schools
Summit Computer Technology LLC, Mongolia; MCS Electronics, Mongolia	Instructional Media Equipment for 10 TVET schools
Interactive LLC, Mongolia	National Learning Resource Center (NLRC) online Platform Development for the TVET Sector of Mongolia
Ogawa Seiki Ltd, Japan; ED Corporation, Korea; Nomin Holding LLC, Inter science LLC	Supply of core technology equipment for 5 TVET schools
Mongolian-Korean Technical College, Mongolia	Establishment of NLRC, Mongolian-Korean Technical College
Mongolian Employer's Federation, Mongolia	Introduction of activity based costing technique to support LEVY system in TVET Mongolia

The gradual rollout of equipment upgrades to TVET Evaluation schools was of particular importance to this study's research design. Table 5 below summarizes the delivery dates of the different types of equipment received by this study's 10 evaluation schools, provided by MCA-M[28]. See Table 4 above for

[27] Source: MCA-M VET Project information pamphlet

[28] The delivery dates for equipment upgrades received by non-Evaluation schools are shown in Appendix A, Table 45

the names of the contractors responsible for the upgrades. Equipment deliveries began at the end of 2011; the last upgrades were delivered in August 2013.

Table 5. Date of MCA-M Equipment Upgrades by TVET Evaluation School

	Heavy Machinery	Lathe-Milling	Electricity & Electronics	Plumbing	Welding	Heating & Cooling Technology	Hydraulics & Pneumatics	Concrete & reinforcement	Auto mechanical training
Gobi-Altai VTPC	2/2012			3/2012	7/2012		8/2013		8/2013
Dornod Phased		5/2012		3/2012	10/2012				
Dornod VTPC	8/2013		8/2013						8/2013
Darkhan VTPC		4/2012	7/2013	3/2012	4/2012	12/2011	7/2013		
Orkhon VTPC		4/2012	7/2013	3/2012	10/2012				
Bayan-Ulgii VTPC			3/2012	3/2012	6/2012			12/2012	
Umnugobi VTPC	1/2012	7/2012	3/2012		8/2013		8/2013		
Construction college		10/2012	7/2013	3/2012	7/2012	1/2012			
Mongol-Korean	8/2013						7/2013		
Ulaangom VTPC		6/2012	3/2012	3/2012	6/2012				

As described in the Evaluation Design Report, the focus of the evaluation shifted to the effects of training with upgraded equipment after the new equipment had been installed in all schools selected for upgrades. The original evaluation design did not include a component targeting the effects of equipment upgrades. At the time of the implementation, IPA thus did not monitor first-hand whether equipment upgrades were installed according to schedule, whether teachers of trades affected by the upgrades were appropriately trained on the new equipment and if they were able to integrate them into their lessons right away. MCA-M's direct monitoring of the equipment upgrades component was limited to the delivery and installation of the upgrades.

According to MCA-M monitoring reports, upgrades of some types of equipment at a few schools were delayed by a number of months but all were eventually delivered and installed. According to MCA-M's final Indicator Tracking Table (or ITT, a summary table of implementation monitoring) of the activities outlined as part of Component 5: Improvement of Learning Environment, the implementation of all sub-activities, including equipment upgrades, met or exceeded targets.

2. Implementation Data from Administrative Surveys

To gather detailed information on the characteristics of schools, teachers and staff and the implementation of the VET project, IPA and MCA-M designed a set of Administrative surveys for TVET school staff (more information on which can be found in Appendix B). The last and furthest-reaching round of these surveys was conducted in late 2013 and included questions about equipment upgrades and other learning environment improvements.

Data from the Secondary Information survey (one of the Administrative surveys) confirms that none of the schools that were not selected to receive MCC-sponsored equipment received upgrades from MCA-

M. A small number of schools that were not selected for upgrades received equipment from private companies.[29] Table 48 in Appendix A shows the full list of TVET schools that took part in the Secondary and whether they reported receiving new equipment.

As an additional check on the equipment component, IPA contacted all schools selected for upgrades in mid-2015 to verify they had received the upgrades according to MCA-M's implementation schedule. Due to staff turnover and incomplete school records, most but not all equipment deliveries and installations could be confirmed. There was, however, no instance of school staff denying their school had received an upgrade[30].

Through the Teacher Survey, another component of the Administrative Surveys, close to 1,000 teachers at 50 TVET schools were interviewed to help gauge whether the equipment installed at selected schools was being used in classrooms. Figure 4 shows the distribution of all TVET school teachers' perceptions of the condition of equipment in classrooms in 2009 compared with 2013.[31] About 50 percent of teachers reported equipment to be of sufficient quality for teaching in 2009, compared to 75 percent after all upgrades had been delivered in 2013. The proportion of teachers deeming schools' equipment to be of insufficient quality fell by half compared with their perception of equipment available in 2009.

Figure 4. Quality of equipment in classrooms in 2009 and 2013 (Teacher Survey Wave 3; N=627 TVET school teachers)

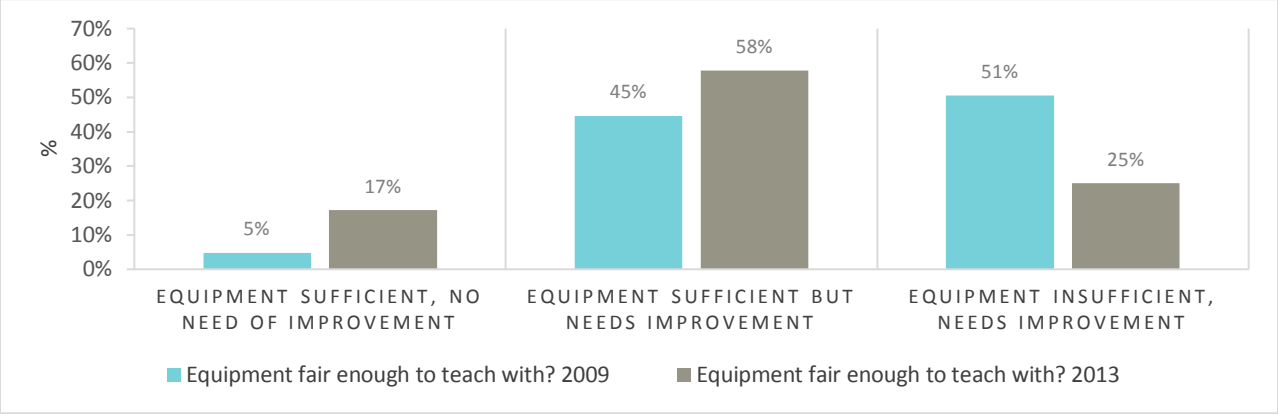
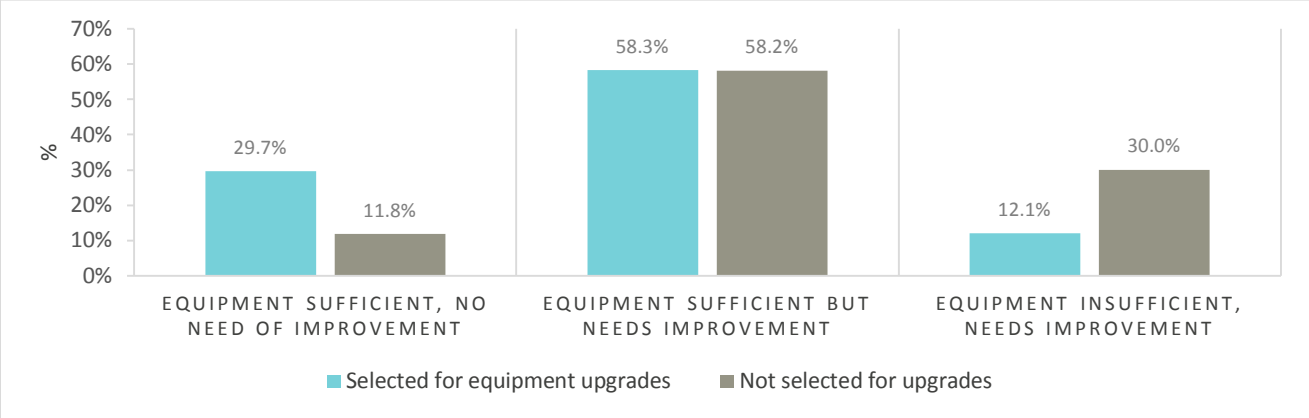


Figure 5 shows the difference in perceptions of the quality of equipment in classrooms (regardless of whether teachers use equipment in their lessons) at schools selected for equipment upgrades compared to non-upgraded schools. 30 percent of teachers at upgraded schools stated their schools' equipment didn't need further improvement, an opinion shared by just 12 percent of teachers at non-upgraded schools.

[29] One school reported receiving four pieces of training equipment from the Asian Development Bank.
[30] On a more anecdotal note, IPA Mongolia staff visited all TVET evaluation schools over the years 2012-2015 and were shown the equipment that had been upgraded by school employees. In some cases, we observed classes that included teaching on upgraded equipment. These visits were not, however, documented systematically.
[31] Figure only includes data from teachers employed at their school since 2009 or earlier.

Figure 5. Quality of equipment in classrooms in 2013 in upgraded schools compared with non-upgraded schools (Teacher survey Wave 3; N=996 TVET school teachers)



Narrowing the sample to teachers who reported using training equipment in their classes and had been at their school since 2009 or earlier, Table 6 shows the distribution of answers about the condition and relevance of the equipment at their disposal before and after it was upgraded. Nearly all teachers reported improvements in relevance and condition since the upgrade.

Table 6. Relevance and condition of equipment before and after upgrade (Teacher survey Wave 3)

	Before upgrade (2009)	**After upgrade (2013)**
Relevance of equipment	*N=323*	*N=347*
Best	4.2%	81.8%
Decent	51.3%	18.5%
Outdated	30.9%	1.2%
Unusable	7.0%	0.6%
Condition of equipment		
Best	0.6%	34.8%
Good	8.1%	61.4%
Average	48.5%	6.9%
Bad	28.7%	0.6%
Worst	10.6%	0.3%

Note: Percentages may not sum to 100% as multiple teachers per school gave their impressions of up to 5 pieces of equipment they used. Number of respondents in two columns differs because not all teachers had access to equipment before the upgrades.

Further, TVET teachers reported that three-quarters of their equipment upgrades were provided with usage guidelines and materials. As to whether MCA-M upgrades were utilized in schools that received them, teachers reported an average of 31 students per day using the upgrades during classes and about 7 per day making use of them after classes (Table 7 below).

Table 7. Equipment upgrade characteristics at recipient TVET schools (Teacher survey Wave 3)

Equipment upgrade characteristics at recipient TVET schools	(*N=292)*
Percentage of equipment upgrades provided with accompanying usage guidelines and materials (%)	76%
Average daily number of students who use the upgraded equipment *during* class	30.9
Average daily number of students who use the upgraded equipment *after* class	7.2

The Administrative Secondary and Teacher Surveys broadly confirm MCA-M monitoring data on the delivery and installation of equipment upgrades. Teachers of classes that make use of equipment report it to be in regular use and students seem have access to it. Further, the data confirms that most equipment upgrades delivered by MCA-M were accompanied with usage guidelines and materials. Although it would have been preferable to possess in-person monitoring data on the utilization of upgraded equipment from the time of delivery and installation, the information at our disposal does not raise concerns that would affect the evaluation's methodology.

III. Literature

A. Existing Evidence

The empirical evidence on the returns to technical and vocational training (TVET) covers a wide range of different types of vocational training in a variety of contexts and countries. This section will describe two broad strands of this literature that are most relevant for the current project: (1) the debate about general secondary education versus vocational training for development policy, and (2) recent randomized evaluations of vocational training in middle-income countries.

1. General education vs. vocational training in development policy

During the 1990s, the World Bank adopted a policy that supported general education rather than school-based vocational training. This policy affected funding for vocational programs in many developing nations and was based on a large number of international case studies. For example, the 1995 World Bank Education Sector Review concluded that "comparative evaluations of earlier, more differentiated, general and secondary education curricula indicated clearly that the rate of return was much higher to investments in general than in vocational secondary education." (IBRD, 1995, p.8) This conclusion was heavily influenced by the extensive reviews of the prevailing research in Zymelman (1976), Psacharapolous (1987, 1993), and Tilak (1988). However, as noted by Bennel (1996), "sample selection bias...is a pervasive weakness of almost all the...studies utilized in the 1993 global update." This is because many of the studies in these reviews compared across individuals who were tracked into general education and vocational schools based on ability.

In a paper that attempts to address the problem of selection bias, Malamud and Pop-Eleches (2010) examine a 1973 educational reform on Romania that essentially shifted secondary-school students from vocational training to general education. They find that men in cohorts who were more exposed to general education and those more exposed to vocational training had very similar levels of labor market participation and earnings in 1992 and 2002 (approximately 20 and 30 years later). These findings are in sharp contrast to potentially biased cross-sectional results where general education is associated with significantly better labor market outcomes than vocational training. While this study did not conduct a full cost-benefit analysis to estimate the relative returns to general education and vocational training, it does suggest that some caution is warranted before rejecting vocational training as a tool for effective development policy.

2. Recent randomized evaluations of vocational training

There have been a number of recent randomized evaluations of technical and vocational training (TVET) programs in middle-income countries. These studies are summarized below with a particular focus on the target population, the characteristics of the vocational training, and the main findings:

- Hirshleifer et al. (2014) evaluate the impact of vocational programs for the unemployed provided through the *Turkish National Employment Agency* (ISKUR). Both public and private vocational programs average approximately 340 hours over 3 months. They use an over-subscription design and find that being assigned to training leads to a positive but insignificant effect on overall employment (2%) and income (5.6%) one year after completing training.
- Card et al. (2007) evaluate the *Juventud y Empleo* initiative in the Dominican Republic which provides low-income youth with vocational training by private institutions up to a maximum of 350 hours. They

find no impacts on employment outcomes but some evidence of a modest (10%) effect on earnings per month among those who are working.

- Attanasio et al. (2011, 2015) evaluate the *Jovenes en Accion* program, which provided three months of in-classroom training and three months of on-the-job training to low-income unemployed youth in Colombia. Following up on these youth 13 to 15 months after they would have completed their training, they find that women randomly offered training earn almost 20 percent more in wages and have a 7 percent higher probability of paid employment than those not offered training. None of these outcomes are significant for men. The impacts remain significant in administrative data up to 10 years later.
- Hicks et al. (2013) randomly provided vouchers worth US$460 to cover all (or almost all) of the tuition costs for private and government vocational programs in Kenya. The sample consisted of 2,160 out-of-school Kenyan youths between 18 and 30 years of age; the majority (78%) chose courses of 2 years or more, while 20% chose courses of 1 year or less. There is mixed evidence that the program affected total earnings with negative impacts several months after completing training but positive impacts a year later (which only significant in some specifications). There is also some evidence of a significant increase in wage earnings among those who earned wages.

It is important to distinguish between formal vocational programs lasting at least a year that take place in schools and less formal programs targeted at unemployed youth which last only a few months at a time.[32] Among the studies listed above, only the Hicks et al. (2013) evaluation of vocational training in Kenya includes formal in-school technical and vocational programs that last more than a year. Another relevant set of studies by Angrist et al. (2002, 2006) evaluate the PACES program which provided over 125,000 pupils in Colombia with vouchers for private secondary school. They find large positive impacts on educational outcomes and conclude that the PACES program was very cost-effective. Bettinger, Kremer, and Saavedra (2007) further note that the greatest impact of this program was in the private vocational sector, although this could also be due to the different types of students who chose to attend certain types of schools. Finally, there has been some research in the United States showing the effectiveness of career academies which provide vocational training to students in secondary school (Kemple and Snipes, 2000; Cullen et al., 2005).

B. Evidence Gaps

As noted in the previous section, there is remarkably little rigorous empirical evidence on the impact of formal in-school vocational programs. Moreover, few studies have examined the importance of access to proper equipment and infrastructure for vocational training programs. As far as we are aware, none have scrutinized the effects of improved equipment on students' wages and employment. MCC's investments improved existing educational infrastructure and the vast majority of TVET students would have applied to and attended TVET schools in absence of the reforms. One of the unique aspects of this TVET investment—and its evaluation—is the focus on reforming existing multi-year vocational programs at a national scale rather than creating new educational infrastructure or pushing unemployed youths into short-term programs they would not have otherwise attended. Thus, this study may be the first to

[32] In addition, there are several randomized evaluations of specialized vocational and apprenticeship programs in developing countries. These include programs that provided tailoring courses to women in the slums of New Delhi, India (Maitra and Mani, 2012), training on livestock management to women in Bangladesh (Bandiera et al., 2013), training for Ugandan women to run small businesses (Bandiera et al., 2014), apprenticeships to youth in Malawi (Cho et al., 2013), and cash grants to fund businesses or training in Uganda (Blattman, Fiala, and Martinez, 2013).

evaluate an improvement in the *quality* of an established vocational program. Finally, this study will contribute to the existing literature by being the first of its kind conducted in Central Asia.

This evaluation also stands out in terms of its breadth of scope and its intensive data collection effort over a relatively long time horizon. We follow three separate cohorts of applicants for up to 4 years after completion of their vocational training. In addition to collecting basic social, economic and demographic characteristics, the baseline surveys also included a general knowledge test to measure skill levels and academic performance cognitive skills. The follow-up surveys gathered standard information on education attainment, employment history and earnings, as well as household assets consumption, and expenditures. However, they also included standardized tests which measured trade-specific skills and may help us better understand the causal pathways that could explain the observed impacts. Together, this extensive data collection effort can serve to inform policy on vocational training in the future.

IV. Evaluation Design

A. Overview of the Design

As explained in section **Error! Reference source not found.**, equipment upgrades were identified as the only part of the VET reforms that lent itself to rigorous evaluation. Insofar as we were not able to randomly assign upgraded equipment across schools or trades, we could not estimate the impact of exposure to equipment upgrades directly. However, the gradual rollout of equipment upgrades to TVET schools over time implied that individuals in later cohorts studying trades affected by equipment upgrades were exposed to these upgrades for longer than individuals in earlier cohorts. This impact evaluation estimates the causal impact of exposure to upgrades equipment on subsequent outcomes using a quasi-experimental difference-in-differences methodology.

B. Evaluation Questions

The main question that the evaluation is designed to answer is: **What is the effect of learning and training with upgraded equipment on graduates' employability and wages?**

Consistent with the project logic model illustrated in Figure 4, we hypothesized that the equipment upgrades would improve students' employment prospects and increase their earnings. These changes could then improve the overall economic wellbeing of the household. The theory of change is straight forward. Receiving the equipment upgrades would cause students in treated trades to be more likely to train with improved equipment. This experience with modern, relevant equipment would improve their factual understanding of the trade and familiarize the students with the tools used by employers. Employers should then find students more productive than they otherwise would, making it more likely that students will be able to find employment and increasing the wages that employers are willing to pay them.

In addition to the primary intended outcomes of the projects, the intervention might also have ancillary effects on graduates' household assets and consumption levels. The higher income will allow graduates to purchase various household assets, increase consumption, and provide general support to the household. However, we do not anticipate strong short-term effects on household assets and consumption. Over time, with demonstrated wage increases and employability of graduates, it may be possible to detect effects on household assets and consumption in longer-term follow-up surveys.

C. Methodology

The simplest strategy to evaluate the effects of the equipment upgrades would be to compare the outcomes of students who studied trades that received the upgrades to students enrolled in trades that did not receive the upgrades. However, this approach faces two key limitations. First, students may self-select into specific trades. This raises the possibility that students in trades that received the upgraded equipment are different from those in non-upgraded trades. Second, trades differ in more respects than simply the receipt of equipment upgrades. The job prospects for students who study nursing, for example, is different from the job prospects for students who study automotive repair, regardless of whether one received upgraded equipment. Thus, simply comparing the outcomes of students who studied trades that received the upgrades with students enrolled in trades that did not receive the upgrades would likely be confounded by other differences.

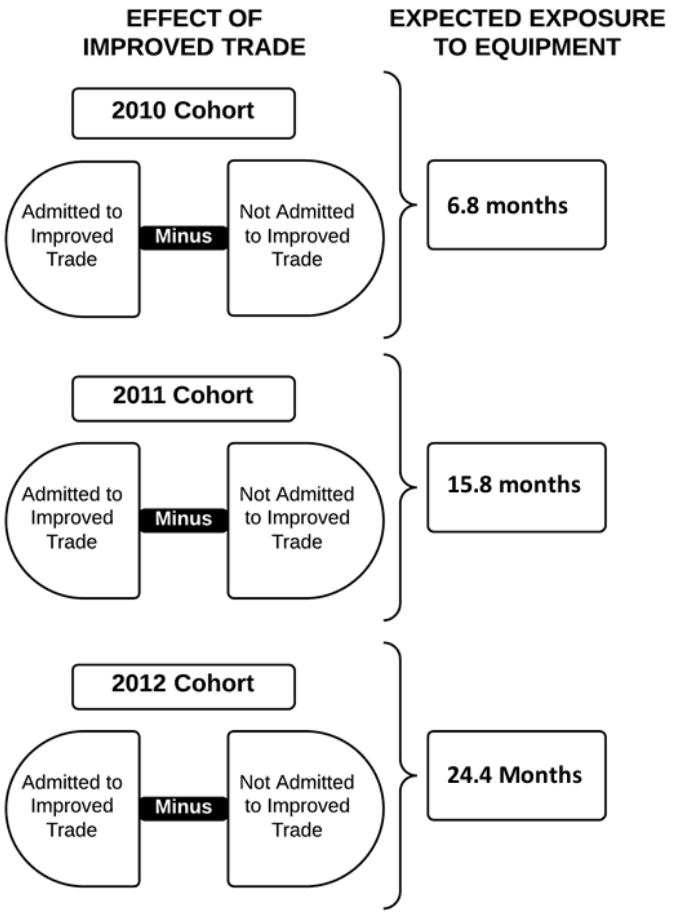
The ideal approach for addressing the two limitations described above would be to randomly assign applicants to schools and trades, and to randomly assign equipment upgrades across schools and trades. We were able to conduct randomized lotteries to determine admission of students to schools and trades. Unfortunately, randomizing equipment upgrades across schools and trades proved to be infeasible. Instead, we sought to take advantage of the gradual rollout of equipment upgrades to TVET schools over time and thereby exploit the variation in exposure to equipment upgrades across cohorts. We therefore proceeded to estimate the impact of exposure to upgraded equipment as follows:

Students were recruited in three annual cohorts from 2010 to 2012. First, all trades that received upgraded equipment—collectively referred to as "improved trades" or "upgraded trades"—were identified. The random assignment of students to improved trades was then used to estimate the effect of being offered admission to an improved trade for each of the cohort. This is done by comparing the average outcomes of students assigned to receive an offer of admission to an improved trade to those students who did not receive an offer. This effect is then compared across cohorts, exploiting the fact that the students in later cohorts were more exposed to equipment upgrades than students in the 2010 cohort. If students do benefit from the upgraded equipment, the effect of attending an improved trade should increase each year as each cohort is more exposed to the equipment. The research design thus ultimately involves the estimation of two levels of differences:

1. Comparing students admitted to an improved trade with those not admitted to an improved trade
2. Comparing the differential impacts of being admitted to an improved trade across cohorts.

This strategy is described in Figure 6. For each cohort, we use the random assignment of applicants to trades to estimate the difference in wages and employment rates. This is done by subtracting the average outcomes of those not admitted to the project from the averages of those who are admitted. This is depicted for each of the three cohorts by the semi circles representing the averages of each group that are differenced. The change in the probability of exposure to upgraded equipment is depicted in the second column, with the exposure increasing by cohort. The 2010 cohort would only be exposed to the upgrades for an average of 6.8 months, while the 2012 cohort could expect to be exposed for more than 24 months. Table 5 above shows the delivery dates of equipment upgrades for each evaluation school.

Figure 6. Evaluation Strategy



Consistent with the project logic model in Figure 3 above, we hypothesized that the equipment upgrades would improve students' employment prospects and increase their earnings. The theory of change underlying these impacts is as follows: Receiving the equipment upgrades would cause students in upgraded trades to be more likely to train with improved equipment. This experience with modern, relevant equipment should improve their factual understanding of the trade and familiarize the students with the tools used by employers. Employers would then find students more productive than they otherwise would, making it more likely that students will be able to find employment and increasing the wages that employers are willing to pay them.

It is important to emphasize that the research design for estimating the impact of upgraded equipment is not a true randomized evaluation. While students were randomized across schools and trades, the comparison across cohorts rests on the assumption that the effects of exposure to different trades would remain constant in the absence of the upgraded equipment. Any change in labor market opportunities across cohorts that differentially affects students exposed to "improved trades" would potentially confound our estimates. Unfortunately, there is no obvious way to completely eliminate this potential source of bias.

D. Admissions and Lottery Process

The admissions and lottery process negotiated between IPA and MCA-M and the participating evaluation schools proceeded as follows in accordance with the admissions regulations of each individual school.

To assist with the admissions process, IPA subcontracted a firm, Mongolian Marketing and Consulting Group (MMCG), a research and consulting firm and member of the European Society for Opinion and Marketing Research (ESOMAR)[33]. MMCG supported the collection of applications and performed the data entry of all information gathered. The application forms required applicants to rank their trade

[33] The European Society for Opinion and Marketing Research (ESOMAR) is an organization dedicated to encouraging, the advancement of market research worldwide.

preferences, which were then used in the lottery process described below to determine which applicants would be admitted to each trade.[34]

Lotteries were held in every one of the TVET Evaluation schools for each round and year of admissions.[35] The majority of lotteries were held as public events, open to applicants and other interested parties. In accordance with their internal policies and preferences, some schools decided to hold them as closed events in the MCA-M office in Ulaanbaatar. Before the lotteries, MCA-M and IPA confirmed the final number of slots available for each trade and the following criteria that factored into the lottery process:

Minimum and Trade-Specific Criteria

Each of the schools set the minimum criteria that applicants must meet to be considered qualified for admissions and thus eligible to be included in the lottery. Some schools had specific minimum criteria that applicants had to meet to be admitted into certain trades. For example, some schools required that applicants were of a certain age to be admitted to trades that were particularly physically demanding. Over the three years of admissions covered by this study, some schools made slight changes to their minimum admissions criteria.

Preferred Status

Some schools expressed the desire to guarantee admissions for highly qualified applicants that met certain criteria such as having a GPA of over 85 or participating in state Olympiads. In other cases, schools requested that applicants with guaranteed employment after graduation and disabled and disadvantaged applicants be granted a preferred status for admissions. All students identified by the schools as "preferred applicants" were guaranteed admission.

Repeat Applicants

To ensure all applicants received a fair and equal chance of being selected for admissions, it was determined that applicants who participated in a spring admissions round would not be eligible for the fall admissions round lottery at the same school. Participants of a lottery at one school were also not allowed to participate in a lottery at another evaluation school. These restrictions were adhered to in over 98 percent of cases, with just 229 duplicate or triplicate applications. More information on repeat applicants can be found in Section V.D.3 below.

The process remained consistent across the study's three cohorts of students.

IPA prepared a computer program that randomly assigned applicants into trade slots based on how they had ranked their trade preferences on the application form. For example, if there were three applicants eligible for the lottery who put down construction as their first ranked trade but only two spaces were available, the computer program randomly assigned two out of the three applicants to the construction

[34] While there were not many differences in the information schools collected from applicants, schools did differ in terms of the timing and the approaches used to collect applications. See Appendix C in the Admissions Baseline Report (2013) for a detailed description of the timeline and approaches employed by each of the schools. Most of the schools held two separate rounds of admissions—one in mid-May through early July and a second in late August. Additional information about the data collection process can be found in Section IV.

[35] See Table 47 for the date of each of the lotteries.

trade. The remaining applicants then went through the same process for her second ranked trade and so on. The higher students ranked a trade, the higher their probability of being accepted to that trade.

Lottery observers witnessed each of the lottery computer program's steps on a projection screen to ensure transparency. Everyone in attendance was walked through each lottery step during the event. After every step, a hard copy was printed and signed to verify and document the process. At the end of the process, the lists of trades with accepted students and the list of rejected students were provided to the school officials responsible for publicizing the lottery results. The full list of lottery steps can be found in Appendix A, Note 1.

E. Study Sample

The study sample includes 12,806 prospective students to the 10 schools participating in the study. Of these, 12,250 applicants were qualified for at least one of the trades to which they applied. These criteria included conditions such as a minimum grade point average (GPA) or subject test scores. The minimum qualification requirements varied from school to school and were determined by the school itself. Of the 12,250 applicants, another 526 met the conditions for guaranteed admissions, also designated by the schools usually due to superior academic performance or special talents.

Some applicants were randomly assigned to trades that received equipment upgrades. This group had potential to use upgraded equipment for varying lengths of time, depending on the admission year and the date that the trade received upgraded equipment. In comparison, the complement to this group includes applicants who were admitted to trades that did not receive upgrades and those who were not admitted to any trade at any school. Randomized admission to trades depended on applicants' ranked preference for various trades available at the school.

The 10 schools that were part of the study were not randomly chosen and are not a representative sample of TVET schools in Mongolia. In order to have randomized admission, schools that were recruited as part of the study had to have an applicant pool that was larger than the number of available admission slots. Thus, these schools were likely more competitive than the typical TVET institution in Mongolia. There were a total of 12 oversubscribed schools that were identified as potential partners for this study. All 12 schools were approached and ultimately 10 of the oversubscribed schools decided to participate in the study.

F. Timeframe and Data Collection Schedule

Students were recruited over three annual cohorts starting in 2010, covering applicants to both 1 year and 2-2.5 year programs. To measure the effects laid out in Section A above, three types of survey instruments were administered to students. Students of each cohort completed an Admissions survey in which they provided demographic information and took a simple aptitude test that IPA developed with the TVET schools. Students were then offered admission to a particular trade at the school they applied to or were rejected.[36]

[36] Lotteries were held at each participating school. The process started with excluding applicants who did not meet the minimum criteria for the school, and then screening them for their trade-specific eligibility. Admission to specific trades was then assigned from a pool of eligible applicants who applied for each trade; an applicant was admitted to the applicant's highest ranked trades in which admissions slots were still available. Appendix A provides more details on the lottery process.

Students then took part in a phone-based Tracking survey each year to update contact information and to collect basic information on their educational and job-related achievements. In the year after their expected graduation, each student completed an in-person Graduate Follow-Up (GFU) survey which includes all the information in the Tracking Survey, further questions about asset ownership, consumption, expenditure and other household activities as well as a written trade-based skills test. The skills tests contained technical questions specific to the trade students studied and general questions on numeracy and computer literacy.

A follow up period of up to 1 year after students' expected graduation[37] was chosen for several reasons. It is a widely used time frame for a first follow up survey to measure short term program effects, especially with measurements such as skills tests (more on which in Section IV. C. below) that rely on relatively detailed knowledge of the trades respondents had applied for. As the first in-person contact with respondents since their Admissions survey, which took place before 2.5 to 3 years prior, it was also chosen to minimize attrition. Finally, this study's evaluation design included tentative plans for additional rounds of data collection 3 to 4 years after the first in-person follow up to measure medium-term effects. These plans were eventually dropped due to the lack of effects on employment and income and the significant costs associated with additional field work.

After taking the GFU survey, students were followed annually through the Tracking survey. All data collection activities have now been ceased, with the last round of tracking and Graduate Follow-Up surveys completed in August 2015.

In addition to the student surveys, Administrative surveys were conducted with teachers and administrators at up to 50 TVET institutions over three years to capture characteristics such as school size, funding and availability and utilization of equipment.

See Appendix B for a more detailed description of this study's survey instruments. All data was collected according to the schedule described in Table 8 below.

[37] The main analysis was conducted on data gathered from TVET applicants to 2 or 2.5 year programs. An applicant to a 2.5-year program was administered the Graduate Follow Up survey 3-6 months after her expected graduation date. An applicant to a 2-year program was interviewed about 9-12 months after his expected graduation. The range reflects the amount of time survey rounds took to complete. 1-year applicants were interviewed about 9-12 months after their expected graduation.

Table 8. Data Collection Schedule

		Year of Data Collection				
			Wave 1	Wave 2	Wave 3	Wave 4
Cohort	**Program Duration**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**
2010	1 year	Admissions Administrative Tracking	Grad FU	Grad FU[38]	Tracking	Tracking
	2/2.5 year	Admissions Administrative Tracking	Tracking	Grad FU	Tracking	Tracking
2011	1 year		Admissions Administrative Tracking	Grad FU	Tracking	Tracking
	2/2.5 year		Admissions Administrative Tracking	Tracking	Grad FU	Tracking
2012	1 year			Admissions Administrative Tracking	Grad FU	Tracking
	2/2.5 year			Admissions Administrative Tracking	Tracking	Grad FU

G. Policy Relevance

More than half of MCA-M's investment in the TVET sector paid for equipment upgrades and improvement of training facilities. This costly investment was made under the assumption that hands-on training on modern equipment in classroom settings was a critical aspect of turning out graduates who would succeed in the labor market. Understanding the real effect of learning on modernized equipment will help Mongolian policy makers and international donors to assess the relative value of investing in equipment upgrades, which tend to be the costliest investment in the TVET sector, in relation to other potential areas of investment such as teacher training, curriculum development, and private-public partnerships.

Globally, this research complements the existing literature on vocational education programs in developing countries. For example, while existing studies on vocational education focus on understanding the effect of the entire vocational education program, there is no evidence regarding the effectiveness of specific components of vocational education such as training on relevant and modern equipment.

[38] The Graduate Follow-Up Survey was administered twice to the 2010 cohort of applicants to 1 year programs. The Graduate Follow-Up Survey was revised after round 1 and it was decided to re-administer it to the 2010 1 year cohort to ensure students were assessed using comparable survey instruments.

V. Data Collection

This section covers the data collection process for the tracking, Graduate Follow-Up and administrative surveys and only briefly covers the admissions baseline surveys of 2010, 2011 and 2012. For a detailed overview of the admissions survey data collection procedures, please consult the Admissions Baseline Report (2013). See Appendix B for a summary of modules included in each of the survey instruments.

A. Contracting

Prior to each round of data collection, a Request For Proposals (RFP) to gather bids from Mongolian data collection companies was released. The company would be responsible for the following:

- Translate and pilot survey instruments
- Hire field operators and train the field team using IPA's training guidelines
- Administer the respective surveys to the right respondents
- Monitor field activities to identify and correct problems
- Send IPA regular updates on the status of data collection activities and correct any problems identified by IPA's monitoring team
- Provide detailed documentation of every step of data collection activities

The first two rounds of data collection, Waves 1 and 2, were procured by MCA-M. IPA organized procurement for the third Wave[39] of data collection. IPA hired the Mongolian Marketing Consulting Group LLC (MMCG), which had carried out most of the previous TVET data collection work. Over the years, they were responsible for the following activities:

- Admissions surveys in 2010, 2011 and 2012
- Annual Tracking and Graduate Follow-Up surveys from 2011-2015
- Annual Administrative surveys from 2011-2013

The firm had the ability to efficiently coordinate qualified staff across all evaluation schools and was able to locate and reach respondents in all parts of the country. The firm also possessed strong data management skills and showed capable of entering and processing large amounts of data in a limited time period.

What follows briefly summarizes MMCG's responsibilities for each survey.

1. Admissions

MMCG supported the collection of applications to ensure proper implementation of the new admissions system. MMCG was also responsible for reviewing all applications received by each school and checking them for accuracy, consistency and coherence. If any information was missing or ambiguous on the application forms, MMCG followed up with applicants to clarify the issue. In addition, they performed the double data entry of information gathered through the application forms. If the applicant was under the age of 16, the legal age of majority in Mongolia, a legal guardian had to sign the written consent form.

[39] No RFP was issued for Wave 4 data collection in 2015, which involved the Tracking and Graduate Follow-Up surveys. The Wave 3 contract included a renewal clause, which IPA activated.

2. Tracking and Graduate Follow-Up Surveys

Until the third wave of data collection, all surveys were administered using the PAPI (Paper and Pencil Input) method. Starting with Wave 3, MMCG administered the Graduate Follow-Up survey using the CAPI (Computer Assisted Personal Interview) method. The phone-based Tracking survey was administered using the CATI (Computer Assisted Telephone Interview) method.

3. Administrative Surveys

MMCG implemented the three rounds of administrative survey data collection from 2011 to 2013. Enumerators conducted the surveys in person and on paper at the vocational schools. Completed paper surveys were encoded according to the double data entry standard and submitted to IPA in digital form.

B. Participating schools

We recruited oversubscribed TVET schools to participate in the evaluation. Such schools, which receive more applications than can be accommodated, were plausible candidates for the introduction of lotteries to determine which students would be admitted.[40] IPA research, confirmed by MCA-M findings, showed that twelve VET schools shortlisted for participation in the MCA-M project routinely turned away students because they lacked the resources to serve all applicants.

As part of the recruitment process, the MCA-M Monitoring and Evaluation (M&E) team and IPA held a number of workshops for the Ministry of Education, Culture, and Science (MECS), the Agency for Technical and Vocational Education and Training (ATVET), TVET school directors and staff, secondary school staff, local government officials and other stakeholders. MCA-M M&E and IPA also met individually with each recruited school to discuss the logistics of the evaluation. Ten of the twelve schools ultimately decided to participate in the evaluation. Dornod VTPC participated in the study in 2010 and 2011 but decided to drop out in 2012[41]. Nine schools thus participated in all three admissions lotteries in 2010, 2011, and 2012.

In 2011, the 10 TVET schools that participated in the evaluation enrolled 23 percent of all students in a TVET program in Mongolia. Table 9 and Figure 7 give an overview of the participating schools and their locations.

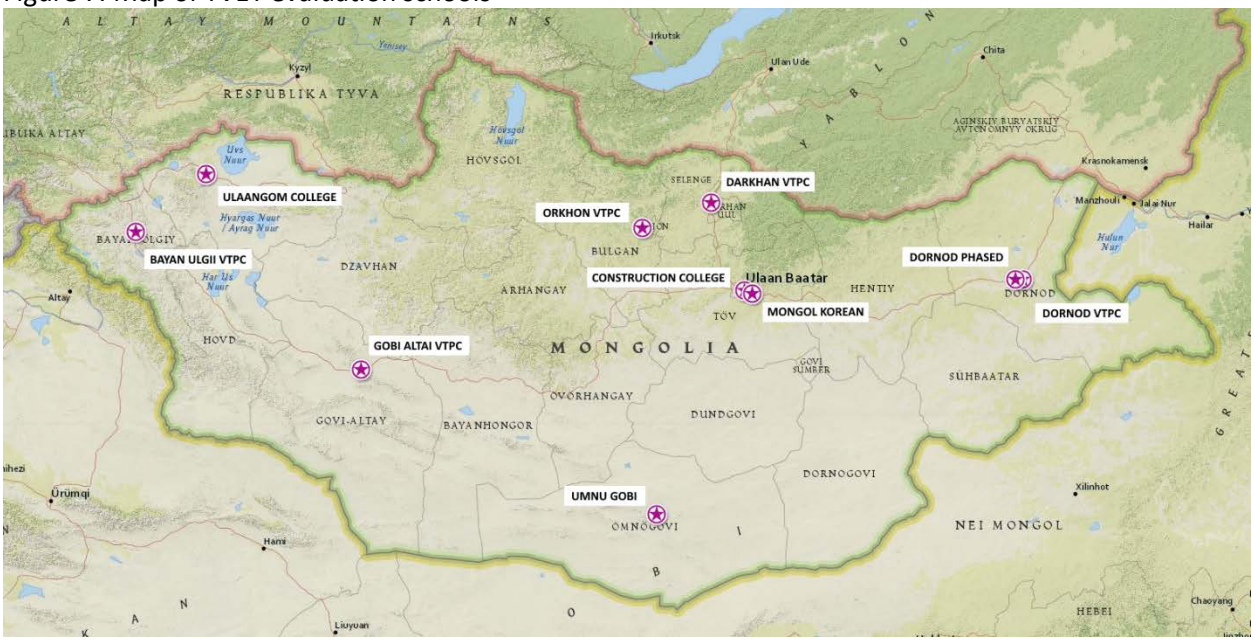
[40] This is common practice in settings where slots are oversubscribed. For example, in the United States, slots at oversubscribed publicly-funded charter schools are regularly assigned by lottery and public housing units has been allocated by lottery when demand exceeded supply.

[41] The school provided a number of reasons, including not being able to fill the number of study slots available for 2010 and 2011 and feeling hesitant about the random admissions process.

Table 9. TVET Schools Participating in the MCA-M Evaluation Randomized Admissions System

School	Location
Bayan-Ulgii VTPC (Vocational Training & Production Center)	Ulgii City, Bayan-Ulgii Aimag
Polytechnic College (formerly Construction college)	Ulaanbaatar, Bayangol Aimag
Darkhan-Uul VTPC	Darkhan, Darkhan-Uul Aimag
Dornod Phased Technical School	Choibolson, Dornod Aimag
Dornod VTPC[42]	Choibolson, Dornod Aimag
Gobi-Altai VTPC	Altai City, Gobi-Altai Aimag
Mongolian-Korean Technical College	Ulaanbaatar, Khan-Uul Aimag
Orkhon VTPC	Erdenet, Orkhon Aimag
Ulaangom College	Ulaangom, Uvs Aimag
Umnu-Gobi VTPC	Dalanzadgad, Umnu-Gobi Aimag

Figure 7. Map of TVET evaluation schools[43]



MCA-M and all participating schools agreed on individualized admissions protocols that included the following[44]:

1. The desired timeline for accepting applications
2. The minimum criteria that all accepted students must meet
3. The criteria for applicants that should receive preferred status
4. A list of all trades taught at each school

[42] Dornod VTPC opted out of the 2012 admissions process

[43] Created using the National Geographic Map Maker, available at http://mapmaker.education.nationalgeographic.com

[44] See the Admissions Baseline Report, Section II D2, for more information on schools' individual admissions criteria.

5. Any specific criteria that had be met for admission to specific trades and the estimated number of slots available for each trade.

Admissions protocols were updated annually to allow schools to learn from previous experience.

C. Questionnaire administration

All surveyors were trained on surveying and the relevant survey instrument by MMCG prior to field work, under supervision of a local IPA employee. Trainings typically took three days. Interviewer manuals were developed for each survey. They typically included an introduction to the TVET evaluation, surveyor responsibilities, a general interview guide, guidelines on the appropriate use of the relevant interview method (paper or computers) and a question-by-question walk through of the survey instrument.

1. Admissions

For the admissions survey, MMCG placed staff at each school to coordinate and assist with the collection of applications. MMCG held a public outreach event at each of the schools to inform potential applicants and local stakeholders about the new admissions process. Table 10 below shows the breakdown of 2.5 and 1 year program admissions applicants by school, year and round. A total of 12,240 students[45] took the admissions survey over the years.

Table 10. Applicants by year and round

	2010		2011		2012	
	Round 1	**Round 2**	**Round 1**	**Round 2**	**Round 1**	**Round 2**
By Round	3,022	2,028	2,483	1,370	2,103	1,244
By Year	5,050		3,843		3,347	
Total	12,240					

2. Tracking and Graduate Follow-Up

Table 11 below show the full sample[46] of tracking and GFU respondents MMCG was expected to interview during each year of data collection.

[45] This total includes duplicate respondents. See Table 13 for more information on duplicate admissions.

[46] This table shows the full sample of students who participated in the lottery, not accounting for duplicates and attrition. For more information, see Section V.E

Table 11. Respondents to be interviewed by program, year and type of survey

		2012		2013		2014		2015	
		Wave 1		Wave 2		Wave 3		Wave 4	
Cohort	Program	**GFU**	**Tracking**	**GFU**	**Tracking**	**GFU**	**Tracking**	**GFU**	**Tracking**
2010	1 year	524	-	524[47]	-	-	524	-	524
	2-2.5 year	-	4,526	4,526	-	-	4,526	-	4,526
2011	1 year	-	-	335	-	-	335	-	335
	2-2.5 year	-	-	-	3,508	3,508	-	-	3,508
2012	1 year	-	-	-	-	348	-	-	348
	2-2.5 year	-	-	-	-		2,999	2,999	-
		524	4,526	5,385	3,508	3,856	8,384	2,999	9,241

The GFU surveys required MMCG to track down and arrange in-person interviews with respondents across the country. Over the data collection period, their field teams covered all of Mongolia's 21 aimags (provinces) and 232 of 329 soums (districts).

MMCG employed up to 47 interviewers and supervisors for each wave of the Tracking and Follow-Up surveys, including 4 Kazakh speakers who were fielded in the Kazakh speaking western Mongolian province of Bayan Ulgii. Table 12 below outlines the type and number of staff employed for each survey and wave. It includes employees of two Mongolian telecommunications companies, Mobicom LLC and Unitel LCC, hired by MMCG to administer phone-based tracking surveys in Waves 1, 3 and 4. For Waves 3 and 4, MMCG hired additional in-house staff to administer the tracking surveys.

Table 12. Number of MMCG staff employed by survey and wave

	Survey							
Capacity	**GFU 1**	**TRK 1**	**GFU 2**	**TRK 2[48]**	**GFU 3**	**TRK 3**	**GFU 4**	**TRK 4**
Supervisors	10	-	9	6	12	11	10	9
Interviewers	20	-	35	18	34	18	29	20
Mobicom LLC	-	10	-	-	-	17	-	13
Unitel LLC	-	-	-	-	-	11	-	10
Tracking field team[49]	-	-	-	-	-	17	-	19

3. Administrative Survey

The administrative survey of 2010-2011 was conducted between April and July 2011 and covered the 10 TVET evaluation schools. Separate questionnaires were administered to administrative and teaching staff

[47] 2010 1 year students took the GFU survey twice, after changes to the survey instruments after Wave 1

[48] Tracking Wave 2 was administered by MEC LLC, a data collection firm contracted by MCA-M

[49] The tracking field interviewers who surveyed tracking respondents that couldn't be reached over the phone in-person included staff that had originally been hired for the Graduate Follow-Up survey. In-person interviews of Tracking respondents who couldn't be reached on the phone began in Wave 3.

and a random sample of students admitted in 2010 were evaluated by their vocational teachers. The survey also recorded classroom observations of teachers and the attendance rate of students.

The third administrative survey round of 2013 was the most comprehensive and covered 50 of the 52 VET project schools. MMCG employed 9 supervisors and 33 interviewers. 512 management staff and 1,068 teachers were surveyed and a total of 3,836 students from the 2011 and 2012 cohorts assessed by their teachers. Surveys of administrative staff and teachers were largely conducted based on their availability when surveyors visited the schools. Additionally, 131 classroom observations were recorded in facilities upgraded by MCA-M investments and administrative staff at 50 schools filled out the secondary information data sheets.

D. Data Quality Monitoring

MMCG's contract included a commitment to maintain high data quality standards. To ensure compliance, IPA conducted its own data quality monitoring. MMCG was responsible for the following:

- Training plans for the interviewers hired for each survey
- A full data collection plan, including location and timing of field team operations
- Weekly delivery of a selection of interview audio recordings, randomly sampled by IPA
- Weekly delivery of data sets in Stata or Excel format (Waves 3 and 4)
- Weekly delivery of scanned survey copies (Waves 1 and 2)
- Weekly reports on the progress of data collection, number and identity of interviewers involved and updates on errors pointed out by IPA

1. Manual checks

IPA hired its own data quality monitoring (DQM) team[50] to assist with data quality assurance. Typically consisting of four people, including a Kazakh speaker, IPA's DQM team had the following responsibilities:

- Attend MMCG's staff trainings and report on the quality of instruction and any problems
- Perform survey accompaniments and visits to MMCG's field offices and headquarters
- Attempt to contact respondents marked as unreachable by MMCG to confirm their attrited status
- Contact successfully surveyed respondents to make sure they were appropriately compensated
- Check select audio samples for consistency with the digital data sets delivered by MMCG and for audio quality
- Compile weekly reports outlining any errors encountered in the survey's administration and encoding

[50]For the first (and smallest) wave of tracking and Graduate Follow-Up data collection, IPA hired the Mongolian Center for Development Studies (MCDS) to monitor MMCG's data collection efforts. They took the following steps to assure data quality:

1. Attend MMCG's staff trainings
2. Listen to 20 percent total calls made for the tracking survey
3. Re-interview 20 percent of respondents using a reduced form of the questionnaire and re-enter data for another 20% of respondents for comparison with MMCG's dataset. The re-interviews also contained questions about the interview process, number of contact attempts, compensation and the communication skills of MMCG's interviewers.
4. In-person visits to MMCG's field offices

The reports were sent to MMCG to advise them on any problems with the work of individual interviewers, to correct data entry mistakes and to confirm that data collection protocols were observed.

In addition, IPA operated a hotline for respondents with any questions, concerns or complaints about the study or their rights as participants. Respondents could find the hotline number on their questionnaire's consent form.

2. High Frequency, Logic and Translation Checks

In Waves 3 and 4, IPA implemented computerized high frequency checks to assess data quality and the performance of interviewers based on all of their work. These tests compiled factors such as average interview length, number of answers per interview, number of interviews and persistence of outliers (as measured by standard deviations from the mean) to determine whether individual interviewers were consistently above or below the norms of their peers. Irregularities were checked against the audio recordings and, if necessary, reported to MMCG. Logic checks were performed on data collected during Waves 1 and 2 using the PAPI method, to ensure interviewers didn't skip sections they shouldn't have, and vice versa. Translation checks were introduced in Wave 3, when MMCG became responsible for the translation of all open-ended questions from Mongolian to English. IPA reviewed a randomly selected sample of the translated responses against the Mongolian original after the delivery of the translated data sets and reported any inconsistencies to MMCG and repeated the process if necessary.

3. Duplicate Respondents

A minority of respondents managed to apply to the same school during two subsequent rounds in the same year, or to two or more schools during the same round of admissions, even though schools had measures in place to avoid this.

To resolve these cases, it was decided to keep only their first application. If a respondent applied to two schools in the same round of admissions, only their first application was kept, determined by which of the schools was the first to hold the round's admissions lottery that round. If a respondent applied to the same school in subsequent rounds, only the first round's admissions application was kept. Table 13 shows how many respondents managed to apply two or more times.

We identify multiple applicants using their registration ID. This ID consists of two Cyrillic letters followed by the participants' birth date and two other numbers. It serves as the unique identifier for all Mongolians. First, we single out all duplicate occurrences of registration IDs. Using the date of the admissions lotteries at each school, round and year, we then keep only their first occurrence in the data. Subsequent occurrences were dropped from the data set.

Table 13. Duplicate and triplicate admissions respondents

	One application	Two applications	Three applications	Total
Number of respondents	12,011	224	5	12,240
Percent	98.13%	1.83%	0.04%	100%

Out of 12,240 admissions applicants, 229 were duplicates or triplicates. Taking them into account brought the sample to 12,011 students, or 98.1% of the original admissions sample.

E. Response Rate and Attrition Analysis

1. Survey response over the years

The response rate is calculated by dividing the number of respondents successfully interviewed in each round of data collection by the sample of respondents sent to MMCG by IPA to locate and interview.[51] Table 14 shows the response rate by survey type and wave.[52] For the Graduate Follow-Up and tracking survey waves 2, 3 and 4, the response rate was consistently above 90%, with the exception of the last tracking round which had a rate of about 87%.

Table 14. Response rates by survey type and wave

		Sample sent to Surveyor by IPA	Successfully Surveyed	Response Rate by Survey (%)	Response Rate by Wave (%)
Wave 2	GFU[53]	5,264	4,958	94.2%	94.8%
	Tracking[54]	3,447	3,303	95.8%	
Wave 3	GFU	3,651	3,334	91.3%	92.0%
	Tracking	7,957	7,342	92.3%	
Wave 4	GFU	2,923	2,696	92.2%	88.2%
	Tracking	8,570	7,442	86.8%	

For the fourth and final wave of tracking and Graduate Follow-Up, 10,138 respondents were interviewed. The original admissions surveys were taken by 11,973 non-duplicate students who were eligible for the lottery and applied to a 2/2.5 or 1 year program. This translates into a response rate of 84.7% after up to five years of interview rounds.

Of the 11,973 admissions baseline respondents, 10,950, or 91.2%, were administered the study's main instrument, the Graduate Follow-Up survey, in 2013, 2014 or 2015.

2. Attrition Analysis

The high rates of survey response shown above are a strong testament to the quality of data collection. They ensure that our sample size remains large over the years and allow us to discern even relatively small impacts on subsequent outcomes. They also reduce the scope for differential survey responses, or attrition, between our treatment and untreated samples. Attrition can introduce estimation bias if there are significant differences between respondents who wouldn't (or couldn't) be surveyed across these different samples. If there are systematic differences between these two groups, the final sample may no longer be balanced, threatening the internal validity of the study.[55] We evaluate these potential threats to validity by calculating the differential rates of attrition across our samples and by checking for balance in baseline characteristics across our samples. These are presented in conjunction with our estimation techniques in Section VI.

[51] The sample of respondents sent by IPA included all students in the baseline sample except students who had previously refused to be interviewed or were deceased.
[52] Table 11 includes duplicate respondents
[53] Wave 2 included 2010 1 year students who took the GFU survey a second time
[54] Tracking Wave 2 was administered by MEC LLC. All other surveys were carried out by MMCG
[55] The Admissions Baseline Report (2013) presented balance tests of baseline characteristics for the admissions sample.

F. Descriptive Summary of Applicants

Before we turn to the analysis of the impact of equipment upgrades, this section provides a brief socio-economic description of applicants. Appendix C contains more detailed information on this study's applicants, as well as a descriptive summary of Mongolian TVET schools and staff affected by MCC-sponsored activities.

1. Baseline Characteristics

What follows is a brief summary of the findings from the admissions survey, which served as the source of the baseline data collected for this study. A more extensive picture of applicant characteristics is provided in the Admissions Baseline Report (2013). Most of the tables below are reproduced with the same methodology used in the baseline report, albeit updated to reflect the removal of duplicate applicants.

a) Number of Applicants by School

A total of 12,011 applicants to 1 and 2/2.5 year programs went through the lottery process designed and organized by IPA and MCA-M at the 10 evaluation schools in 2010, 2011 and 2012. This number excludes 10 six-month program applicants who were dropped from the study and 556 applicants that did not meet the minimum requirements and were excluded from the lottery. Table 15 below summarizes the number of applicants by lottery result. 516 applicants were automatically accepted and a further 8,952 accepted through the lottery. 2,543 were rejected by the lottery process.

Table 15. Number of lottery applicants by school and lottery results

All Applicants	Rejected through Lottery	Accepted through Lottery	Automatically Accepted
12,011	2,543	8,952	516

b) Applicant Characteristics

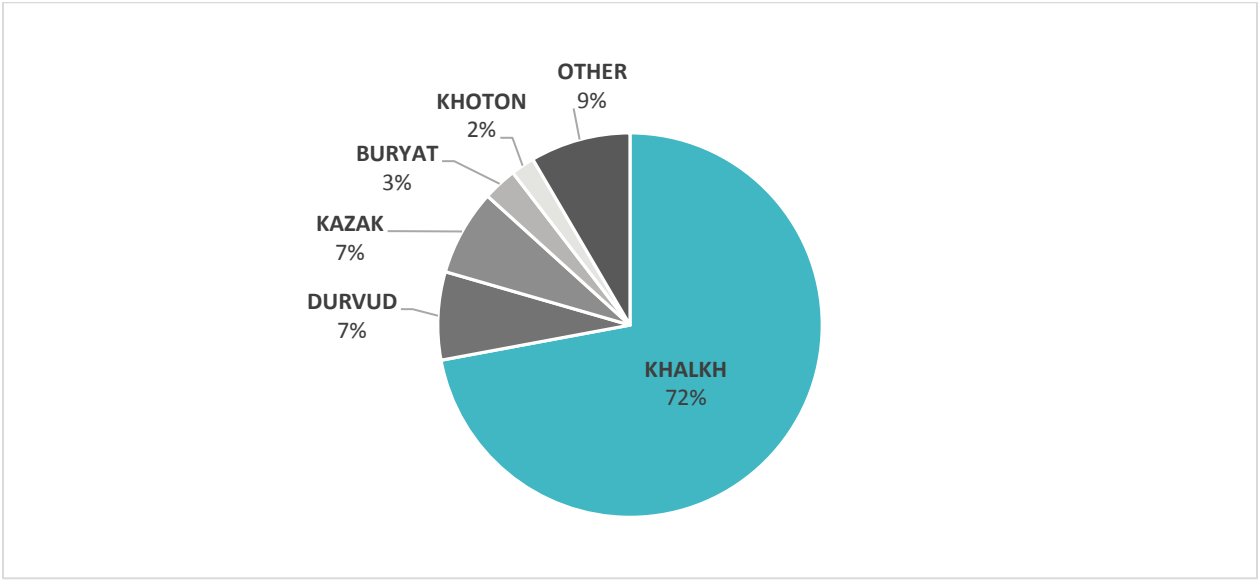
Table 16 shows select characteristics of applicants before the admissions lotteries. Overall, they were about 16 and a half years old at the time and 60 percent male. There are some key differences between 1 year and 2/2.5 year applicants. The 1 year cohorts are close to 3 years older, predominantly female and more likely to be married, have children or both. Being older, they tend to have completed secondary grade 11, compared to almost all 2/2.5 year respondents applying to vocational school after 9th grade. 6 percent of 1 year applicants had already completed some vocational program at the time of their application.

Table 16. Applicant characteristics at the time of their application

Characteristics	1 Year *(N= 1,167)*	2/2.5 Year *(N=10,844)*	Total *(N=12,011)*
Age of applicants	19.03	16.16	16.44
Male applicants (%)	44.6%	61.9%	60.2%
Married applicants (%)	4.3%	0.5%	0.9%
Applicants with children (%)	4.9%	0.6%	1.0%
Disabled applicants (%)	0.0%	0.0%	0.0%
Highest education level (%)			
Secondary grade 8	0.4%	2.9%	2.6%
Secondary grade 9	16.1%	95.6%	87.9%
Secondary grade 10	3.7%	0.2%	0.6%
Secondary grade 11	72.4%	0.8%	7.8%
Vocational	6.3%	0.0%	0.6%

Summarized in Figure 8 below, the majority of respondents identify themselves as Khalkh, followed by Durvud and Kazak (the main ethnic group in the western part of the country, close to Kazakhstan). The remaining 14 percent are split into smaller ethnic groupings. As noted in the admissions baseline report, this study over-represents minority ethnicities. According to government statistics, 82 percent of Mongolia's population is made up of Khalkh Mongolians[56].

Figure 8. Respondents' ethnicity



As shown in Table 17, about 20 percent of respondents are from Ulaanbaatar, Mongolia's capital and home to two of the evaluation schools. 14 percent are from Uvs, in the north-west of the country and 12 percent from Dornod, north of the capital. Gobi Altai hosts another 11 percent of our sample. These four areas account for more than half of all TVET respondents.

[56] The World Factbook, 2016

Table 17. Respondents by residency

Residency of Respondents (Province)	Number	Percent
Ulaanbaatar*	2,146	19.6%
Uvs*	1,509	13.8%
Dornod*	1,360	12.4%
Gobi Altai*	1,242	11.4%
Umnu Gobi*	922	8.4%
Bayan Ulgii*	883	8.1%
Orkhon*	725	6.6%
Darkhan Uul*	566	5.2%
Sukhbaatar	456	4.2%
Selenge	426	3.9%
Tov	287	2.6%
Arkhangai	241	2.2%
Bulgan	237	2.2%
Ovorkhangai	223	2.0%
Khovsgol	167	1.5%
Zavkhan	141	1.3%
Dundgobi	126	1.2%
Khentii	126	1.2%
Bayankhongor	80	0.7%
Khovd	80	0.7%
Dornogobi	43	0.4%
Gobi Sumber	13	0.1%
Total	11,999	100

* Area is home to one or more of this study's evaluation schools

At the time of their application, just 5 percent of respondents had some form of paid work experience, 31 percent of whom gained it through employment at their family's business. Those who worked put in an average of 241 hours a month and were paid an average MNT 228,000 per month (Table 18).

Table 18. Applicants' work experience

Employment experience	Percent
Applicant has paid work experience (%)	5.2%
If applicant worked, employed by Family Business (%)	30.9%
If applicant worked, salary (MNT)	227,950
If applicant worked, hours worked per month	240.7

2. Admissions Lottery Outcomes

This section shows select set of characteristics and outcomes associated with the admissions lotteries held in 2010, 2011 and 2012. The results reported in this section are mostly derived from the Graduate Follow Up survey, administered to 10,950 of the original 12,011 lottery applicants.

a) Lottery Outcome, Trade Assignments and Trades Studied

Close to 80 percent of applicants were accepted to a TVET school through the lottery, with a slightly higher proportion among males:

Table 19. Admissions lottery outcomes, by gender

Lottery outcome	Male	%	Female	%	Total	%
Not accepted to TVET	1,295	20%	973	22%	2,268	21%
Accepted to TVET	5,172	80%	3,510	78%	8,682	79%

Of those admitted to TVET schools through the lottery, 44 percent studied their first ranked trade and 40 percent graduated, indicating low dropout rates for those who began their studies. There are no large differences between men and women:

Table 20. Trade outcomes for applicants accepted to TVET

Outcome	Male	Female	Total
Studied first ranked trade	44.7%	43.4%	44.2%
Studied second ranked trade	8.1%	8.9%	8.4%
Graduated first ranked trade	40.8%	40.9%	40.8%
Graduated second ranked trade	7.3%	7.9%	7.5%

Fifty percent of the sample accepted to TVET graduated from the school and trade assigned by the lottery. A further 20 percent graduated from the school, but not their assigned trade.

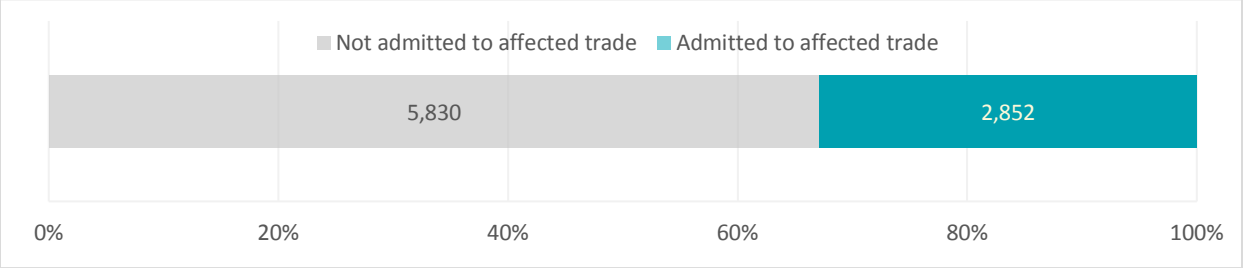
Table 21. Graduation outcomes for applicants accepted to TVET

Outcome	Male	Female	Total
Graduated from school and trade assigned by the lottery	51.0%	49.3%	50.3%
Graduated from school assigned by the lottery	71.5%	72.1%	71.7%

b) Exposure to Equipment Upgrades

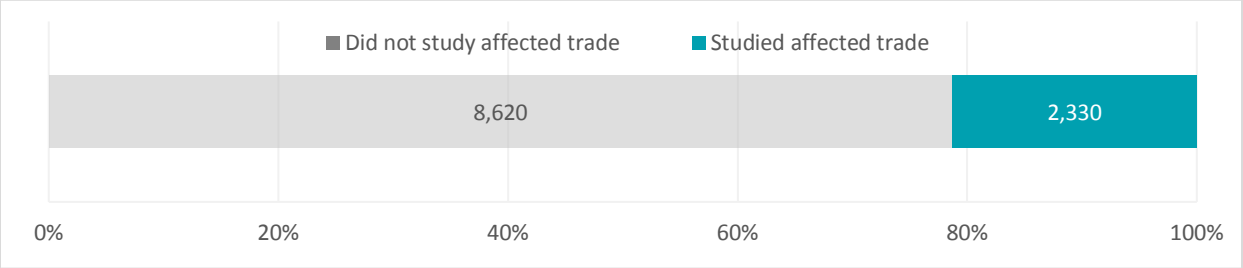
Shown in Figure 9, 2,852 applicants were admitted to a trade through the lottery that was eventually affected by equipment upgrades. 5,830 were admitted to trades that were not. However, students could be exposed to equipment upgrades even though not admitted to a trade affected by them. They could have changed trades or studied at a different school that received upgrades. Being admitted to a trade was also not a guarantee of exposure to upgraded equipment since students may have dropped out or changed trades.

Figure 9. Students admitted to trades affected by equipment upgrades (of students accepted to TVET)



A total of 2,330 students ended up exposed to trades with equipment upgrades. These students include both those that were and were not admitted to improved trades.

Figure 10. Students who studied trades affected by equipment upgrades



If there had been perfect compliance with lottery results, all students admitted to trades affected by equipment upgrades would have gone on to study those trades (and none of the unadmitted ones). Table 22 shows that 64 percent of those admitted to an upgraded trade studied an upgraded trade. 94 percent of students not admitted to an trade affected by upgrades did not study such a trade.

Table 22. Admitted to improved trades vs. studied improved trades

GFU respondents	**Admitted to upgraded trade**		**Not admitted to upgraded trade**	
Number of applicants	2,330		8,620	
	Number	**Percent of total**	**Number**	**Percent of total**
Studied upgraded trade	1,817	64%	513	6%
Did not study upgraded trade	1,035	36%	7,585	94%

Table 23 summarizes months of exposure to equipment upgrades by cohort. Those admitted to improved trades experienced 9 more months of exposure to classes with equipment upgrades than those not admitted. Those who actually studied improved trades were exposed for an average of 16.6 months.

Equipment upgrades were rolled out from 2010 to 2013, which is reflected in the figures below. A student from the 2010 cohort admitted to a trade selected for equipment upgrades could expect 8.7 months of exposure if she studied the trade. A student admitted to the same program in 2012 could expect an average of 24.4 months of exposure to new equipment, or almost three times as long as someone from the 2010 cohort.

Table 23. Months of exposure to equipment upgrades by cohort

Exposure to equipment upgrades	**2010**	**2011**	**2012**	**Total**
Months of exposure if not admitted to improved trade	0.5	1.0	1.4	0.9
Months of exposure if admitted to improved trade	4.7	10.0	15.3	9.9
Months of exposure if studied improved trade	8.7	17.0	24.4	16.6

3. Selected Follow-up Outcomes from the GFU Survey

As a precursor to the formal analysis of causal impacts, this section presents descriptive statistics on our main follow-up outcomes. These are reported for all respondents who took the Graduate Follow-Up survey, which included detailed questions about assets, expenditures and transfers not covered by the tracking survey, in addition to sections on education, employment and earnings. Appendix C contains

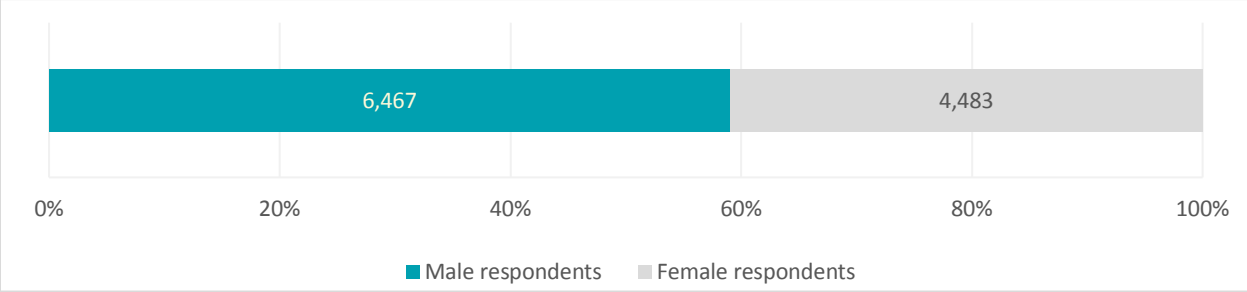
more detailed descriptive characteristics of our sample gathered from the Graduate Follow Up survey, including on their expectations, assets and expenditures.

Mongolia has been credited with being one of the most gender equal countries in Asia. The World Economic Forums' 2013 Gender Gap report places it 33rd out of 136 countries overall and number 2 with respect to economic participation. The report does highlight major shortcomings in women's political empowerment, where the metrics place it 108th (Word Economic Forum, 2013).

Primary school enrollment rates are about balanced among boys and girls. Women outnumber men in both secondary and tertiary education. In part because of the imbalance in post-primary education, men have a higher labor force participation rate at 69 percent compared to 58.4 percent for women. In non-agricultural wage employment, females account for close to 50 percent of the total. This proportion has fallen from almost 55 percent in 2007, in part because of the rapid growth of mining and construction, which favors employment sectors dominated by men (Mongolian Ministry of Economic Development, 2013).

The fraction of males and females in our final Graduate Follow Up sample is shown below:

Figure 11. GFU respondents by gender



41 percent of the sample of 10,950 students is female and 59 percent male. Although males are in the majority, a large enough proportion of the sample is female to provide a meaningful descriptive comparison. Consequently, the outcomes below are presented separately by gender.

a) Personal and Household Characteristics

At the time of their respective GFU surveys, respondents of the 2010, 2011 and 2012 cohorts were 19.5 years old on average, with women a few months older than men. Female respondents come from slightly bigger households, with 4.2 other members compared to 3.9 for men. In terms of household members above the age of 24, men and women report the same figures.

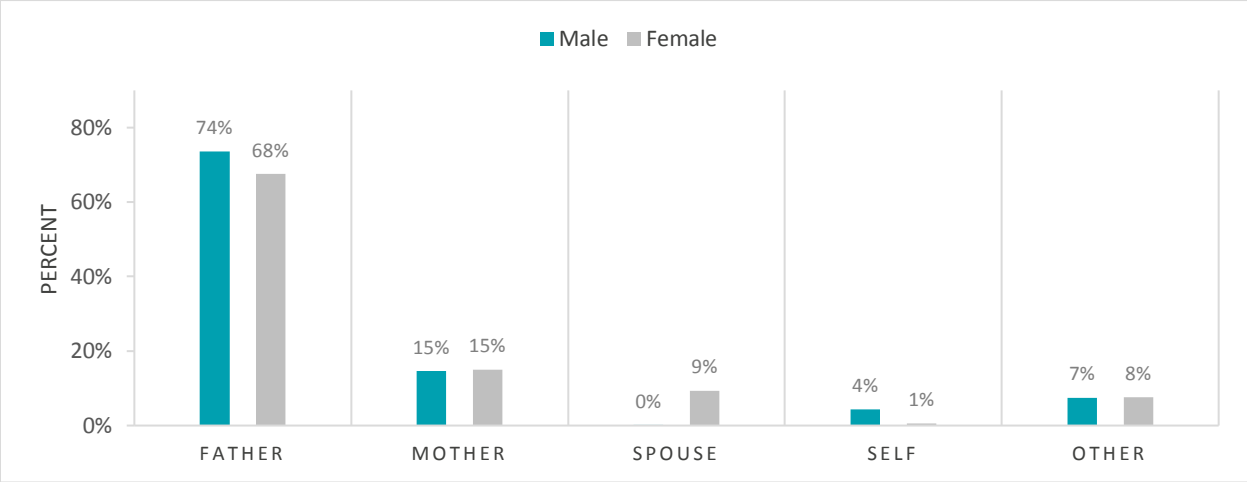
Table 24. Characteristics at the time of GFU

	Male	Female	Total
Respondent age at the end of the GFU survey	19.3	19.7	19.5
Number of household members (not including respondent)	3.9	4.2	4.0
Male household members over 24	1.1	1.1	1.1
Female household members over 24	1.2	1.2	1.2

Consistent with the young age of our sample, the majority of respondents live at home, and 85-90 percent name one of their parents as their household head. Almost 10 percent of women name their husband

compared to a very small number of men naming their wives. 4 percent of men report themselves as the head of their household. The "Other" category includes other family members such as older siblings and grandparents.

Figure 12. Respondents' relationship to household head (percent)



b) Education

Turning to education outcomes over the 18-22 months period leading up to the GFU survey, Figure 13 shows two types of graduation rates for men and women. The left side includes 8,289 respondents that report having attended any TVET school over that period. Of those who were enrolled in one or more TVET schools, almost 90 percent graduated from at least one program.

The right side of the graph shows the rates for the whole sample of 10,950 students. It includes respondents who never attended a TVET school, perhaps because they were rejected through the lottery, and those still studying or who dropped out. The overall graduation rate for men and women is just above and a little below two-thirds, respectively.

Figure 13. Respondents' graduation rates from any TVET school, by gender (percent)

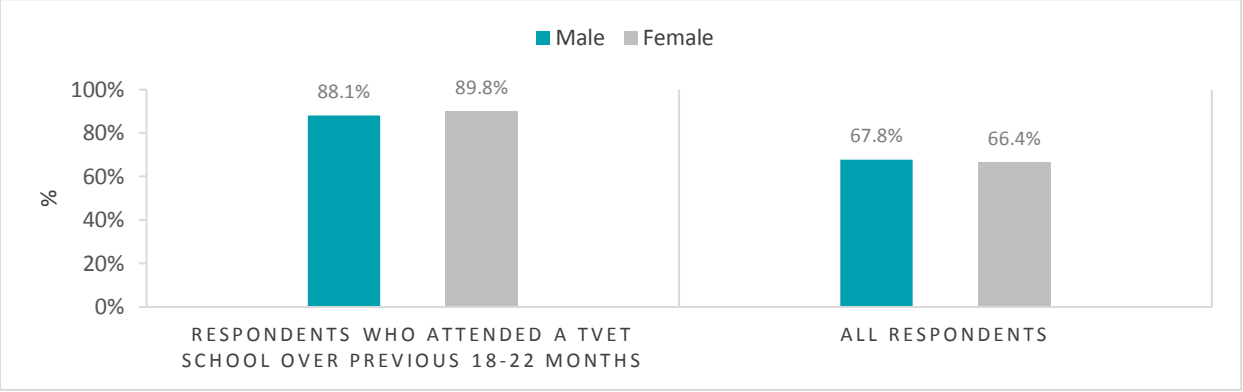


Table 25 and Table 26 respectively show the most common 2/2.5 and 1 year trades men and women were assigned to by the admissions lottery (based on their preferences). The only top ten 1 year trades the

genders have in common are computer operator, construction decoration[57], and construction. For 2/2.5 program trades, the common ones were computer operator and construction. Women were generally accepted to trades that require less heavy manual labor than male applicants.

The top three 1-year trades for female applicants were cooking and food production, hairdresser/beautician, and construction decoration; their top three 2/2.5 year trades were sewing, cooking and food production and construction decoration. The top three trades among men assigned 1 year trades were construction, automobile repairs and usage and construction montage; for 2/2.5 year trades, they were electric and gas welding, construction plumbing and welding and automobile repair and usage.

Table 25. Number and percent of applicants accepted to the 10 most common 2/2.5 trades, by gender[58]

	Male 2/2.5 years	**Freq.**	**%**	**Female 2/2.5 year**	**Freq.**	**%**
1	Electric, gas welding	525	11.1%	Sewing, sewing production	411	14%
2	Construction plumbing, welding	521	11.0%	Cook, food production	404	14%
3	Automobile repairs, usage	519	11.0%	Construction decoration	340	11%
4	Wood and household carpenter	453	9.6%	Computer operator (secretary)**	203	7%
5	Construction**	391	8.3%	Construction**	188	6%
6	Construction montage	298	6.3%	Hairdresser, beautician	153	5%
7	Concrete reinforcement	175	3.7%	Weaving machine operator	77	3%
8	Lathing	143	3.0%	Shoe making	75	3%
9	Light industry machinery repairs, welding	138	2.9%	Trade worker	72	2%
10	Computer operator (secretary)**	132	2.8%	Material tailor, sewer	65	2%

**Top 10 trade for both genders.

Table 26. Number and percent of applicants accepted to most common 1-year trades, by gender

	Male 1 year	**Freq.**	**%**	**Female 1 year**	**Freq.**	**%**
1	Construction**	87	19.8%	Cook, food production	114	21%
2	Automobile repairs, usage	71	16.1%	Hairdresser, beautician	57	11%
3	Construction montage	44	10.0%	Construction**	36	7%
4	Electric, gas welding	30	6.8%	Construction decoration**	34	6%
5	Heavy machine, machinery repairs	27	6.1%	Sewing, sewing production	33	6%
6	Circuit repair	19	4.3%	Environment protection	32	6%
7	Construction plumbing	17	3.9%	Hairdresser (only)	31	6%
8	Construction decoration**	14	3.2%	Leather art	25	5%
9	Electrical machine installer	14	3.2%	Computer operator (secretary)**	24	4%
10	Computer operator (secretary)**	13	3.0%	Orchardist	21	4%

**Top 10 trade for both genders

[57] This trade involves learning construction and painting skills

[58] Note: percent figure refers to the proportion of male and female respondents respectively who were assigned a trade

c) Employment and Earnings

Men are more likely to report being currently employed or having ever been gainfully employed for one month or longer over the previous 18-22 month period. Close to 62 percent of them report such work experience, compared to 48 percent of women.

Table 27. Employment by gender

Employment (%)	Male	Female	Total
Currently employed in paid job (>1 month)	30.1%	22.5%	27.0%
Ever employed in paid job (>1 month)	61.8%	48.0%	56.1%
Ever employed in paid job (any)	78.9%	64.5%	73.0%
Ever employed in paid or unpaid job (any)	90.0%	82.1%	86.7%

In terms of earnings (Table 28) men earn more than women on all related measures: they earned substantially more in total, current and recent incomes.

Table 28. Income by gender (MNT)

Earnings (MNT)	Male	Female	Total
Monthly earnings if currently employed	219,910	110,071	174,952
Most recent monthly earnings	430,041	228,565	347,574
Average earnings per month	424,606	224,405	342,661
Total earnings	2,646,008	1,312,992	2,100,384

These differences in earnings could be due to the different trade and career choices made by males and females. For example, social expectations may lead men to consistently choose trades with higher average wages than those traditionally associated with women's career paths.

This concludes the descriptive section. Section VI considers the main question this evaluation was designed to answer: what is the effect of learning and training with upgraded equipment on graduates' employability and wages? It begins with a brief summary of the estimation strategy used to answer the research question.

VI. Findings: The effect of equipment upgrades

A. Estimation Techniques

The gradual rollout of equipment upgrades over time implies that individuals in later cohorts studying trades affected by equipment upgrades would have been exposed to these upgrades for longer than those in earlier cohorts. Therefore, we can infer the impact of exposure to upgraded equipment by comparing the impact of admission to "upgraded trades" for individuals in later cohorts with the impact of admission to "upgraded trades" for individuals in earlier cohorts. Individuals who were admitted to upgraded trades are compared to those who were admitted to TVET schools but not to improved trades. Thus, all the analysis in this section is restricted to students who were admitted to TVET schools.[59] In other words, we compare the average outcomes of students who were admitted to improved trades with those of students who were admitted to non-improved trades in earlier cohorts vs. later cohorts. Insofar as students in later cohorts were more exposed to equipment upgrades than students in earlier cohorts, we would expect to observe larger differences the impact of admission to upgraded trades if students did benefit from the upgraded equipment. Note that we focus our analysis on individuals who applied to 2-2.5 year programs for ease of interpretation (though estimates are similar when including applicants to 1 year programs).[60]

1. The Effect of Admission to Upgraded Trades across Cohorts

We begin by estimating the impact of admission to trades that were affected by equipment upgrades separately by cohort using the following regression model estimated via ordinary least squares (OLS):

$$y_{ijl} = \beta' X_{ijl} + \tau AdmittedUpgraded_{ijl} + f\left(p_{ijl}^{Upgrd}\right) + \mu_{jl} + \varepsilon_{ijl} \quad (1)$$

The variable y_{ijl} is an outcome such as employment or earnings for student i in school j participating in round l of the lottery. $AdmittedUpgraded_i$ is an indicator variable for whether or not student i was admitted to a trade affected by equipment upgrades through the lottery. The coefficient of interest in these regressions is τ which captures the difference in outcomes for students who were admitted to an upgraded trade and those students who were not admitted to an upgraded trade, after controlling for the probability of admission to an upgraded trade and fixed effects for each lottery round. We estimate this coefficient for each cohort separately to obtain τ_{2010}, τ_{2011}, and τ_{2012}. These are the causal impacts of being admitted to a trade affected by equipment upgrades on outcome y for each cohort.

The causal impact of being admitted to an upgraded trade captures all differences between upgraded trades and non-upgraded trades, and not just the exposure to equipment upgrades. For example, if the types of trades that received equipment upgrades tend to be associated with greater labor opportunities, this would also be captured by the impact of admission to an upgraded trade. However, as explained above, the difference in the impact of being admitted to an upgraded trade between earlier and later cohorts provides an estimate for the impact of exposure to upgraded equipment. This is often referred to as a "difference-in-difference" estimate. One difference-in-difference estimate could represent the

[59] We also considered an alternative approach in which we compared individuals who were admitted to upgraded trades with those who were not admitted to any trade in TVET evaluation schools (instead of those who were admitted to non-upgraded trades). The pattern of results using this approach were qualitatively similar to those with our preferred comparison group.

[60] The number of applicants who were admitted to 1-year programs in upgraded and non-upgraded trades in TVET schools is too small to allow for the possibility of analyzing this group separately.

difference between τ_{2011}, the difference in outcomes between those individuals admitted and not admitted to upgraded trades in 2011, and τ_{2010}, the difference in outcomes between those individuals admitted and not admitted to upgraded trades in 2010. This difference-in-difference estimate of $\tau_{2011} - \tau_{2010}$ captures the causal impact of the differential exposure to equipment upgrades in 2011 vs. 2010 under the assumption that there are no confounding factors that affect upgraded trades differentially in 2011 compared to 2010. A similar difference-in-difference estimate based on $\tau_{2012} - \tau_{2011}$ would represent the differential exposure to equipment upgrades in 2012 vs. 2011.

$f\left(p_i^{Upgrd}\right)$ is a polynomial function of the probability that student i was admitted to an upgraded trade. This function effectively controls for any differences in student characteristics associated with different preferences among trades as expressed in the rankings submitted during the application process. For this analysis, we use a cubic polynomial but the results are robust to using alternative polynomial functions.[61] The probabilities were estimated empirically based on 10,000 iterations of the actual lottery algorithms used to assign students in the admissions process.[62] The function also includes indicator variables for students who were guaranteed admission to an upgraded trade and for students who had no chance of being admitted to an upgraded trade.

μ_{jlm} represents fixed effects for each round of the lottery by school and cohort. Each lottery represents a separate randomized experiment. The inclusion of fixed effects effectively estimates the treatment effects for each lottery and then averages these effects across the different lotteries. We implement these fixed effects by including indicator variables for each round of the lottery.

Finally, X_i is a vector of baseline controls that includes a constant and can also include demographic information and baseline test scores from the admissions survey. However, because our baseline controls are mostly balanced between those students admitted to upgraded trades and those not admitted to upgraded trades, the inclusion or exclusion of baseline controls does not affect the magnitude of our estimates. In our preferred specifications, we do not include any baseline controls for the sake of parsimony. The standard errors in these and all subsequent regressions are adjusted for heteroscedasticity, following Abdulkadiroglu et al. (2015) as well as studies utilizing charter school lotteries for estimating causal impacts (e.g. Dobbie and Fryer, 2015; Hoxby and Rockoff, 2004).[63]

2. The Effect of Exposure to Upgrades

It is also possible to estimate the impact of exposure to equipment upgrades directly using the following regression model estimated via two-stage least squares (2SLS):

$$y_{ijlm} = \beta' X_{ijlm} + \delta \widehat{Exposure Upgrades}_{ijlm} + \alpha Admitted Upgraded_{ijlm} + f\left(p_{ijlm}^{Upgrd}\right) + \mu_{jlm} + \varepsilon_{ijlm} \quad (2)$$

[61] This is the same polynomial function used in the baseline report. Our results are essentially unchanged when using linear, quadratic, and 10th order polynomial functions of the probability of admission. We have also considered specifications which interact this polynomial function with indicators for cohort or program and the results are similar.

[62] Abdulkadiroglu et al. (2015) discuss the use of lotteries within school assignment procedures to estimate causal impacts and consider alternative approaches for estimating probabilities of admission to schools.

[63] Our results are unchanged if we cluster our standard errors at the level of each lottery (i.e. lottery round by school by cohort) but the standard errors do increase in magnitude.

where $\widehat{ExposureUpgrades_i}$ is the number of months of exposure to equipment upgrades experienced by student i in school j, lottery l, and cohort m as predicted in the following first stage regression: $ExposureUpgrades_{ijlm} = \beta' X_{ijlm} + \theta AdmittedUpgraded_{ijlm} * \phi_m + \gamma AdmittedUpgraded_{ijlm} + f\left(p_{ijlm}^{Upgrd}\right) + \mu_{jlm} + \varepsilon_{ijlm}$. This first stage regression predicts exposure to equipment upgrades with the *interaction* between an indicator for whether student i was admitted or not to a TVET school and a set of indicators for each cohort represented by ϕ_m.[64] In essence, the first stage regression is a generalized difference-in-difference estimate for the impact of exposure to equipment upgrades based on the number of months of exposure associated with different cohorts.[65] The second-stage regression then uses this variation in exposure across cohorts to estimate the impact of upgraded equipment on subsequent outcomes. The coefficient of interest here is δ which captures the causal effect of an additional month of exposure to equipment upgrades on outcome y.

The other variables are defined as above. However, in this case, it is important allow the polynomial functions of the probability that student i was admitted to an upgraded trade, $f\left(p_i^{Upgrd}\right)$ to vary across cohorts by also interacting them with the set of cohort indicators, $Cohort_m$. This is because the probability of admission to an upgraded trade appears to have a different effect on outcomes by cohort.

B. Analysis of Threats to Validity

The key identification assumption underlying the estimation of the impact of exposure to equipment upgrades is that there are no confounding factors influencing those trades affected by equipment upgrades differentially across cohorts. For example, if there were fewer employment opportunities for students who graduated from upgraded trades in later cohorts due to changes in the labor market (e.g. a decline in the mining sector), we would mistakenly attribute these changes to the impact of exposure to upgraded equipment. Unfortunately, we cannot test this assumption directly because many confounding factors are unobserved.

We did conduct a series of statistical tests on the key socioeconomic and demographic variables collected in the admissions survey to test whether our baseline characteristics appear balanced between students admitted to upgraded trades and those admitted to non-upgraded trades across cohorts. Specifically, we estimated equation (2) by replacing the outcome variables with baseline characteristics instead. The table below shows these estimates for a selected set of baseline characteristics among students who responded to the GFU survey (a table with the full set of baseline characteristics is relegated to the Appendix VIII.D):

Table 29. Balance on selected baseline characteristics by exposure to equipment upgrades

Selected Baseline characteristics	**Control Group Mean (No exposure)[1]**	**Exposure to equipment upgrades[2] <std. error>**
Age	16.546	-0.002
		<0.013>
Male (%)	48.806	0.626
		<0.423>
Has Prior Work Experience (%)	5.318	0.010
		<0.231>

[64] The main effects of the indicators for each cohort are also included in this regression but they are subsumed in the fixed effects for each round of the lottery by school and cohort.

[65] A similar 2SLS model incorporating a difference-in-difference framework is used in Duflo (2001) and Fields (2007)

Applicant Years of Schooling	9.200	0.002
		<0.004>
Applicant GPA (Out of 100)	74.705	0.036
		<0.069>
Percent Correct on Entrance Exam (Math)	36.121	0.043
		<0.226>
Percent Correct on Entrance Exam (Logic/Problem Solving)	30.974	0.003
		<0.197>
Percent Correct on Entrance Exam (Reading)	32.255	-0.058
		<0.271>
Percent Correct on Entrance Exam (Essay)	40.539	-0.156
		<0.275>
Percent Correct on Entrance Exam (Overall)	34.631	-0.035
		<0.151>

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
[1] This column shows the average value for the sample of students who were not admitted to improved trades
[2] This column shows the coefficient of the variable for months of exposure to upgraded equipment
N=8,682 students accepted to a TVET school through the lottery who were administered the Graduate Follow Up survey

After adjusting for the probability of admission and including fixed effects, we observe few if any statistically significant differences by exposure to upgraded equipment. This suggests that differences in student characteristics are correlated with variation in exposure levels over time. However, these tests do not rule out the presence of unobserved differences across cohorts at baseline, or the potential for confounding effects upon entry into the labor market.[66]

We also examined the possibility of differential attrition between students who were more and less exposed to equipment upgrades. Specifically, we estimated equation (2) by replacing the outcome variables with an indicator for responding to the GFU survey:

Table 30. Differential attrition by exposure to equipment upgrades

	All cohorts (std. error)
Interviewed as part of the graduate follow up survey	0.000587
	(0.00305)
Obs	9,470

*** p<0.01, ** p<0.05, * p<0.1
N=9,470 students accepted to a TVET school through the lottery

As seen in the table, there were no significant difference in attrition by exposure. Moreover, as confirmed in balance tests on the final analysis shown above, any differences in observed characteristics among those who attritted and those who did not attrit are balanced between these groups.[67]

[66] We also examined whether (i) students admitted to TVET schools differed significantly from students who were not admitted and (ii) whether students admitted to improved trades differed significantly from students admitted to non-improved trades, after accounting for their respective probabilities of admission. These tests address the validity of the random admission lotteries, not the evaluation strategy itself, so results are relegated to Appendix VIII.D.
[67] We also checked for differential attrition between (i) students admitted and not admitted to TVET schools as well as (ii) students admitted to improved trades and those admitted to non-improved (tables in Appendix D).

C. Comparing the Effects of Admission to Improved trades across Cohorts

1. Education and Exposure to Equipment Upgrades

This section estimates the impact of admission to trades that received equipment upgrades across cohorts. We begin by examining these impacts on a set of educational outcomes: (1) whether individuals studied trades affected by equipment upgrades, (2) whether individuals graduated from such upgraded trades, (3) the number of months they were enrolled in vocational schools, and (4) the number of months individuals were exposed to upgraded trades. Table 31 presents the estimated impacts on each of these outcomes by cohort:

Table 31. Impact of admission to upgraded trades on educational outcomes, by cohort (GFU)

Samples	(1) **Studied an improved trade**	(2) **Graduated from an improved trade**	(3) **Months enrolled in vocational school**	(4) **Months of exposure to upgraded equipment**	(5) N
2010 Cohort	0.496***	0.478***	-0.194	4.543***	3,270
	(0.0276)	(0.0275)	(0.544)	(0.276)	
Percentage impact[68]	**1444%**	**1689%**	-1.2%	**1391%**	
2011 Cohort	0.571***	0.537***	-0.541	9.180***	2,268
	(0.0270)	(0.0270)	(0.576)	(0.539)	
Percentage impact	**1302%**	**1482%**	-3.2%	**1390%**	
2012 Cohort	0.532***	0.518***	-0.359	13.56***	2,168
	(0.0309)	(0.0301)	(0.682)	(0.818)	
Percentage impact	**1294%**	**1577%**	-2.1%	**1446%**	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

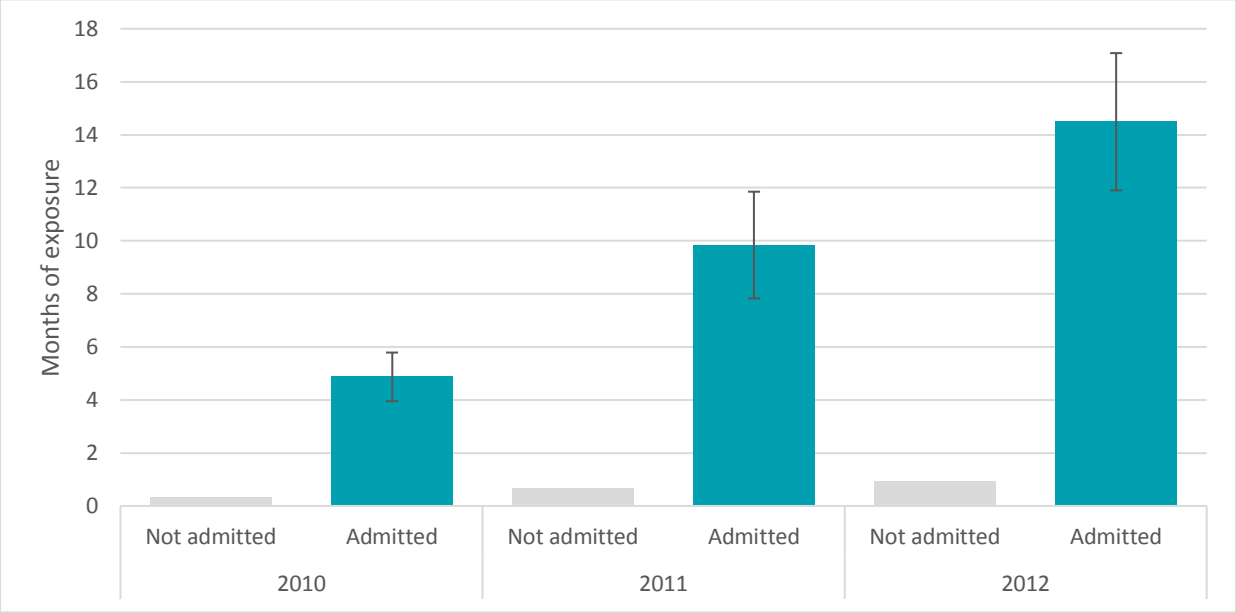
These results show that applicants admitted to trades affected by equipment upgrades were approximately 50 percentage points more likely to study and graduate from these trades. The estimates are fairly similar across cohorts, with slightly larger impacts for the 2011 cohort and slightly smaller impacts for the 2010 cohort. These should be interpreted as measures of compliance with the random assignment (or admission) to different trades. There is no evidence for any differences in the overall number of months students were enrolled in vocational school, which is expected given that all these students were admitted to TVET schools.

Individuals who were admitted to upgraded trades were significantly more likely to be exposed to equipment upgrades in all cohorts. However, there are large differences in the length of exposure. As shown in Figure 14 below, individuals in the 2010 cohort who were admitted to upgraded trades were exposed to upgraded equipment for only 4.5 more months than those not admitted on average, whereas

[68] In this table and what follows, "Percentage impact" refers to the marginal percentage difference of the Treatment group estimate and the Control group average. Percentages in blue bold-type show significance at the 5% level; Percentages in blue regular-type significance at the 10% level. Percentages in grey type are not significant at conventional levels.

those in the 2011 and 2012 cohort who were admitted to upgraded trades were exposed to upgraded equipment for an additional 9.2 and 13.6 months respectively.[69]

Figure 14. Months of exposure to upgraded equipment by cohort and treatment status.



2. Employment

If greater exposure to equipment upgrades in later cohorts led to improved outcomes, we would expect to see larger impacts of admission to upgraded trades on employment and earnings in later cohorts. We consider impacts on four alternative measures of employment: (1) currently employed in a paid job longer than 1 month, (2) ever employed in a paid job longer than 1 month, (3) ever employed in a paid job longer of any length, and (4) ever employed in a paid or unpaid job of any length.[70] Employment in paid jobs that last longer than 1 month are likely to represent more stable attachments to the labor market. Therefore, we view these outcomes as more valuable ones. However, there is also value in employment more generally, whether paid or unpaid, so we present these broader measures of labor market participation as well.[71] Table 32 below presents these impacts on our four main employment outcomes:

[69] The error bars in these figures, and those that follow, represent 95% confidence intervals of the estimates.
[70] All these outcomes are based on employment questions pertaining to the 18-22 months prior to the GFU survey.
[71] A potential challenge in examining early labor market outcomes for this population is that some individuals may still be enrolled in educational programs at the time of the survey. However, since we are comparing among students who were all admitted TVET schools (whether to upgraded trades or to non-upgraded trades), the differences in enrollment at the time of the GFU survey and the cumulative enrollment rates since graduation are quite small.

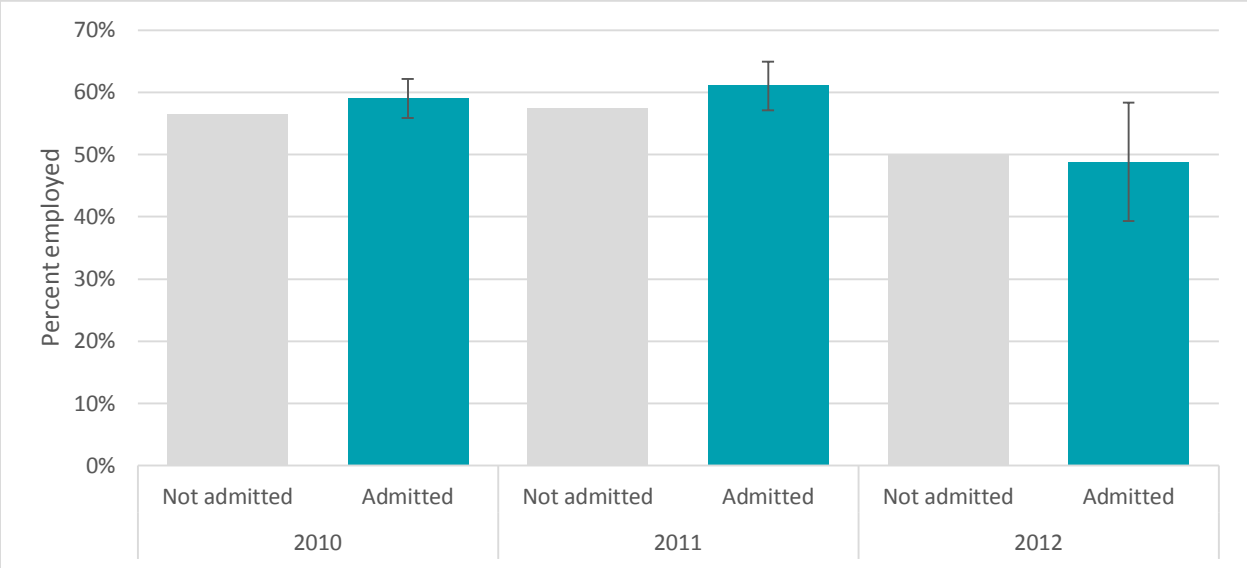
Table 32. Impact of admission to improved trade on employment, by cohort (GFU)

Samples	(1) **Currently employed in paid job (>1 month)**	(2) **Ever employed in paid job (>1 month)**	(3) **Ever employed in paid job (any)**	(4) **Ever employed in paid or unpaid job (any)**	(5) N
2010 Cohort	-0.0159	0.0257	0.0350	0.0282	3,270
	(0.0297)	(0.0311)	(0.0281)	(0.0185)	
Percentage impact	-5.5%	4.6%	4.8%	3.2%	
2011 Cohort	0.0431	0.0360	0.00266	0.0121	2,268
	(0.0321)	(0.0308)	(0.0254)	(0.0185)	
Percentage impact	14.9%	6.3%	0.4%	1.4%	
2012 Cohort	0.0169	-0.00992	-0.0106	-0.0190	2,168
	(0.0303)	(0.0367)	(0.0323)	(0.0253)	
Percentage impact	9.0%	-2.0%	-1.6%	-2.2%	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The patterns in impacts on employment are not very clear-cut. There does seem to be an increase in the impact of admission to an upgraded trade between the 2010 and the 2011 cohorts for our measures of currently employed and ever employed in a paid job over one month in duration. However, these impacts decline between the 2011 and 2012 cohorts when individuals studying improved trades would have been exposed to equipment upgrades for even longer. The decline in impacts on the likelihood of gainful employment for longer than one month between the 2011 and 2012 cohorts is further illustrated in Figure 15 below.

Figure 15. Percent ever gainfully employed for longer than 1 month by cohort and treatment status



The patterns for our broader measures of employment are even less promising with declines from both 2010 to 2011 and from 2011 to 2012. This would suggest that exposure to equipment upgrades did not improve employment prospects for affected students.

3. Earnings

We estimate the impact of admission to an improved trade on four measures of earnings: (1) monthly earnings if currently employed, (2) monthly earnings in most recent job, (3) average monthly earnings to date, and (4) total earnings to date.[72] These are all measures of earnings associated with stable paid jobs of one month and longer (including earnings from jobs of less than one month makes almost no difference to any of our resulting estimates). There are advantages and disadvantages to each measure. For example, one's monthly earnings if currently employed reflects the most up-to-date earnings at the time of the survey but also incorporate differences in current employment rates across respondents. On the other hand, total earnings include all earnings to date but may be less informative about future prospects because they can be unduly influenced by past earnings. We consider the monthly earnings in the most recent job and the average monthly earnings as likely the most informative outcomes, but we show impacts on them all. Table 33 below presents the impacts of admission to a trade affected by upgraded equipment on our four main earnings outcomes:

Table 33. Impact of admission to improved trade on earnings, by cohort (GFU)

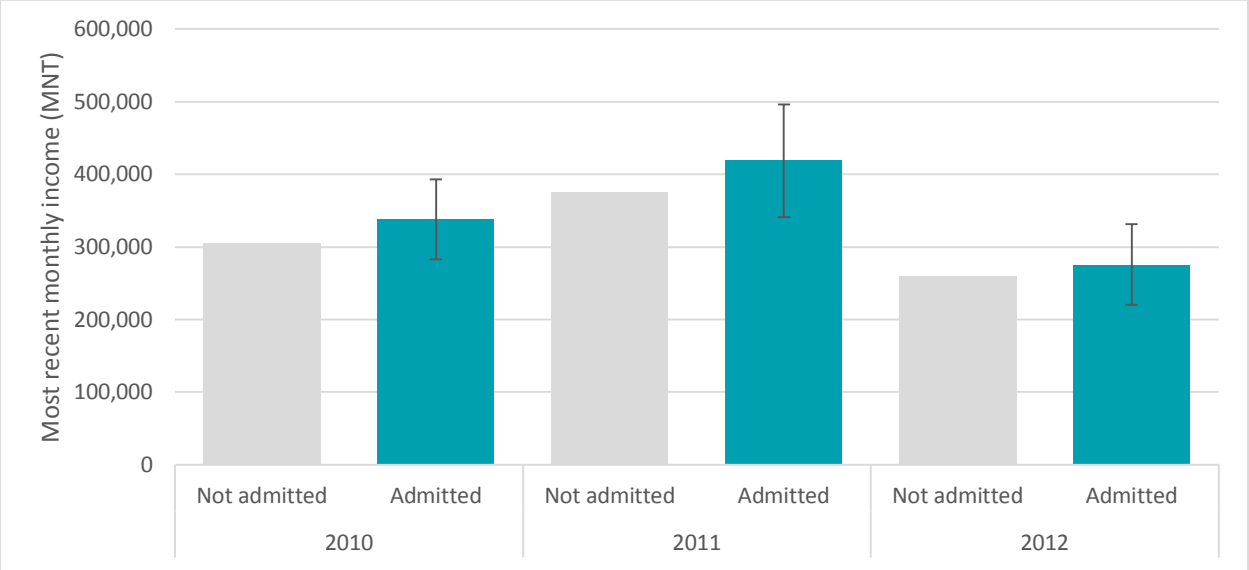
Samples	(1) **Monthly earnings if currently employed**	(2) **Most recent monthly earnings**	(3) **Average earnings per month**	(4) **Total earnings**	(5) N
2010 Cohort	5,418	32,396	29,949	78,542	3,270
	(27,143)	(30,118)	(28,284)	(220,802)	
Percentage impact	3.3%	10.6%	9.9%	4.2%	
2011 Cohort	38,533	42,581	48,078	500,553	2,268
	(34,349)	(36,163)	(34,145)	(312,575)	
Percentage impact	18.8%	11.3%	12.9%	22.3%	
2012 Cohort	9,842	15,581	20,478	35,157	2,168
	(23,136)	(30,040)	(28,572)	(218,004)	
Percentage impact	10.0%	6.0%	8.1%	2.9%	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The patterns for earnings are more encouraging if we focus on changes between the 2010 and 2011 cohorts. There is an unambiguous increase in the impact of admission to an upgraded trade between the 2010 and the 2011 cohorts for all our earnings measures. However, these impacts decline from the 2011 to the 2012 cohorts when individuals studying improved trades would have been exposed to equipment upgrades for longer. This is further illustrated in Figure 16 below.

[72] All earnings measures are expressed in 2015 MNT to make them comparable across cohorts and over time. We winsorize earnings by censoring observations in the top 1 percent of the earnings distribution for each cohort. Our findings are qualitatively unchanged if we include all earnings observations. Note that we do not estimate log earnings regression as our main specification because there is a large fraction of individuals with zero earnings (which would be dropped from the sample when applying logarithms).

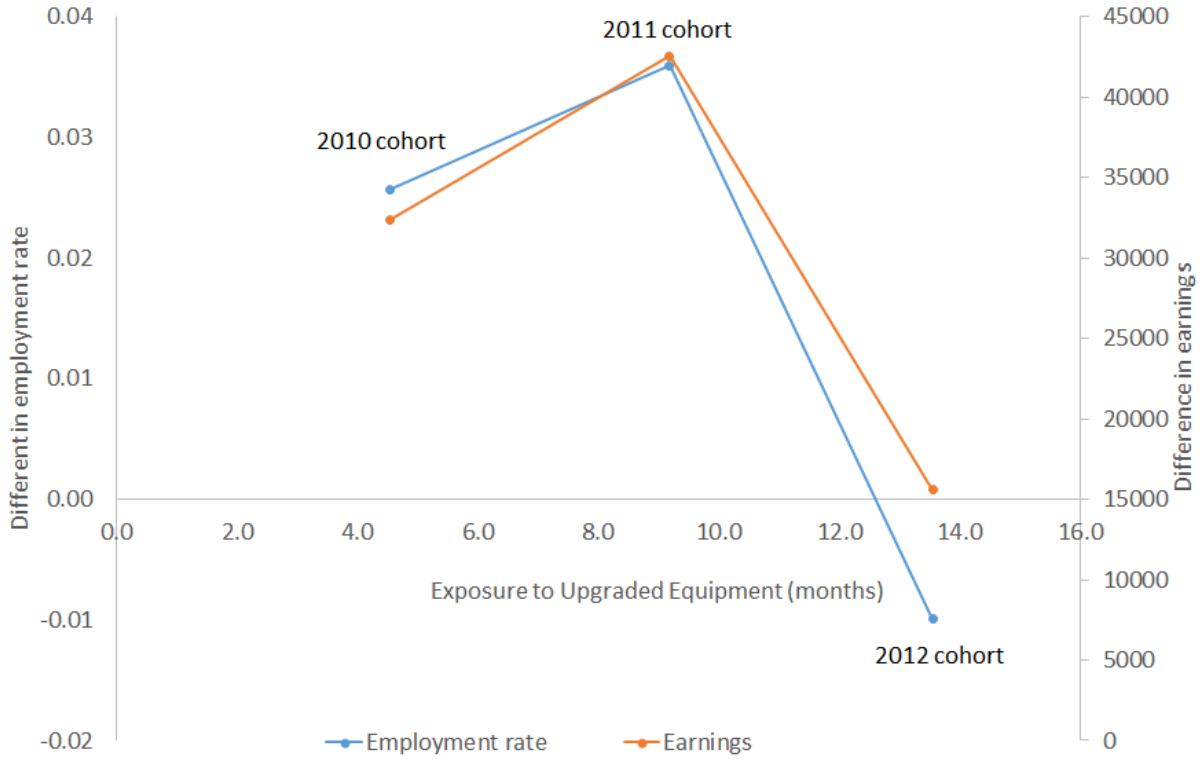
Figure 16. Most recent monthly earnings by cohort and treatment status



These patterns suggest that, similar to the results for employment, exposure to equipment upgrades did not improve earnings for affected students.

To summarize, the large increases in exposure to upgraded equipment across cohorts were not accompanied by significant or consistent increases in employment or earnings. When we estimate the differences in employment rate and earnings between improved and non-improved trades for the 2011 cohort, they are larger than those for the 2010 cohort but not statistically significantly so. Moreover, the differences in the employment rate and earnings between improved and non-improved trades decline markedly from the 2011 cohort to the 2012 cohort, despite the continued increase in exposure to upgraded equipment in improved trades. This can be seen graphically below over the full sample for our preferred measures of (ever in paid) employment and (average monthly) earnings:

Figure 17. Difference in employment and earnings between improved and non-improved trades



D. Effects of Exposure to Equipment Upgrades

In this section, we evaluate the impact of exposure to equipment upgrades directly by estimating the impact of an additional month of exposure to equipment upgrades on employment, earnings and other outcomes. As explained earlier, this approach essentially applies the intuition described in the preceding section in a more formal statistical framework: i.e. using the variation in exposure to equipment upgrades across cohorts to derive the impact of exposure to equipment upgrades.

1. Employment

Table 34 below presents the results from this estimation procedure on our standard set of employment outcomes from the GFU survey:

Table 34. Impact of exposure to upgraded equipment on employment, all and by gender (GFU)

Samples	(1) **Currently employed in paid job (>1 month)**	(2) **Ever employed in paid job (>1 month)**	(3) **Ever employed in paid job (any)**	(4) **Ever employed in paid or unpaid job (any)**	(5) N
All	0.00418	-0.00358	-0.00518	-0.00514	7,706
	(0.00473)	(0.00530)	(0.00474)	(0.00350)	
Males	0.00327	-0.00628	-0.0104*	-0.00421	4,732
	(0.00542)	(0.00597)	(0.00531)	(0.00386)	
Females	0.0183	0.0104	0.0238	0.00405	2,974
	(0.0141)	(0.0157)	(0.0163)	(0.0116)	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Overall, exposure to upgraded equipment does not appear to improve employment outcomes. The estimates are always positive for female but far from statistically significant. The estimates for men are mixed but also largely insignificant (with one marginally significant coefficient that is negative). Most of these estimates are also fairly precise. For example, given the coefficient and standard errors in column (2) of Table 34 showing the likelihood of being ever employed in a paid job over a month, we can rule out effects larger than 0.68 percentage points. With employment rates of approximately 60% in 2010 and 2011, this appears to be a precisely estimated zero.

We examine the impact of exposure to upgraded equipment on employment in subsequent years using the Tracking surveys for the 2010 and 2011 cohorts. These took place approximately one year following the GFU surveys, or 15-24 months after students' theoretical graduation. These estimates are shown in the table below:

Table 35. Impact of exposure to upgraded equipment on employment (2010 and 2011 cohorts only)

Samples	(1) **Currently employed in paid job (>1 month)**	(2) **Ever employed in paid job (>1 month)**	(3) **Ever employed in paid job (any)**	(4) **Ever employed in paid or unpaid job (any)**[73]	(5) N
All: Tracking 2 years out	0.00535	-0.00602	-0.00613	-	5,103
2010 & 2011	(0.0144)	(0.0125)	(0.0109)	-	
Males: Tracking 2	0.00336	-0.0169	-0.0187	-	3,017
years out 2010 & 2011	(0.0175)	(0.0147)	(0.0128)	-	
Females: Tracking 2	0.0719	0.0440	0.0551	-	2,086
years out 2010 & 2011	(0.0925)	(0.0881)	(0.0920)	-	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Again, it does not appear that there are any significant impacts of exposure to upgraded equipment on employment in subsequent years. Due to the smaller sample sizes with just two cohorts, the standard errors in these regressions are somewhat larger and the resulting estimates are less precise. However,

[73] The tracking survey did not ask about unpaid employment

the patterns are similar to those using all three cohorts. To summarize our findings from this section, we do not find evidence for positive impacts of upgraded equipment on employment.

2. Earnings

We evaluate the impact of exposure to equipment upgrades on earnings directly by estimating the effect of an additional month of exposure to equipment upgrades. Again, we use the variation in exposure to equipment upgrades across cohorts to derive the impact of exposure to equipment upgrades. Table 36 presents the results from this empirical specification on our standard set of earnings outcomes using the GFU survey:

Table 36. Impact of exposure to upgraded equipment on earnings in GFU survey

Samples	(1) **Monthly earnings if currently employed**	(2) **Most recent monthly earnings**	(3) **Average earnings per month**	(4) **Total earnings**	(5) N
All	883.2	-1,626	-758.2	839.3	7,706
	(4,002)	(4,728)	(4,462)	(34,524)	
Males	2,046	-260.8	544.5	16,758	4,732
	(4,821)	(5,546)	(5,213)	(42,115)	
Females	8,775	-3,362	-3,148	-17,114	2,974
	(8,048)	(11,194)	(10,800)	(61,139)	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As with employment, exposure to upgraded equipment does not appear to increase earnings for either men or women. The estimates are sometimes positive and sometimes negative but always insignificant. They are also quite precisely estimated. For example, given the coefficient and standard errors in column (3) of Table 34 showing average earnings per month, we can rule out effects larger than 8000 MNT. With earnings ranging between 250,000 and 450,000 MNT across our various subgroups, this is a fairly precisely estimated zero effect. Furthermore, it is consistent with the patterns we observed for the impact of admission to upgraded trades on earnings across cohorts.

Finally, we can examine the impact of exposure to upgraded equipment on earnings using the Tracking surveys for the 2010 and 2011 cohorts which took place approximately 15-24 months following the GFU surveys. These estimates are shown in the table below:

Table 37. Impact of exposure to upgraded equipment on earnings using Tracking survey[74]

Samples	(1) **Monthly earnings if currently employed**	(2) **Most recent monthly earnings**	(3) **Average earnings per month**	(4) **Total earnings**	(5) N
All: Tracking 2-2.5 years out 2010 & 2011	-4,163 (12,860)	-30,414* (15,708)	-20,241 (14,184)	-8,675 (173,662)	5,103
Males: Tracking 2-2.5 years out 2010 & 2011	-9,109 (16,290)	-37,126* (19,902)	-22,167 (17,614)	-76,371 (219,412)	3,017
Females: Tracking 2 years out 2010 & 2011	35,694 (44,240)	-51,241 (65,445)	-46,523 (62,256)	613,797 (674,850)	2,086

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Again, it does not appear that there are any significant impacts of exposure to upgraded equipment on earnings in subsequent years, although the estimate are somewhat less precise. Thus, to summarize, we do not find evidence for positive impacts of upgraded equipment on earnings.

3. Intermediate Outcomes

We investigated a number of intermediate outcomes to better understand the mechanisms underlying the absence of impacts on employment and earnings. All of these outcomes were reported in the GFU survey in the year after expected graduation.

We first examine four outcomes related to the trades that individuals studied in TVET schools: (1) their standardized scores on a test of trade-related knowledge in their top-ranked trade, (2) their standardized scores on a test of trade-related knowledge in their 2nd-ranked trade, (3) whether individuals were currently employed in a paid job of longer than 1 month related to their TVET trade, and (4) whether individuals were ever employed in a paid job of longer than 1 month related to their TVET trade. The impacts of exposure to upgraded trades on these outcomes are presented below:

[74] The number of observations is smaller than in other tables as we only include Wave 3 and Wave 4 Tracking survey estimates for the 2010 and 2011 cohorts, respectively.

Table 38. Impact of exposure to upgrades on trade outcomes, all and by gender (2 year programs)

Samples	(1) **Currently employed in trade studied**	(2) **Ever employed in trade studied**	(3) **Std. Test score on 1st ranked trade test**	(4) **Std. Test score on 2nd ranked trade test**
All	0.000161	-0.00650	0.00348	-0.0130
	(0.00264)	(0.00471)	(0.0117)	(0.0123)
	N=7,706	*N=7,706*	*N=6,784*	*N=5,973*
Male	-0.000987	-0.00784	-0.00004	-0.0109
	(0.00309)	(0.00549)	(0.0135)	(0.0146)
	N=4,732	*N=4,732*	*N=4,223*	*N=3,906*
Female	0.000904	-0.00402	0.00529	-0.0220
	(0.00484)	(0.0123)	(0.0347)	(0.0291)
	N=2,974	*N=2,974*	*N=2,561*	*N=2,067*

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

We also examine several factors related to employment and work intensity: (1) whether individuals applied for or were offered job, (2) total months employed in paid jobs of longer than one month, (3) average number of days worked per month, and (4) average number of hours worked per day. The impacts of exposure to upgraded trades on these outcomes are presented below:

Table 39. Impact of exposure to upgrades on work intensity, all and by gender (2 year programs)

Samples	(1) **Applied for or was offered a job**	(2) **Total months employed (>1 month)**	(3) **Average days per month worked**	(4) **Average hours per day worked**	(5) N
All	-0.00370	0.00111	-0.0689	0.00732	7,706
	(0.00502)	(0.0466)	(0.144)	(0.0557)	
Male	-0.00831	-0.00147	-0.122	-0.0145	4,732
	(0.00577)	(0.0561)	(0.162)	(0.0629)	
Female	0.0248	0.0149	0.281	0.0549	2,974
	(0.0156)	(0.0828)	(0.430)	(0.162)	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Finally, we examine the type and sector of employment in more detail by considering the following outcomes: (1) whether individuals are employed in in internships, (2) whether individuals are self-employed, (3) whether individuals are employed in the government sector, and (4) whether individuals are employed in the private sector.[75] The impacts of admission exposure to upgraded trades on these outcomes are presented in the table below:

[75] There are additional employment types and employment sectors (e.g. military, non-profits) but these represent a very small fraction of overall employment.

Table 40. Impact of exposure to upgrades on employment type and sector, all and by gender (2 year programs)

Samples	(1) **Employment type: Internship**	(2) **Employment type: Self-employed**	(3) **Employed in Government sector**	(4) **Employed in private sector**	(5) N
All	-0.00368	0.00245	-0.00152	-0.00379	7,706
	(0.00437)	(0.00221)	(0.00224)	(0.00530)	
Male	-0.00266	0.00186	-0.00228	-0.00561	4,732
	(0.00499)	(0.00270)	(0.00253)	(0.00605)	
Female	-0.00325	0.00733	0.0106	-0.00374	2,974
	(0.0129)	(0.00653)	(0.00784)	(0.0149)	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

To summarize, none of the estimates of impacts on intermediate outcomes are significant. Given the absence of impacts on these intermediate outcomes, it may not be surprising that we do not find impacts on employment and earnings.

4. Expectations, Assets, and Expenditures

Exposure to upgraded equipment could also have impacts beyond the labor market. We consider impacts on future expectations, household assets, and expenditures. All of these outcomes were reported in the GFU survey in the year after expected graduation.

Almost none of the estimates in the tables below are significant, and those that are significant are only marginally so, such that we cannot rule out the presence of spurious correlation associated with multiple hypothesis testing. However, given the absence of impacts on employment and earnings, it is not surprising that we do not find impacts on other outcomes.

We begin by considering future expectations on several different dimensions: (1) expected number of weeks to find next job, (2) expected number of months employed in the following year, (3) expected monthly earnings one year from now, and (4) future plans to enroll in any education program. The impacts of exposure to upgraded equipment on these outcomes are presented in the table below:

Table 41. Impact of exposure to upgrades on future expectations, all and by gender (2 year programs)

Samples	(1) **Weeks to find next job**	(2) **Months employed, 1 year from now**	(3) **Monthly earnings, one year from now**	(4) **Plans to enroll in education program**
All	-0.0243	-0.0417	-14,144*	0.00269
	(0.0199)	(0.0370)	(8,573)	(0.00526)
	N=7,532	*N=7,697*	*N=7,559*	*N=7,706*
Male	-0.0406*	-0.0376	-10,672	0.00499
	(0.0236)	(0.0410)	(8,833)	(0.00584)
	N=4,614	*N=4,726*	*N=4,647*	*N=4,732*
Female	0.0134	-0.0119	-29,974	0.000429
	(0.0426)	(0.120)	(22,181)	(0.0160)
	N=2,918	*N=2,971*	*N=2,912*	*N=2,974*

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

We collected detailed information about household assets in the GFU survey. However, for the analysis here, we constructed standardized indices of assets in several broad categories: (1) an index of ownership of utilities such as fridges, stoves, TVs, etc., (2) an index of transportation assets such as cars, trucks, tractors, etc., (3) and an index of livestock assets such as cattle, horse, sheep, etc., and (4) total financial assets.[76] The estimated impacts for these outcomes are presented in the table below:

Table 42. Impact of exposure to upgrades on assets, all and by gender (2 year programs)

Samples	(1) **Std. Utility ownership index**	(2) **Std. Transportation assets index**	(3) **Std. Livestock assets index**	(4) **Std. Total financial assets (MNT)**	(5) N
All	0.00368	0.0115	-0.000263	-0.00859	7,706
	(0.0106)	(0.0116)	(0.00971)	(0.00874)	
Male	0.0133	0.0154	0.00526	-0.0104	4,732
	(0.0120)	(0.0131)	(0.0115)	(0.0112)	
Female	-0.0414	-0.00801	-0.0350	-0.00452	2,974
	(0.0329)	(0.0272)	(0.0245)	(0.0130)	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Finally, we examine the impacts of standardized indices of expenditures in several categories: (1) an index of expenditures on frequent consumed items such as food, alcohol, and entertainment, over the past 30 days (2) an index of expenditures on less frequently consumed items such as shoes, clothes, and jewelry, over the past 12 months, (3) an index of transfer to friends and family over the past 12 months, and (4) an index of expenditure on education over the past 12 months. These outcomes are presented in the table below:

[76] The first three indices were constructed by standardizing the sum of the standardized number of each asset. Appendix C1 contains estimates for impacts on each specific asset. However, these need to be interpreted with care because there is potential for spurious significance due to multiple hypothesis testing.

Table 43. Impact of exposure to upgrades on expenditures, all and by gender (2 year programs)

Samples	(1) **Std. Expenditures (30d) index**	(2) **Std. Expenditures (12m) index**	(3) **Std. Transfers index**	(4) **Std. Education expenditure index**	(5) N
All	-0.00825	-0.00145	-0.0141	-0.00235	7,706
	(0.00973)	(0.0101)	(0.0100)	(0.0101)	
Male	-0.00495	0.00771	-0.0127	-0.00273	4,732
	(0.0114)	(0.0119)	(0.0120)	(0.0117)	
Female	-0.0359	-0.0507*	0.00315	0.0108	2,974
	(0.0236)	(0.0270)	(0.0210)	(0.0259)	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The section that follows briefly discusses our response to MCC's ERR estimates before we turn to implications of our findings.

E. Evaluator's post-compact ERR estimate and comparison with ex-ante ERR projections and M&E Plan targets

As shown in Sections VI.C. and VI.D. above, we do not find evidence that exposure to training on upgraded equipment resulted in higher wages and employment for our sample of TVET students admitted through the lottery at 10 Evaluation schools. As noted in Section II.C, the last available version of the MCC Economic Rates of Return projections for the VET Project dates from 2007, before the addition of the equipment upgrades component. Without the projected rates of return associated with equipment upgrades, we are not able present a meaningful comparison with our findings.

The next section discusses some of the assumptions made in our project logic and why we might not observe effects on earnings and employment.

F. Implications of Estimated Impacts on the Project Logic

How do our estimated impacts inform the program logic that underlies this study? Are there any specific links in the program logic that were missing in practice? What potential issues may have led to the absence of significant impacts on employment and earnings?

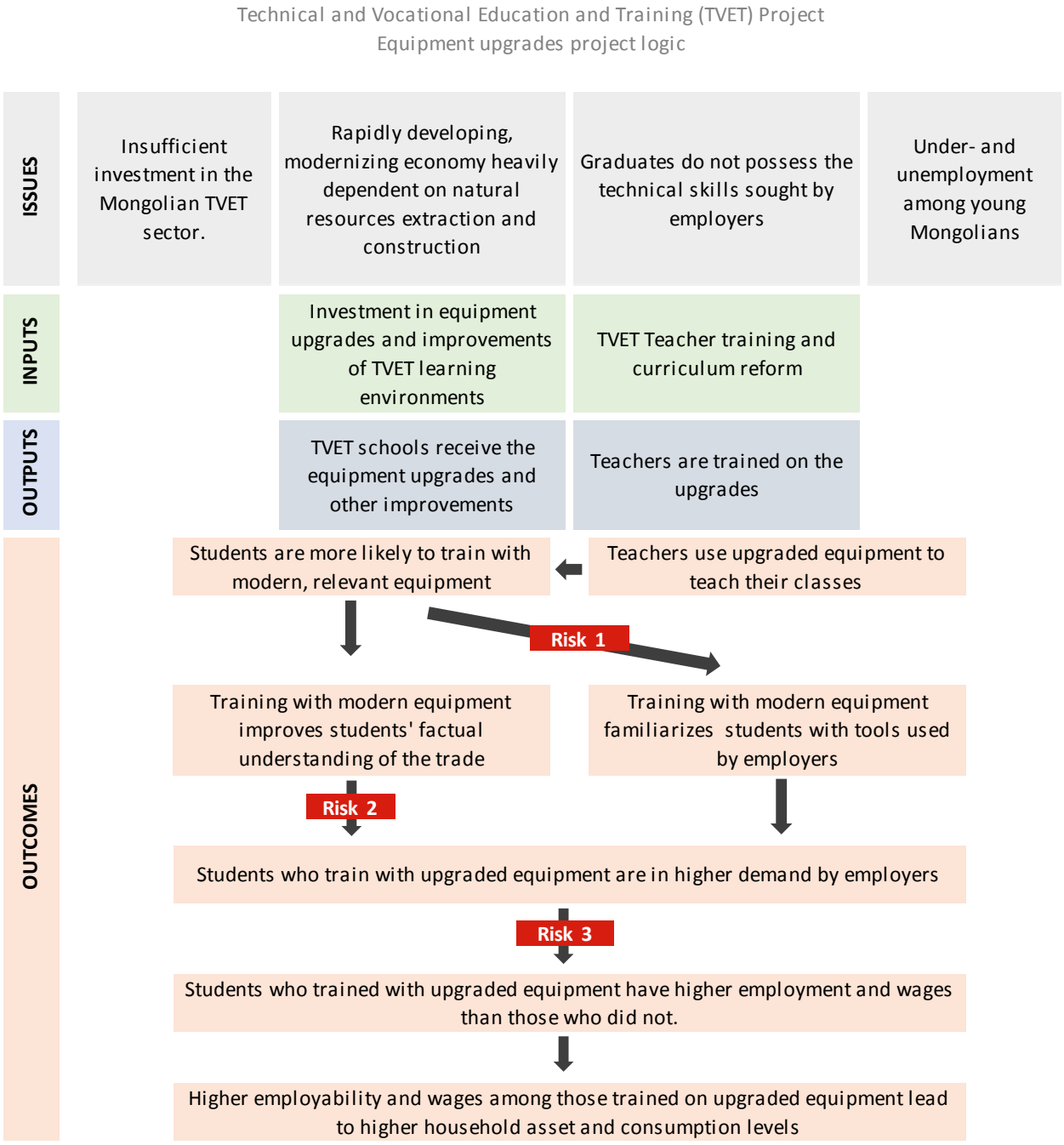
We have strong evidence that schools received equipment upgrades, as documented in this report. Unfortunately, we have less evidence about the extent to which teachers were trained to use the upgraded equipment or exactly how much more likely students were to train with the upgraded equipment. The classroom observations only recorded whether teachers used "technical equipment" and not whether that equipment was of the upgraded type. Nevertheless, we believe that the implementation of the equipment upgrades was generally successful in providing inputs and generating some of the proximate outputs.[77] Additional information about program implementation would have been extremely valuable. These issues were not considered at the time of the project design and weren't part of the Monitoring & Evaluation plan.

One potential issue that emerges from our analysis of impacts on intermediate outcomes is that exposure to upgraded trades did not improve students' factual understanding of the trade. However, it is possible that the tests used to measure student knowledge of the trade did not distinguish between the skills learned with different types of equipment. Unfortunately, it was not feasible to evaluate student familiarity and knowledge of different types of equipment with practical tasks on the machines themselves.

An important gap in understanding potential missing links in the program logic, reproduced in Figure 18 below, is the lack of information about employers.

[77] More anecdotally, we visited almost every evaluation school over the years where we saw the installed upgrades and, in some cases, briefly observed classes taught by teachers of those trades. Discussions with teachers in TVET schools suggested that many but not all teachers had the necessary training to operate the upgraded equipment

Figure 18. Equipment upgrades project logic (Innovations for Poverty Action)



We did not survey employers directly about whether training with upgraded equipment familiarized students with the necessary tools to make valuable contributions. Moreover, we do not know whether students who trained with upgraded equipment were preferred by employers as compared to those who trained on older equipment.[78] While there are certainly some logistical challenges to surveying employers

[78] For example, a training manager from a large employer in Mongolia noted that they preferred to train workers with their own machines which were different (and cheaper) than the upgraded equipment used in TVET schools.

which are affected by TVET reforms, future evaluations of vocational and technical education should consider ways of gathering such information.

Finally, it is important to remember that one of the reasons that we do not find significant impacts may be because the labor market opportunities for those who studied upgraded or improved trades deteriorated relative to those who studied other trades. Indeed, there is some evidence for a general deterioration of labor market opportunities for individuals admitted to TVET schools in the 2012 cohort (see the results in Appendix F1). Perhaps this weakening of the labor market was more significant for graduates of upgraded trades. Unfortunately, because we were not able to randomly assign upgraded equipment across schools or trades, we cannot rule out this alternative explanation for the absence of significant impacts. Future evaluations should heed the challenges inherent in research designs that do not rely solely on random assignment.

VII. Conclusions

The Vocational Education and Training Project is one of the five overarching Millennium Challenge Account Mongolia (MCA-M) projects funded by the Millennium Challenge Corporation. The project aims to alleviate the mismatch that exists between the supply and demand for skilled labor by providing young Mongolians with an opportunity to study in a modern vocational educational environment. This follow-up report presents results from a rigorous impact evaluation of sub-activity 5.1 of the VET project: Improvement of Learning Environments in selected schools through equipment upgrades in 10 Technical and Vocational Education Training schools. The report describes the VET Project's implementation, evaluation design and collection of baseline and follow-up data between 2010 and 2015 and presents the descriptive characteristics of applicants in the 2010, 2011, and 2012 cohorts to the 10 TVET schools which participated in the impact evaluation. However, the primary purpose of the report is to evaluate the impact of exposure to upgraded equipment in TVET schools on measures of employment and income of young Mongolians.

We do not find evidence for positive impacts of exposure to upgraded equipment on employment or earnings. Moreover, we can rule out fairly modest impacts on employment and earnings. There is also no evidence for impacts on intermediate or other outcomes. Why do we not find positive impacts from exposure to upgraded equipment? A number of factors may have been responsible: It is possible that, although received by schools, the upgraded equipment was not appropriately or sufficiently used by teachers of improved trades. Another possibility is that employers did not value students who were exposed to upgraded equipment more than those who were not, or could not differentiate between them. There is anecdotal evidence from discussions and observations for all of these factors. The available data is, however, insufficient for their systematic assessment. An alternative explanation is that labor market opportunities for those who studied upgraded or improved trades deteriorated relative to those who studied other trades. Indeed, there is some evidence for a general deterioration of labor market opportunities for individuals admitted to TVET schools in the 2012 cohort.[79] Estimates for the effect of exposure to equipment upgrades that only use data from the 2010 and 2011 cohort are generally insignificant. However, because we were not able to randomly assign upgraded equipment across schools or trades, we cannot rule out these alternative explanations for the absence of positive impacts. Future evaluations should heed the challenges inherent in research designs that do not rely solely on random assignment.

In addition to enabling this evaluation, the resulting data collection effort also provides valuable information about Mongolian TVET schools in general. To our knowledge, this is the only large scale longitudinal survey of such students in Mongolia. In 2011, for example, the 10 TVET schools that participated in the evaluation enrolled 23 percent of all students in a TVET program in Mongolia. The numerous questionnaires used in this study were developed in close coordination with MCA-Mongolia and the participating TVET schools. For instance, we developed the Admissions Survey and baseline aptitude tests based specifically on the needs expressed by each of the ten schools participating in the

[79] Follow-up data on applicants from the 2012 cohort was collected in 2015 using the Graduate Follow-Up (GFU) survey. The downturn in the economy during 2015 led to a deterioration of employment and earnings outcomes for all individual. Moreover, the estimated impacts of admission to a TVET school for students on current employment and earnings were insignificant for all cohorts using Wave 4 data collected in 2015

evaluation. This is a rich data set that could easily be used to investigate other questions of interest to the Government of Mongolia and researchers.

Several other aspects of the data could be of interest to the TVET schools themselves. First, while these schools collect some statistics on their students, they have almost no information on how their students fare after graduation and what options unadmitted students pursue after being declined admission. Second, the lottery process itself has proved potentially useful. After the randomization of the last cohort was complete, we were asked to provide a training conference for the VET schools in how to conduct the lottery-based admissions process so that they could continue using this process. Finally, during the recruitment process, the schools expressed a desire to identify which types of students benefit most from training so that they could target admissions towards these students when their programs are over-subscribed. The data we collected could be used to correlate student characteristics with various outcomes, such as the likelihood that students complete the program or their chances of finding a job, in order to better target admissions policies.

Finally, the data can be used to build on the growing body of research into the effects of vocational training more generally. This evaluation's research design used lotteries to determine admission to trades and schools, making it possible to estimate the impact of admission to a TVET school. This is an important parameter for assessing the value of technical and vocational education in Mongolia. To the extent that TVET schools provide valuable skills that are desired by employers in the labor market, those who are admitted are more likely to be employed and to receive higher earnings. Appendix VIII.E of this report provides a detailed analysis of this ancillary research question. Indeed, we do find that admission and graduation from TVET schools led to some significant improvements in employment and earnings, especially for women. These findings are consistent with the presence of a shortage of vocational students in Mongolia, at least during periods of economic boom—one of the key assumptions underpinning the choice of the TVET sector as a focus of the Mongolia Compact.

A. Dissemination procedures

IPA held a dissemination event in Mongolia in May 2017 with relevant Mongolian stakeholders. Attendees included representatives from the Ministry of Labor, the Institute of Labor Studies, the Ministry of Education, Cabinet Secretariat, TVET school directors and representatives of other donor agencies and private companies that have invested in vocational education in Mongolia. IPA researchers will also present the findings from the study in Washington D.C. with relevant MCC stakeholders and may seek to publish them in an academic journal.

B. Additional analysis and deliverables

IPA plans to write policy briefs and disseminate the results through the IPA and JPAL (Abdul Latif Jameel Poverty Action Lab) network. IPA has a dedicated team that seeks to publicize results through various media outlets.

IPA-affiliated researchers may seek to publish other findings based on the TVET data in academic journals and as policy briefs.

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Appendix

A. Background information

Table 44. List of Regional Methodological Centers (RMC) and Centers of Excellence (CoE). Evaluation schools highlighted in blue.

School name	Designation
Darkhan-Urguu VTPC	RMC
Dornod-Phased VTPC	RMC
Dundgobi VTPC	RMC
Gobisumber CTPV	CoE in mining
Orkhon VTPC	RMC
UB School of Health Technology	CoE in health
UB School of Production and Arts	RMC
UB Technical and Technological College	CoE in construction
Zavkhan VTPC	RMC

Table 45. Equipment upgrade delivery dates at TVET non-evaluation schools[80]

VET Schools	Heavy Machine Operator	Lathe-Milling	Electricity & Electronics	Plumbing	Welding	Heating & Cooling Technology	Hydraulics & Pneumatics	Vehicle Mechatronics	Mechanics & Transmissions	Engine
Arkhangai VTPC			3/2012	3/2012	6/2012					
Darkhan-Urguu VTPC	8/2013									
Dundgobi VTPC			3/2012	3/2012	7/2012					
Gobisumber VTPC	2/2012	11/2012	3/2012		11/2012		7/2012	7/2012	7/2012	7/2012
Khugjil VTPC, Khovd	2/2012		3/2012							
Nalaikh VTPC	1/2012		3/2012			1/2012	7/2013			
Selenge VTPC			5/2012	5/2012	6/2012					
Technical and Technological College, UB	1/2012		4/2012	3/2012	7/2012		5/2012	5/2012	5/2012	
Tuv VTPC			7/2012	7/2012	6/2012					
Zavkhan VTPC	8/2013			3/2012	7/2012					
Nursing School			5/2012							
School of Art and Production			6/2012		8/2013		5/2012			
Mechanical Engineering			5/2012				5/2012			
Food Technology College			5/2012				5/2012			

VET Schools	Concrete and reinforcement	Carpentry	Geodesy	Plastering & decoration	Auto mechanical	Medical Lab	Mechatronics	Mechanics	Sewing
Arkhangai VTPC									
Darkhan-Urguu VTPC					8/2013				
Dundgobi VTPC									
Gobisumber VTPC									
Khugjil VTPC, Khovd									
Nalaikh VTPC									
Selenge VTPC									
Technical and Technological College, UB	3/2012	2/2012	2/2012	2/2012			5/2012	5/2012	
Tuv VTPC									
Zavkhan VTPC									
Nursing School						1/2011	5/2012		10/2012
School of Art and Production							5/2012	5/2012	
Mechanical Engineering							5/2012	5/2012	
Food Technology College							5/2012	5/2012	10/2012

[80] Source: MCA-Mongolia

Table 46. Trades affected by MCC-sponsored equipment upgrades

EQUIPMENT CATEGORY	HEATING AND COOLING	ELECTRICITY AND ELECTRONICS	WELDING	LATHING
TRADES AFFECTED	Construction plumbing	Construction machine, Machinery repairs	Welding	Construction plumbing
	Welding	Agriculture machine, equipment repair	Construction plumbing	Welding
	Construction machine, Machinery repairs	Automobile repairs, usage	Concrete reinforcement	Construction machine, Machinery repairs
	Agriculture machine, equipment repair	Light industry equipment repairs, building	Agriculture machine, equipment repair	Agriculture machine, equipment repair
	Automobile repairs, usage	Electrical machine installer	Automobile repairs, usage	Automobile repairs, usage
	Heavy machine equipment technician	Heavy machine equipment technician	Wood and household carpenter	Heavy machine equipment technician
	Light industry equipment repairs, building	Lathing	Electrical machine installer	Lathing
	Construction montage	Tractor Driver, its Usage and Driver	Heavy machine equipment technician	Tractor Driver, its usage and driver
	Tractor Driver, its usage and driver	Bulldozer driver, its repairs and usage	Lathing	Bulldozer Driver, its repairs and usage
	Bulldozer driver, its repairs and usage	Mining technique and usage	Tractor Driver, its usage and driver	Mining technique and usage
	Mining technique and usage	Petroleum - equipment repair	Bulldozer driver, its repairs and usage	Engine repair
	Engine repair	Circuit repair	Mining technique and usage	Mountain work machine, equipment repair
	Small and medium Industry electrician	Engine repair	Circuit repair	
	Technology line installer	Small and medium Industry electrician	Mountain work machine, equipment repair	
	Wood and household carpenter	Technology line installer	Technology line installer	
		Construction montage		
		Carpet production equipment repair		

EQUIPMENT CATEGORY	PLUMBING	SEWING AND COMPUTER LAB	HEAVY MACHINERY OPERATOR
TRADES AFFECTED	Construction plumbing	Computer operator /Secretary/	Mining technique and usage
	Welding	Carpet production equipment repair	Bulldozer driver, its repairs and usage
	Concrete reinforcement	Clothing repair, design	tractor driver, its usage and driver
	Lathing	Sewing, sewing production	Road, construction machinist
	Petroleum - equipment repair	Leather, suedette material tailor sewer	Excavator machinist
		Accountant-financial assistant	Mountain work machine, equipment repair
		Secretary	Agriculture machine, equipment repair
			Heavy machine equipment technician

Table 47. Admissions lottery dates by school, year and round[81]

School	2010 Round 1	2010 Round 2	2011 Round 1	2011 Round 2	2012 Round 1	2012 Round 2
Gobi-Altai VTPC	15-Jun-10	2-Sep-10	29-May-11	30-Aug-11	4-May-12	3-Jul-12
Dornod Phased	15-Jun-10	3-Sep-10	10-Jun-11	31-Aug-11	18-Jun-12	30-Aug-12
Dornod VTPC	15-Jun-10	3-Sep-10		2-Sep-11		
Darkhan VTPC	23-Jun-10	5-Sep-10	25-Jun-11	30-Aug-11	25-Jun-12	1-Sep-12
Orkhon VTPC	17-Jun-10	3-Sep-10	23-Jun-11	30-Aug-11	21-Jun-12	29-Aug-12
Bayan-Ulgii VTPC		5-Sep-10	25-Jun-11	28-Aug-11	10-Jun-12	30-Aug-12
Umnugobi VTPC	2-Jul-10	2-Sep-10	1-Jul-11	27-Aug-11	1-Jul-12	26-Aug-12
Construction college	6-Jul-10	16-Aug-10	7-Jul-11	30-Aug-11	2-Jul-12	30-Aug-12
Mongol-Korea VTPC	1-Jul-10	30-Aug-10	5-Jul-11	30-Aug-11	5-Jul-12	30-Aug-12
Ulaangom VTPC		4-Sep-10	30-May-11	27-Aug-11	5-May-12	23-Aug-12

Table 48. Equipment upgrades reported by TVET schools through the Secondary Information survey (2013)

TVET school	School selected for equipment upgrades	Number of equipment upgrades reported from Governments/NGOs	Number of equipment upgrades reported from private sector
1. Gobi Altai VTPC	Yes	5	0
2. Dornod PTC	Yes	6	3
3. Dornod VTPC	Yes	0	4
4. Darkhan-Uul VTPC	Yes	3	0
5. Orkhon VTPC	Yes	3	1
6. Bayan-Ulgii VTPC	Yes	3	0
7. Umnugobi VTPC	Yes	3	4
8. PTC of MUST	Yes	6	1
9. Mongol korean polytecnic college	Yes	2	2
10. Ulaangom VTPC	Yes	5	2
11. Darkhan-Urguu VTPC	Yes	3	1
12. Darkhan PTC	Yes	1	3
16. Arkhangai ar VTPC	Yes	2	0
17. Dundgobi VTPC	Yes	5	1
18. Selenge VTPC	Yes	5	0
20. Selenge Shaamar VTPC	Yes	3	0
21. Gobisumber PTC (Coe)	Yes	8	0
26. Nalaikh VTPC	Yes	0	8
30. VTPC at Mechanical engineering school of MUST	Yes	2	2
32. Institute of Technique and technology	Yes	2	5
34. Production and Art PTC	Yes	6	0
35. Construction technology college	Yes	1	1
36. Food technology college	Yes	3	2
38. Khovd Khugjil PTC	Yes	3	0

[81] Source: MCA-Mongolia & IPA

40. Zavkhan VTPC	Yes	5	2
44. Khentii VTPC	Yes	1	1
46. Uvurkhangai Technological school of MUST	Yes	1	1
47. Bulgan VTPC	Yes	2	2
49. Tuv zaamar VTPC	Yes	2	1
50. Tuv Erdene VTPC	Yes	3	1
13. Darkhan-Uul branch of Univeristy of agriculture	No	0	0
14. Orkhon technical school of MUST	No	0	1
15. Orkhon agriculture VTPC	No	0	0
19. Selenge Zuunkharaa VTPC	No	0	0
22. Tuv VTPC	No	0	0
23. USI TVET	No	0	0
24. Amidrakh Uhaan VTPC	No	0	1
25. Khangai Institute	No	0	0
27. Mongol farmer VTPC	No	0	0
28. School of health technology (Coe)	No	0	0
29. Ikh zasag VTPC	No	0	0
33. Baz school	No	0	0
37. Donbosko VTPC	No	0	0
41. Bayankhongor VTPC	No	0	0
42. Dornogobi VTPC	No	0	2
43. Khentii Bor-Undur VTPC	No	0	1
45. Sukhbaatar technological school of MUST	No	0	2
48. Khuvsgul VTPC	No	4*	1
51. Wood capacity center of MUST	No	0	0
52. Arkhangai Province Bulgan VTPC	No	0	1

*Khuvsgul received upgrades from the Asian Development Bank

Note 1. Admissions lottery process

After confirming all the details with the schools, IPA prepared a computer program to randomly assign applicants into trade slots. Lottery observers were able to watch each of the following steps of the lottery computer program via projection screen:

1. The computer program generates a list of all applications received and prints them. The printout is stamped and signed by official witnesses designated by the school.
2. The computer program then identifies the unqualified applicants that do not meet the schools' minimum criteria for acceptance (such as having a GPA of 60 and a lower secondary school certificate). The list of unqualified applicants is printed, stamped, and signed by official witnesses.
3. The computer program then identifies all qualified applicants that meet the school's minimum criteria for acceptance. The list of all qualified applicants is printed, stamped, and signed by official witnesses. Only applicants on this list are eligible to be included in the lottery.
4. The admissions process then begins, with only qualified students eligible to be assigned a slot.
    a. First the program identifies applicants with preferred status and assigns them to trade slots according to their preferences.

b. The lottery process begins: from the remaining applicants, the program randomly selects applicants one by one and assigns each applicant into his/her top trade preference. To be assigned to a trade, the student must meet the trade-specific criteria.
c. If all the slots in an applicant's top trade preferences are filled, the applicant is assigned their next highest trade preference with an open slot.
d. This process continues until all trade slots are filled. A final list of accepted students for each trade is printed, stamped, and signed by official witnesses.

5. The remaining applicants that were not selected for admissions through the lottery are displayed. This list is printed, stamped, and signed by official witnesses.
6. Finally, the log of the entire computer program is printed and given to schools. This log is provided to schools in case of any disputes as to the lottery's transparency and fairness: interested parties can review the time stamped computer program code.

B. Questionnaire Description

The following briefly summarizes the study's survey instruments.

Admissions Survey[82]

The Admissions questionnaire recorded basic social, economic and demographic characteristics and contact information of students. The survey also served as the application form for the 10 schools that participated in the study. It included a general knowledge test to measure skill levels and academic performance.

Tracking Survey

For the evaluation strategy to succeed, all students had to be tracked and interviewed several times over the period of study. Young and highly mobile, many respondents were expected to relocate during the data collection period. To minimize attrition leading up to the Graduate Follow-Up survey, IPA and MCA-M developed the Tracking survey, which collected updated contact information of respondents, their parents, relatives and friends. For the majority of respondents, the Tracking Survey was administered over the phone. For the minority who could not be reached by phone, it was administered in person. The questionnaire included the following modules:

Contact Information

To maximize the likelihood of finding respondents in later survey rounds, their detailed contact information and that of their family and friends was gathered. This included addresses, phone numbers and e-mails. Respondents were also asked about their residency plans for the upcoming year, with a breakdown of where they would be located during different times of the year.

Educational experience

Information about enrollment, attendance and graduation from up to three educational institutions over the previous 18 months

Employment history, monetary and in-kind earnings, type of employment and duration

Short term and longer-term labor force participation over the previous 18 months and, if employed, about sector, wages and in-kind and gratuity payments for up to three prior jobs.

[82] For an in-depth description of the Admissions questionnaire, please consult the Admissions Baseline Report (2013)

For respondents who had already completed the Graduate Follow-Up survey, the employment and educational attainment questions serve to assess labor market outcomes a number of years after the respondents' graduation from their TVET institution.

The final survey round of 2015 added questions about respondents' compliance with lottery results to gain a better understanding of the reasons behind non-compliance, where applicable.

Graduate Follow-Up Survey

As the primary instrument to capture post-graduation labor market outcomes, the GFU survey was administered after students' expected graduation in order learn about the short-term impacts of studying improved trades. It included the following modules:

Household information

Information about household composition and household dynamics, such as who makes financial decisions and deals with government related matters.

Educational experience and future plans

Enrollment, attendance and graduation information on up to three schools they attended over the last 18 months. Future education plans for up to two schools over the next year and questions on lifetime educational achievement.

Employment history, monetary and in-kind earnings, type of employment and duration

Short (less than one month) and longer-term labor force participation over the previous 18 months. If employed, respondents were asked about the frequency and type of employment, wages, in-kind and gratuity payments, work hours, and related information, such as how they found the job and, if applicable, the reason they were no longer employed. For longer term employment, respondents were asked to provide detailed information on up to four jobs over the previous 18 months.

Employment and earnings prospects

This section covered how long respondents expected it would take to find a new job, what sector they would be employed in and their expected future earnings.

Asset ownership

Household assets, including financial assets.

Consumption and expenditures

Respondents' durable and non-durable consumption and expenditure and transfers (monetary and in-kind) to family and friends.

Contact information

Detailed contact information questions for future surveying efforts, including addresses, phone numbers and e-mails of respondents and their friends and family members. Respondents were also asked about their residency plans over the next year.

Skill Tests

The survey also included trade-specific skill tests. Most respondents took two tests, usually covering their first and second ranked trades. The skill tests serve to measure changes in skill level due to studying a trade at a TVET school.

Finally, the last survey round in 2015 included questions about respondents' compliance with lottery results to gain a better understanding of the reasons behind non-compliance.

Administrative Survey

The Administrative survey was fielded in 2011, 2012 and 2013. Administered to management and administrative staff and teachers, it included the following components:

Management

The Management questionnaire was given to senior school management staff, school directors where possible. They contained questions on school level characteristics such as the price of tuition, enrollment and graduation rates, teacher to student ratios, teacher competence and availability and use of equipment.

Teacher

Teacher questionnaires were given to school teachers and included their basic socio-economic characteristics, impressions of classroom quality, student's ability and behavior and questions on the TVET reforms implemented by MCA-M.

Student Performance

The Student Performance questionnaire was given to the teachers of students enrolled in the TVET schools. Teachers were asked to assess students in three common areas (technical ability, attitude and teamwork), as well as on their understanding of specific concepts that depended on the trade the student was enrolled in.

Classroom Observation

Starting with Wave 2 in 2012, the Administrative Survey included the Classroom Observation questionnaire which assessed teachers' application and utilization of MCA-M funded resources and their teaching methods. The survey was filled out by trained interviewers who recorded their classroom observations in a standardized form.

Secondary Information

Also added in 2012, the Secondary Information questionnaire captured information on enrollment and graduation numbers, curricula, private-public partnerships and grants, funding sources and other donor activities provided by the schools' administrative staff.

The first round of the Administrative Survey covered the 10 evaluation schools and consisted of three parts: Management, Teacher, and Student Performance. The latter two rounds included all the above instruments and were administered in 50 TVET institutions that had benefited from MCA-M investments.[83]

[83] There were a total of 52 VET Project beneficiary schools, but only 50 were included in the survey due to contract issues.

C. Descriptive Analysis of Survey Results

This section contains further descriptive information of this study's sample of students, as well as summary statistics on TVET schools and staff affected by MCC-sponsored investments.

1. Student characteristics

a) Trades studied

Table 49 and Table 50 rank the popularity of trades according to what respondents reported studying or having studied most recently. This sub-sample only includes respondents that attended a TVET school over the time period covered by the survey (7,386 students). The two tables list the students' top 10 most studied 2/2.5 and 1 year trades, respectively. Construction decoration, construction and computer operator are the only three 2/2.5 year trades both genders reported studying most frequently.

Table 49. Top 10 2/2.5 year trades respondents study or studied, by gender

	Top 10 Trades - Males 2/2.5y	Freq.	%	Top 10 trades - Female 2/2.5y	Freq.	%
1	Welding	543	13.1	Cook, Food Production	414	14.8
2	Automobile repairs, usage	497	12.0	Construction Decoration**	390	13.9
3	Construction Plumbing	441	10.7	Sewing, sewing production	344	12.3
4	Construction montage	361	8.7	Computer Operator (Secretary)**	207	7.4
5	Wood and Household Carpenter	352	8.5	Hairdresser, Beautician	164	5.8
6	Construction**	309	7.5	Construction**	162	5.8
7	Construction Decoration**	172	4.2	Others	162	5.8
8	Others	164	4.0	Leather, Suede tailor, sewer	90	3.2
9	Computer Operator (Secretary)**	142	3.4	Weave production	71	2.5
10	Heavy machine equipment technician	141	3.4	Trade worker	58	2.1

**Top 10 trades for both genders

Note: Figures in this table only include respondents that studied a 2/2.5 year trade over the survey period: 2,806 female and 4,135 male 2/2.5 students.

Table 50. Top 10 1 year trades respondents study or studied, by gender

	Top 10 Trades - Male 1 year	Freq.	%	Top 10 trades - Female 1 year	Freq.	%
1	Automobile repairs, usage	34	17.0	Hairdresser, Beautician	50	20.4
2	Construction montage	26	13.0	Cook, Food Production	47	19.2
3	Construction	25	12.5	Sewing, sewing production	35	14.3
4	Others	17	8.5	Construction Decoration	22	9.0
5	Heavy machine equipment technician	16	8.0	Computer Operator (Secretary)	14	5.7
6	Construction Plumbing	14	7.0	Mining rehabilitation	12	4.9
7	Welding	14	7.0	Construction	10	4.1
8	Wood and Household Carpenter	7	3.5	Environment protection	6	2.5
9	Computer Operator (Secretary)	7	3.5	Others	6	2.5
10	Hairdresser, Beautician	7	3.5	Cook	4	1.6

*Top 10 trades for both genders

Note: Figures in this table only include respondents that studied a 1 year trade over the survey period: 245 female and 200 male students.

b) Expectations

When asked about plans and expectations, further descriptive differences emerge among the 1 and 2/2.5 year applicants. If not admitted the (older) 1 year cohort were more likely to seek employment, whereas 80 percent of the applicants to 2/2.5 year programs expected to head to a different school. Applicants to 1 year programs planned to finish their program in over 2.5 years, a longer time period than expected by applicants to 2/2.5 year programs. This could be because they expected to seek a 4-year degree after finishing the initial 1 year course.

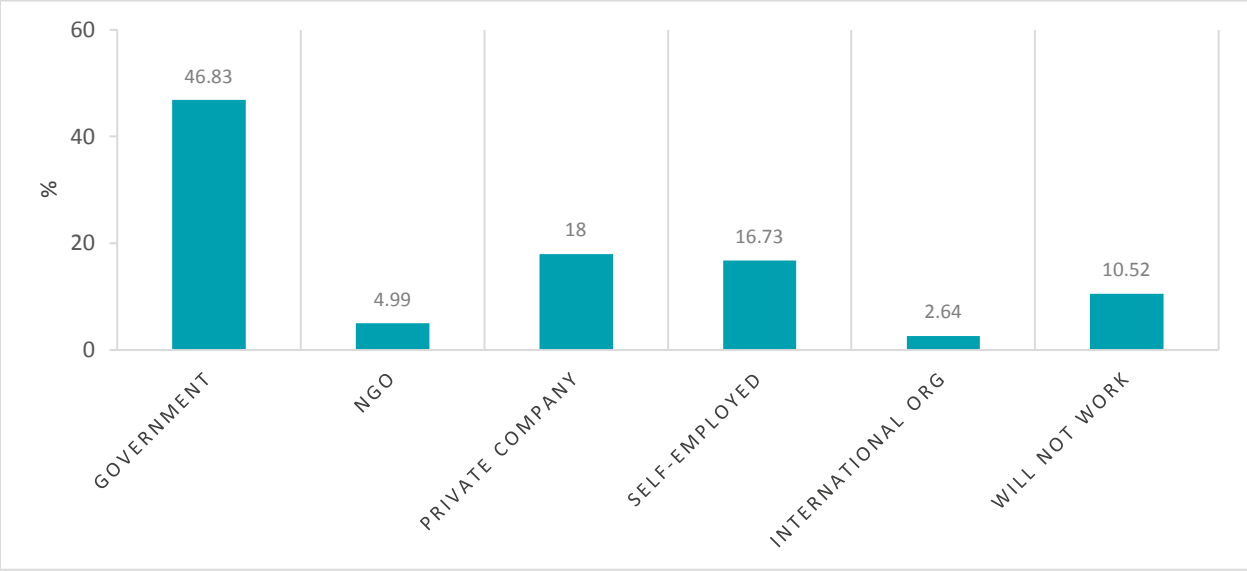
Applicants to 2/2.5 year programs thought they would spend less time looking for employment after graduating and expected a slightly higher starting salary.

Table 51. Expectations

Expectations	1 Year	2/2.5 Year	Total
If not admitted, plan to go to another school (%)	41.3%	80.0%	76.3%
If not admitted, plan to work (%)	50.4%	15.5%	18.9%
Expected years to complete program	2.55	2.32	2.34
Expecting to work while studying (%)	8.6%	8.8%	8.8%
If plan to work after graduation, expected months of job search	4.19	3.26	3.33
If plan to work after graduation, expected salary (MNT)	312,084	315,020	314,795

Finally, most applicants planned to work for the government, followed by the private sector and self-employment. 8 percent would like to join international organizations or NGOs, the remaining 11 percent do not plan to work.

Figure 19. Applicants' planned work sector



c) Characteristics and prospects of those not admitted

This section describes the characteristics and outcomes of unadmitted students. 2,543 of our sample's 12,011 TVET applicants were rejected by the lottery. In theory, rejected applicants should not have been able to enroll at any of the evaluation schools during the year of the lottery. To see whether and how well schools enforced this policy, we take a closer look at compliance with lottery results of those rejected by the process. Table 52 shows that of the 2,543 respondents not accepted to the school of their choice, 797, or 31 percent, managed to get into that school during or subsequent to the year they first applied. Of those that circumvented the rejection, 25 percent, or 647, did so in the same year as the lottery was held.[84]

Table 52. Compliance of respondents rejected by the lottery

Compliance	Number	Percent
Complied with lottery result	1,746	68.7%
Did not comply with lottery rejection a year or more after the lottery	150	5.9%
Did not comply with lottery rejection during the same year	647	25.4%
Total rejected by lotteries	2,543	100%

That does not mean all these 647 unadmitted students were able to study the trades they applied for during their lottery year. The application process asked applicants to rank up to ten trades according to their preferences. As Table 53 shows, of the 647 applicants who managed to study at the school they were rejected from in the year they were rejected, 353 studied a trade they had ranked in their top 10 during the applications process. Among those, 57 percent got into their top ranked trade.

Table 53. Ranks of the trades non-compliers managed to study

Trade rank	Number of respondents	Percent
1	202	57.22
2	59	16.71
3	32	9.07
4-10	60	17
Total	353	100

Table 54 describes some of the differences between applicants that complied with the lottery rejection (compliers) and those who bypassed the rejection in the same year the lottery was held (non-compliers). There are differences in employment and income outcomes between the two groups. Non-compliers earned more per month on average and have higher rates of employment, both currently and ever. There are almost no differences by gender between the two groups.

[84] It should be noted that school attendance figures are self-reported

Table 54. Gender, earnings and employment of compliers vs non-compliers

Characteristics	Compliers	Non-compliers	Total
Percent Male	57%	58%	57%
Currently employed in paid job (>1 month)	23%	29%	25%
Ever employed in paid job (>1 month)	50%	64%	54%
Average earnings per month (MNT)	290,570	340,503	304,815

It should be noted that the patterns shown above do enable us to distinguish whether the differences exist because non-compliers managed to circumvent the lottery rejection and thus gained an advantage, or because the types of applicants who don't comply with lottery results differ from those who do in other ways.

d) Employment and Earnings Expectations

When asked about thoughts on future employment, both groups report the same average prospective search length for a new job, at just over 2 weeks. The average number of months they believe they will be employed over the next year is about 8.5 each. Table 55 also shows that men report higher expected earnings at their next job one year from now, while women are more likely to report planning to pursue education in the future.

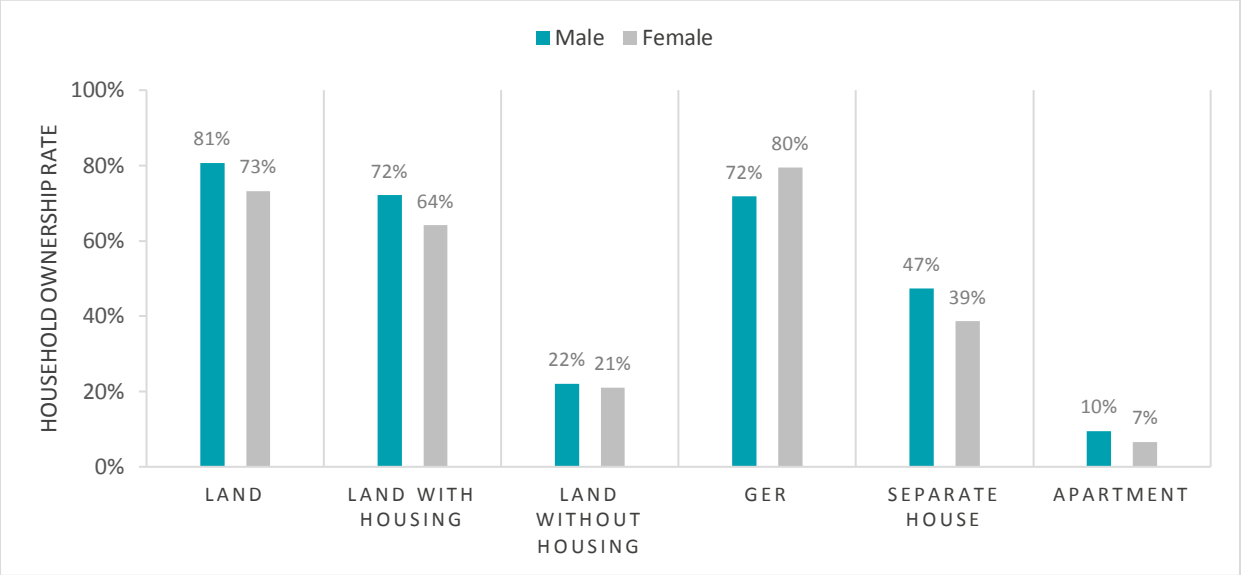
Table 55. Employment and earnings prospects by gender

	Male	Female
Number of weeks to find the next job	2.2	2.2
Months employed per year, one year from now	8.5	8.4
Monthly earnings at the next job (MNT)	657,424	428,790
Monthly earnings, one year from now (MNT)	960,192	675,120
Plans to enroll in education program in future (%)	32.5%	42.1%

e) Household Assets

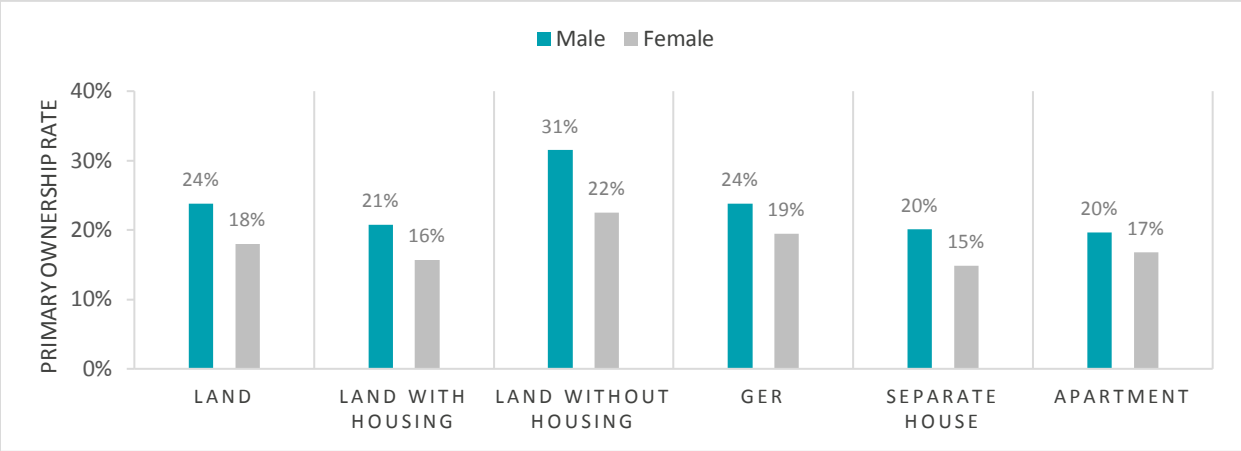
Figure 20 summarizes the respondents' household land and housing assets. Most households own land and gers (yurts, the traditional Mongolian nomadic dwelling), rather than detached housing or an apartment, which are more likely to have stable access to electricity and running water.

Figure 20.Respondent Households ownership of land and housing assets



Of households that own land and housing assets, male respondents are more likely to be their primary owners (Figure 21). Primary ownership rates are relatively low across the board, which isn't surprising as Graduate Follow-Up respondents are young and the majority are likely to still live with family.

Figure 21. Primary ownership of land and housing assets by respondents[85].



The table below outlines ownership rates of smaller assets. Close to half of male respondents report having access to a computer at home, compared to less than a third of women. Male respondents' homes are also more likely to have refrigeration, washing machines and gas or electric stoves. Practically all respondent households have TVs and cell phones.

[85] Note: percentages apply to the fraction of households that own land and housing assets. For example, of the 81 percent of male respondents' households that own land, 24 percent of them are the land's primary owners.

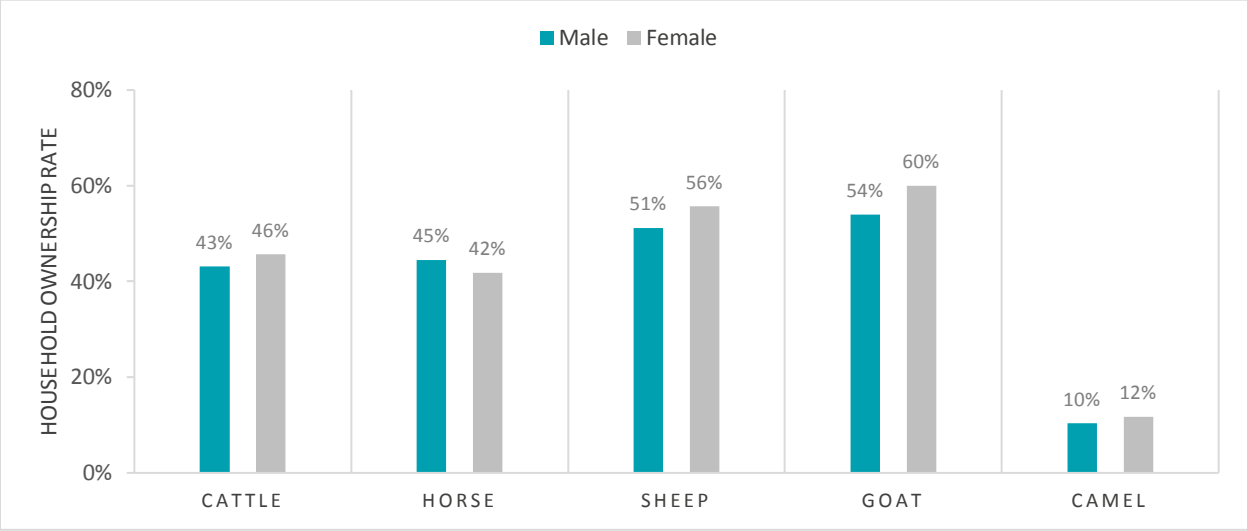
Table 56. Household utilities ownership rates by gender (percent)

Utility Type	Male	Female	Total
Refrigerator, freezer	82%	70%	77%
Washing machine	77%	64%	71%
Fixed electrical/gas stove	23%	17%	20%
Wind power generator	4%	4%	4%
Solar panel	26%	28%	27%
Small size generator	10%	8%	9%
Dish antenna set	40%	36%	38%
TV set	97%	95%	96%
Cell phone	100%	99%	100%
Radio	16%	16%	16%
Computer	45%	28%	38%

f) Livestock and transportation

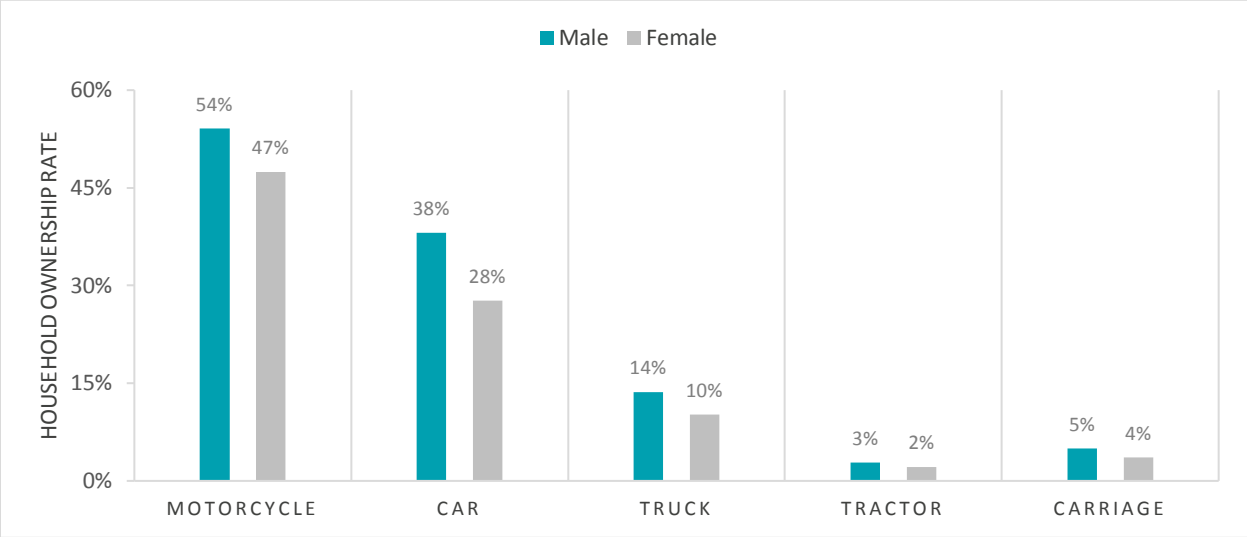
Figure 22 shows the livestock assets that respondents report their households own. They appear more or less balanced, with sheep and goats the most common animal owned and camel ownership being comparatively rare.

Figure 22. Household livestock assets by gender (percent)



About half of households have motorcycles and about a third own a car. Male respondents' households are somewhat more likely to own a motorcycle and 10 percent more likely to own a car. Few households own trucks, tractors or carriages. It should be noted that in rural areas horses are often employed as a mode of transport for short to medium distances in place of motorized vehicles.

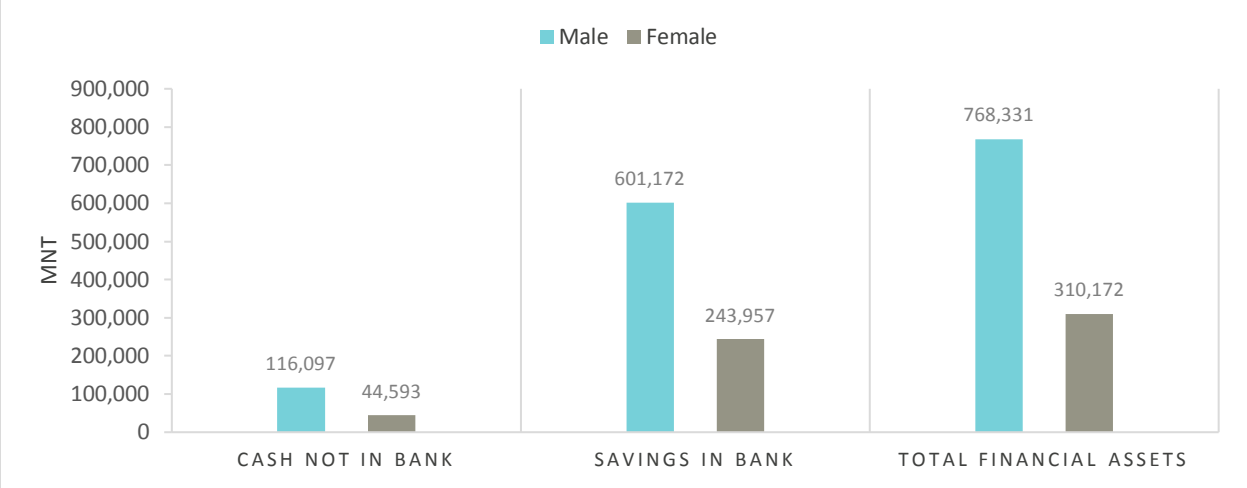
Figure 23. Household transportation assets by gender (percent)



g) *Financial Assets*

The survey included questions about personal[86] cash and savings held in a bank. The figure below shows that male respondents report owning more than twice the total financial assets females do, with about 770,000 MNT compared to 310,000 MNT respectively. This ratio holds up across the individual financial asset categories.

Figure 24. Respondents' personal financial assets (MNT)



h) *Expenditures*

As for spending habits over the previous 30 days, both sexes report roughly the same expenditure amounts on food, communication and utilities. Differences emerge in other categories. Male respondents

[86] The Wave 2 Graduate Follow-Up survey included questions about the respondents' household financial assets on top of personal assets. These were dropped from subsequent rounds as the majority of respondents had difficulty answering them.

are more likely to spend on transport and alcohol and tobacco, while women tend to spend more on medical care and toiletries. Female respondents find themselves spending more on their own children and males have higher expenditures related to other people's children.

Table 57. Personal expenditures over previous 30 days by gender (MNT)

Expenditures over previous 30 days (MNT)	Male	Female	Total
Food Items	61,716	58,565	60,426
Alcohol and tobacco	9,466	2,529	6,626
Transport (including fuel)	47,903	25,839	38,872
Fuel (coal and firewood)	15,710	11,165	13,850
Communication	28,149	24,431	26,627
Entertainment	26,591	15,879	22,207
Utilities	5,745	5,967	5,836
Medical Care	9,228	13,795	11,097
Toiletry and beauty products	11,332	29,716	18,857
Expenses related to other children	9,326	6,010	7,968
Expenses related to own children	1,057	3,932	2,234

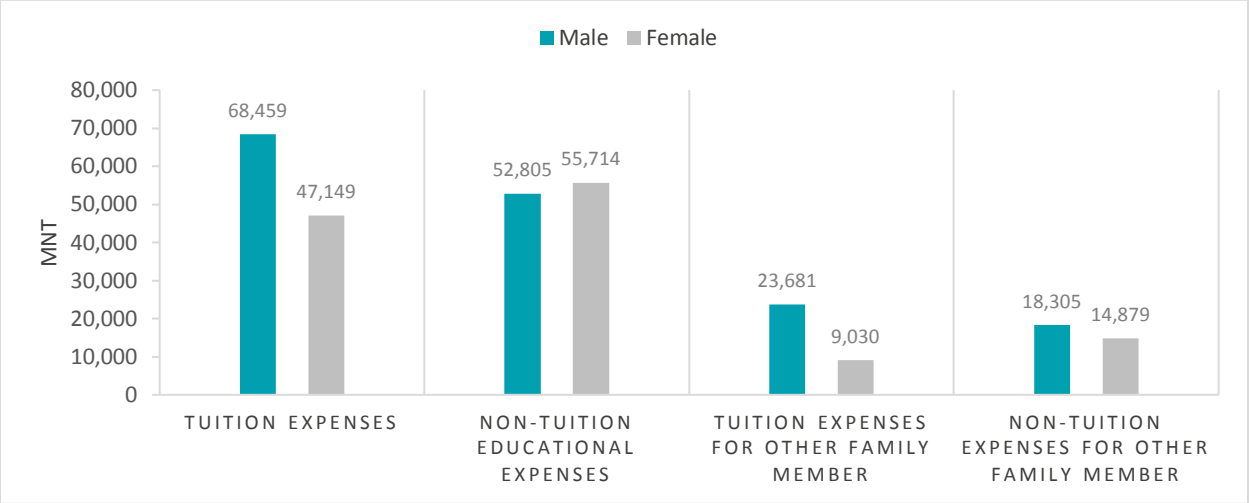
On spending over the previous year (Table 58), men report significantly higher expenditures across most items. They spend nearly four times more on maintenance and repair and close to twice as much on mobile phones and handset repair compared to women. They also spend about 70,000 MNT more on shoes. Women do report to spend more on jewelry and related items, but not by a large margin.

Table 58. Personal expenditure over the previous 12 months (MNT)

Expenditures over previous 12 months (MNT)	Male	Female	Total
Maintenance and repair	91,891	25,163	64,578
Mobile phone and mobile phone repair	112,237	57,525	89,843
Shoes	186,503	116,668	157,918
Clothing and textile	249,497	197,237	228,106
Jewelry, clocks, watches, souvenirs	32,808	37,405	34,690

The figure below shows that men spent more on education-related matters over the previous 12 months than women. They spent about 70,000 MNT on tuition, compared to 47,000 MNT reported by women. They spent an average of nearly 24,000 MNT on tuition expenses for other family members, or more than twice as much as women. Women did spend more than men on personal non-tuition educational expenses, which includes books and stationary, by a margin of about 4,000 MNT.

Figure 25. Education related expenditure over the previous 12 months, by gender (MNT)



The next section outlines some characteristics of schools, teachers and management staff from the administrative survey.

2. School characteristics from administrative data

a) Basic school characteristics

We present attendance, dropout, and enrollment characteristics for the 10 evaluation schools in our sample before and after MCA-M's intervention in Table 59 below. Attendance for the last school year surveyed hovers around the 90 percent mark for most schools. Only Construction College, in Ulaanbaatar, falls far short of the average with a reported attendance of 81 percent.

Dropout rates mostly declined between 2009 and 2013, although not everywhere. Gobi Altai and Mongol Korean top the dropout table, though the latter managed to reduce rates significantly over the survey period.

Table 59. Evaluation school characteristics 2009 vs 2013

	Student attendance 2012-13 (%)	Dropout rate 2009-10 (%)	Dropout rate 2012-13 (%)	Total students 2009-10	Total students 2012-13	Number of VET programs 2009-10	Number of VET programs 2013-14
Gobi Altai	98	5.7	7.2	967	721	13	18
Dornod Phased	95	4.4	2.5	1,113	1,589	20	19
Dornod VTPC	97	4.0	4.5	657	493	8	11
Darkhan	85	0.1	0.9	1,500	961	11	15
Orkhon	88	2.6	3.2	1,120	765	13	17
Bayan Ulgii	90	5.0	3.0	1,450	1,049	15	16
Umnu Gobi	92	4.0	1.0	570	1,062	13	14
Construction College	81	7.0	6.0	1,500	1,966	14	17
Mongol Korean	97	13.5	9.0	1,652	1,875	16	22
Uvs	89	1.5	0.3	1,674	1,350	22	31
Total	91	4.8	3.8	1,220	1,183	15	18

Note: Only showing rates from 2009-10 (start of intervention) and most recent figure

Average total enrolled students have remained steady compared to 2009 at about 1,200. The overall figure does conceal student enrollment swings of close to 30 percent on individual school levels. Dornod Phased increased its student population by more than 500, a rise Construction College almost matched, from a higher base. Uvs lost more students than it gained by a wide margin, as did Darkhan, now home to 500 fewer students in 2013 compared to 2009.

Across all schools, the average number of TVET programs increased from 15 to 18. A positive trend is found at almost every individual school.

b) Teacher characteristics

The Teacher Survey asked 1,000 teachers about their socio-economic characteristics and employment conditions. The averages in the table below show that evaluation school teachers are slightly better paid than non-evaluation school teachers, and employed about a year longer at their present schools. The gap narrows to 20,000 MNT when comparing household incomes. Evaluation school teachers have fewer classes but a higher number of students compared to their non-evaluation peers. Both groups report an average working week of 45 to 46 hours.

Table 60. Teacher characteristics

Teacher characteristics	Non-Evaluation Schools	Evaluation Schools	Total
Age	36.69	37.99	37.09
Net salary after taxes	469,970	508,940	481,943
Household income	852,119	872,131	858,291
Hours worked per week incl. overtime	45.39	45.94	45.56
Years employed at current school	6.70	7.92	7.08
Number of Classes taught	3.83	3.10	3.61
Number of Students per Class	21.53	22.40	21.80

Figure 26 and Figure 27 below indicate that, overall, two thirds of teachers believe the new law on vocational education and training to be effective. Introduced as part of the reforms supported by MCA-M in 2009, a vast majority believes the law has had a discernible effect on the TVET sector.

Figure 26. Effectiveness of VET law

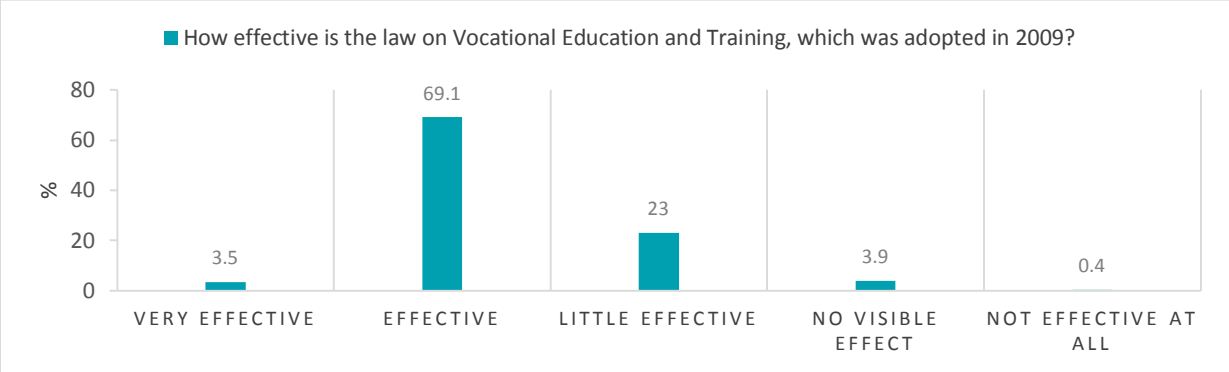
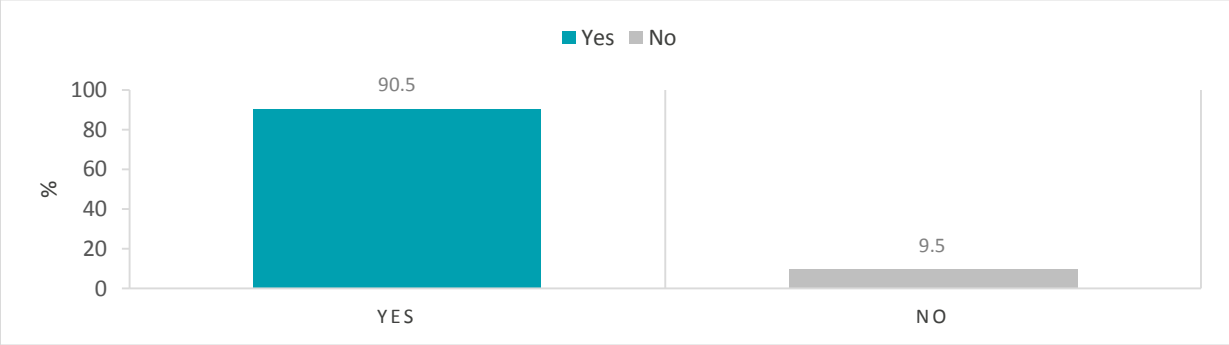
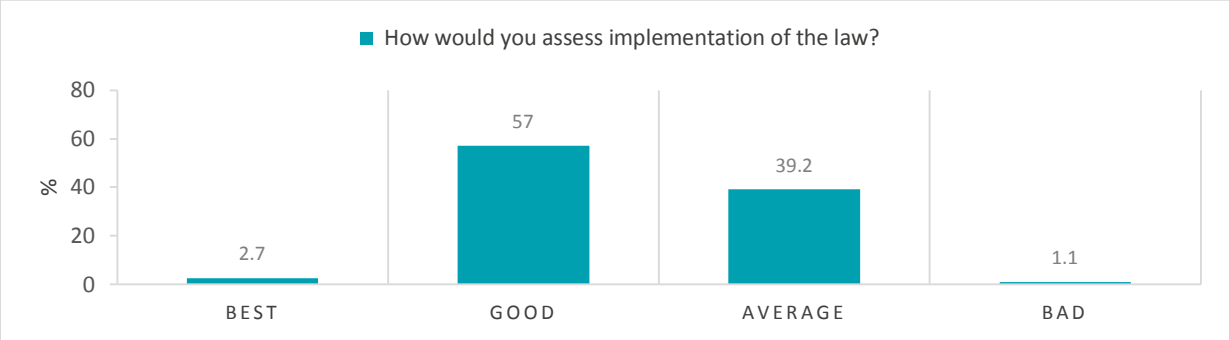


Figure 27. Influence of VET law on TVET sector



In terms of the quality of the law's implementation, Figure 28 shows that 60 percent say that it was well or very well implemented (*Good* + *Best*) and only just over 1 percent find the process to have been badly conducted.

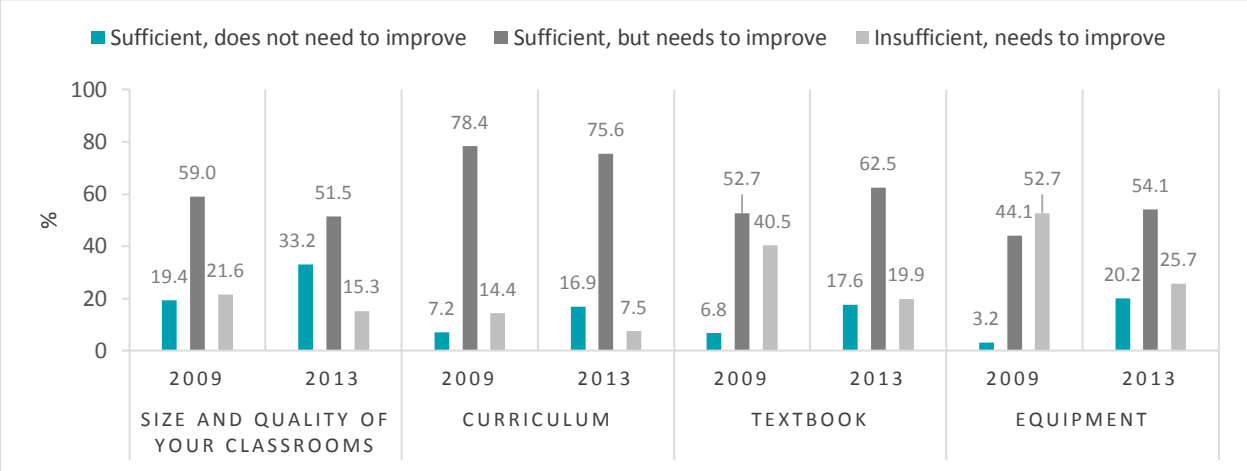
Figure 28. Implementation quality of the VET law



The survey asked teachers about their satisfaction with teaching resources before the reforms were implemented (2009) and after (2013), if they were employed as a teacher at their school in 2009. Figure 29 summarizes the opinions of 627 teachers employed at their school before and after implementation.

Opinions of classrooms, curricula, textbooks and equipment all improved. The quality of equipment registered the biggest rise in relative satisfaction: purely negative opinion fell from 53 to 26 percent. Teachers also seem more satisfied with textbooks, with 18 percent answering that these are now sufficiently good, up from just 7 percent before the reforms. Overall, however, teachers still seem to see a lot of room for improvement concerning the quality of the resources at their disposal.

Figure 29. Teacher satisfaction with resources, before and after intervention



The question on the use and quality of equipment is a relevant one for this study. 822, or 83 percent, of the 966 teachers that answered the question reported the use of some kind of equipment in their current classes.

Figure 30. Use of equipment in current class teaching

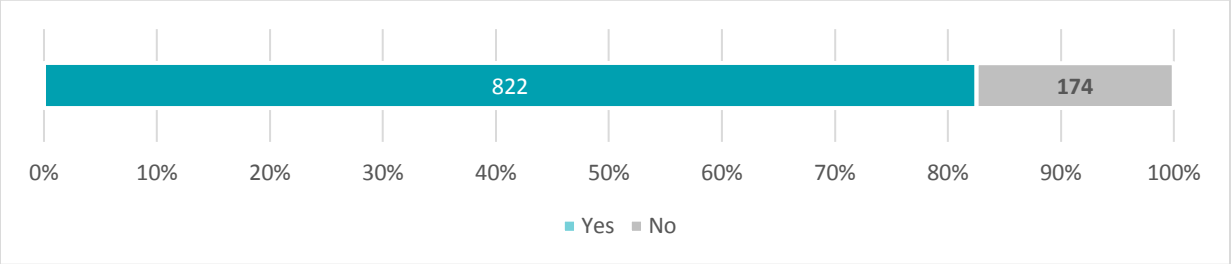


Table 61 shows the top ten trades equipment was used in classroom teaching, by teachers who indicated the use of some type of equipment in both 2009 and 2013.

Table 61. Top 10 trades teachers used equipment for, 2009 vs. 2013

	2009		2013	
Rank	**Trade equipment was used for**	**No. of teachers**	**Trade equipment was used for**	**No. of teachers**
1	Cook And Food Production	44	Automobile Repairs, Usage	71
2	Computer Operator (Secretary)	42	Cook And Food Production	70
3	Automobile Repairs, Usage	39	Computer Operator (Secretary)	63
4	Construction	32	Welding	61
5	Construction Decoration	29	Construction Montage	49
6	Hairdresser, Beautician	28	Construction Decoration	44
7	Wood And Household Carpenter	26	Construction	43
8	Welding	24	Hairdresser, Beautician	39
9	Sewing And Sewing Protection	23	Construction Plumbing	38
10	Construction Plumbing	20	Wood And Household Carpenter	35

In 2013, 71 teachers reported teaching Automobile repairs and usage with the help of equipment when in 2009 39 had. Construction related trades all saw increases of classes supported by the use of equipment.

The next subsection summarizes the characteristics, qualifications and opinions of TVET school management and administrative staff.

c) Management staff characteristics

The management survey wave 3 was administered to staff at 50 TVET schools. Between 1 and 26 members of staff completed the survey at each school. At the ten evaluation schools, between 6 and 22 staff members filled out of the questionnaire. Out of 466 respondents, 111 worked at one of the evaluation schools. Accountants, librarians, directors and training managers of vocational schools were the most common respondents to fill out the survey (Table 62).

Table 62. Position of management survey respondents

Position	Number	Percent
Accountant	48	10%
Librarians	47	10%
Director	40	8%
Training Manager	38	8%
Head of Training Department	32	6%
School Social Worker	32	6%
Department dean of vocational education	26	5%
Head of public partnership and cooperation	22	4%
Human Resource Specialist	16	3%
Training department staff	14	3%
Department dean of general education	12	2%
Deputy Director	10	2%
Department dean of technical education	9	1%
Quality Manager	8	1%
Marketing Manager	1	0%
Other	110	23%
Total	465	100%

TVET school staff is well educated. Every respondent finished secondary school and almost all members have undergraduate degrees. 47 percent possess a graduate qualification:

Figure 31. Education level of TVET management staff

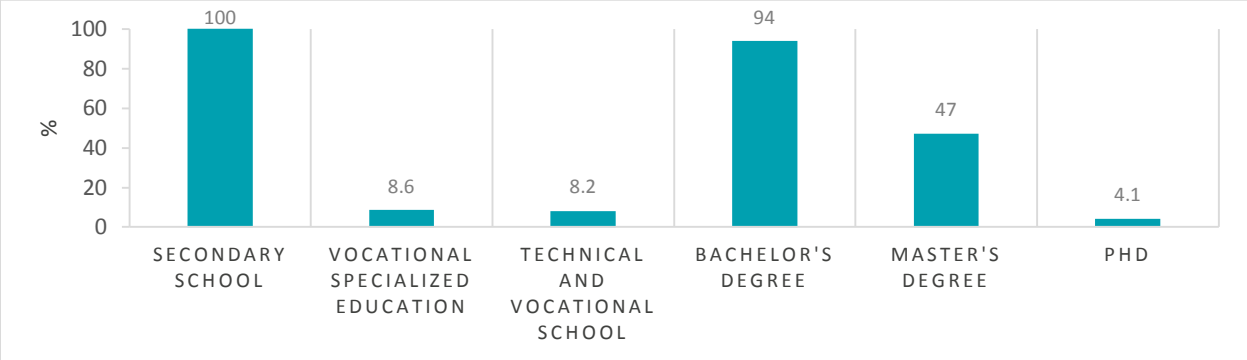


Table 63 shows select characteristics of school staff, by whether they work at non-evaluation or evaluation schools. Evaluation school staff have been in their current position at the school for an average of 4.8 years compared to 3.3 for non-evaluation school employees. As with teacher salaries and household income above, evaluation school staff tend to earn more than those at other schools. That being said, evaluation schools employees are older and stay in the same position for longer than their peers. There's a negligible difference in hours worked per week between the two.

Table 63. TVET management staff characteristics

	Non-evaluation schools	Evaluation schools	Total
Age	38.8	40.4	39.1
Weekly hours, incl. overtime	41.3	41.2	41.3
Years at current school & position	3.3	4.8	3.6
Net monthly salary after taxes	542,613	580,660	551,419
Total household income	935,795	998,148	950,434

Turning to MCA involvement and implementation of TVET reforms, Table 64 below shows that evaluation schools were more likely to be involved with MCA-M activities. In total, 92 percent of respondents confirm their school's engagement with MCA-M activities.

Almost all management staff indicate planning to transition to CBT curricula and that these curricula, developed as part of the VET project, are or will be the main curricula in use. Almost every respondent confirms their school's collaboration with the private sector.

Table 64. MCA-M involvement, CBT implementation and private sector cooperation

	Non-evaluation schools	Evaluation schools	Total
Involved with MCA-M activities	91%	98%	92%
Implemented plan to transition to CBT	96%	98%	96%
Implemented CBT as main curriculum	94%	93%	94%
Collaborates with private sector actors	98%	99%	98%

Finally, most have a positive opinion of both the effectiveness and implementation of the law on vocational education and training:

Figure 32. Assessment of the effectiveness of the VET Law

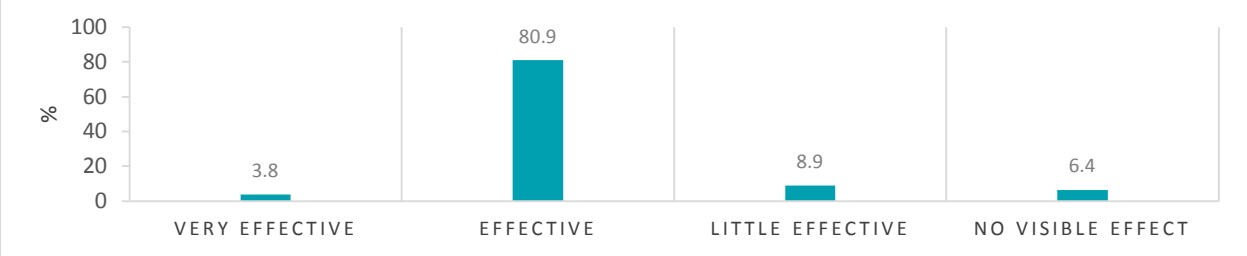
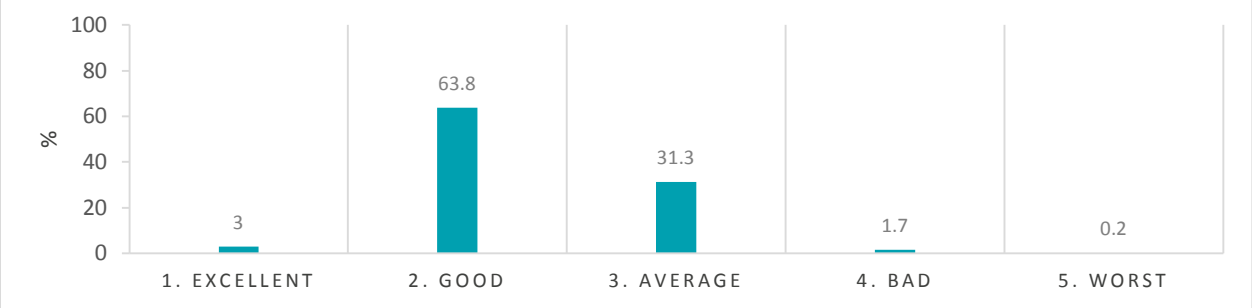


Figure 33. Assessment of the VET Law's implementation



D. Analysis of threats to validity

Table 65. Balance of baseline characteristics between those admitted to TVET through the lottery and those not admitted

Baseline characteristics	**Mean: Control Group[1]**	**Difference: Treatment–Control[2] <std. error>**
Age	16.15	-0.00 <0.03>
Male (%)	0.57	0.00 <0.01>
Has Prior Work Experience (%)	0.04	-0.00 <0.01>
Applicant Years of Schooling	9.04	-0.01 <0.01>
Applicant GPA (Out of 100)	74.13	0.08 <0.19>
Percent Correct on Entrance Exam (Math section)	0.38	-0.01 <0.01>
Percent Correct on Entrance Exam (Logic and Problem Solving section)	0.31	-0.00 <0.01>
Percent Correct on Entrance Exam (Reading section)	0.32	-0.00 <0.01>
Percent Correct on Entrance Exam (Essay section)	0.40	-0.00 <0.01>
Percent Correct on Entrance Exam (Overall)	0.35	-0.00 <0.00>
Head of Household is Applicant's Father (%)	0.76	-0.02 <0.01>
Household Head Years of Schooling	8.86	0.06 <0.06>
Household Head is Employed (%)	0.57	-0.02 <0.01>
Number of Household Members	5.10	-0.09** <0.04>
Lives in Ger (%)	0.62	-0.00 <0.01>
Owns Home (%)	0.96	0.00 <0.01>
A Family Member Practices the First Choice Trade (%)	7.27	0.47 <0.77>
Monthly Family Income is Below 50,000 MNT (%)	0.05	0.01 <0.01>
Monthly Family Income is Between 50,000 and 100,000 MNT (%)	0.14	0.00 <0.01>
Monthly Family Income is Between 100,000 and 200,000 MNT (%)	0.26	-0.00 <0.01>
Monthly Family Income is Between 200,000 and 300,000 MNT (%)	0.21	0.00 <0.01>
Monthly Family Income is Between 300,000 and 500,000 MNT (%)	0.17	0.01 <0.01>
Monthly Family Income is Over 500,000 MNT (%)	0.12	-0.02** <0.01>
Expected Monthly Income While in School (1000's of MNT)	44.70	-0.01 <0.40>
Expected Monthly Income After Graduation if Admitted to First Choice Trade (1000's of MNT)	347.98	-4.25 <4.56>

Expected Time Spent Searching for a Job After Graduation if Admitted to First Choice Trade (Months)	2.34	-0.05
		<0.07>
Will Attend Another School if Not Admitted (%)	0.80	0.01
		<0.01>
Expected Monthly Income After Graduation if Not Admitted (1000's of MNT)	145.74	4.42
		<5.22>
Expected Time Spent Searching for a Job if Not Admitted (Months)	1.77	0.01
		<0.09>
A Household Member Owns Livestock (%)	0.39	-0.01
		<0.01>
Number of Cows Owned	1.98	0.12
		<0.17>
Number of Goats Owned	11.35	0.78
		<1.07>
Number of Horses Owned	1.34	0.11
		<0.14>
Number of Sheep Owned	9.81	-0.12
		<1.07>
Number of Camels Owned	0.25	-0.03
		<0.04>
Owns an Automobile (%)	30.26	-2.50*
		<1.29>
Owns a Computer (%)	24.64	-1.43
		<1.10>
Owns a Clothes-Washing Machine (%)	53.24	1.24
		<1.34>
Owns a Motorcycle (%)	32.64	-0.43
		<1.29>
Owns a Refrigerator (%)	61.61	-0.81
		<1.31>
Owns a Satellite Dish (%)	29.78	-0.75
		<1.31>
Owns a Television (%)	95.10	-1.60**
		<0.71>
Owns a Vacuum Cleaner (%)	33.59	0.58
		<1.26>

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
[1]The second column gives the average value for the sample of students not admitted to a TVET school through the lottery.
[2]The third column gives the coefficient on an indicator variable that is 1 if students were admitted to a TVET school through the lottery and 0 otherwise.
N=10,950 students who were administered the Graduate Follow Up survey

Table 66. Balance within the GFU survey sample between those admitted to upgraded trades and those not admitted to upgraded trades

Characteristics at baseline	**Control: Not admitted to affected (mean)**	**Difference: Treatment–Control <std. error>**
Age	16.203	-0.061
		<0.038>
Male (%)	45.513	23.180***
		<1.581>
Has Prior Work Experience (%)	3.585	1.361
		<0.854>
Applicant Years of Schooling	8.997	-0.001

		<0.006>
Applicant GPA (Out of 100)	74.466	-0.592**
		<0.243>
Percent Correct on Entrance Exam (Math section)	36.645	-0.035
		<0.815>
Percent Correct on Entrance Exam (Logic and Problem Solving section)	30.816	0.938
		<0.698>
Percent Correct on Entrance Exam (Reading section)	32.452	0.887
		<1.023>
Percent Correct on Entrance Exam (Essay section)	41.318	-2.355**
		<1.033>
Percent Correct on Entrance Exam (Overall)	34.937	-0.020
		<0.550>
Head of Household is Applicant's Father (%)	75.921	0.171
		<1.642>
Household Head Years of Schooling	8.669	0.016
		<0.091>
Household Head is Employed (%)	54.879	1.208
		<1.890>
Number of Household Members	5.241	0.005
		<0.062>
Lives in Ger (%)	63.440	-1.069
		<1.704>
Owns Home (%)	96.532	0.457
		<0.597>
A Family Member Practices the First Choice Trade (%)	7.935	-0.367
		<1.117>
Monthly Family Income is Below 50,000 MNT (%)	7.053	-1.043
		<0.816>
Monthly Family Income is Between 50,000 and 100,000 MNT (%)	16.693	-0.385
		<1.366>
Monthly Family Income is Between 100,000 and 200,000 MNT (%)	29.820	-5.489***
		<1.759>
Monthly Family Income is Between 200,000 and 300,000 MNT (%)	21.062	3.704**
		<1.691>
Monthly Family Income is Between 300,000 and 500,000 MNT (%)	14.734	2.263
		<1.474>
Monthly Family Income is Over 500,000 MNT (%)	7.857	0.617
		<1.148>
Expected Monthly Income While in School (1000's of MNT)	44.154	-0.014
		<0.579>
Expected Monthly Income After Graduation if Admitted to First Choice Trade (1000	324.304	10.201*
		<6.168>
Expected Time Spent Searching for a Job After Graduation if Admitted to First Ch	2.474	-0.037
		<0.084>
Will Attend Another School if Not Admitted (%)	80.603	0.673

		<1.572>
Expected Monthly Income After Graduation if Not Admitted (1000's of MNT)	279.098	-3.408
		<7.604>
Expected Time Spent Searching for a Job if Not Admitted (Months)	3.437	0.014
		<0.183>
A Household Member Owns Livestock (%)	44.984	-1.224
		<1.883>
Number of Cows Owned	2.983	0.085
		<0.305>
Number of Goats Owned	37.136	-0.186
		<2.613>
Number of Horses Owned	3.708	-0.075
		<0.368>
Number of Sheep Owned	30.917	-2.331
		<2.764>
Number of Camels Owned	0.855	-0.297**
		<0.132>
Owns an Automobile (%)	25.357	2.301
		<1.711>
Owns a Computer (%)	18.434	0.288
		<1.465>
Owns a Clothes-Washing Machine (%)	46.166	4.464**
		<1.897>
Owns a Motorcycle (%)	34.916	-0.835
		<1.771>
Owns a Refrigerator (%)	53.552	4.629**
		<1.826>
Owns a Satellite Dish (%)	31.958	1.065
		<1.801>
Owns a Television (%)	92.413	1.423
		<0.892>
Owns a Vacuum Cleaner (%)	27.229	2.726
		<1.752>

Standard errors in parentheses

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

[1]The second column gives the average value for the sample of students not admitted to a TVET school through the lottery.

[2]The third column gives the coefficient on an indicator variable that is 1 if students were admitted to a TVET school through the lottery and 0 otherwise.

N= 8,682 students who were accepted to a TVET school by lottery and administered the Graduate Follow Up survey

Table 67. Balance on baseline characteristics between students not exposed to equipment upgrades and those exposed to the upgrades

Baseline characteristics	**Control Group Mean - No exposure[1]**	**Exposure to equipment upgrades[2] <std. error>**
Age	16.546	-0.002
		<0.013>
Male (%)	48.806	0.626
		<0.423>
Has Prior Work Experience (%)	5.318	0.010

		<0.231>
Applicant Years of Schooling	9.200	0.002
		<0.004>
Applicant GPA (Out of 100)	74.705	0.036
		<0.069>
Percent Correct on Entrance Exam (Math)	36.121	0.043
		<0.226>
Percent Correct on Entrance Exam (Logic and Problem Solving)	30.974	0.003
		<0.197>
Percent Correct on Entrance Exam (Reading)	32.255	-0.058
		<0.271>
Percent Correct on Entrance Exam (Essay)	40.539	-0.156
		<0.275>
Percent Correct on Entrance Exam (Overall)	34.631	-0.035
		<0.151>
Head of Household is Applicant's Father (%)	75.499	0.253
		<0.452>
Household Head Years of Schooling	8.685	-0.010
		<0.024>
Household Head is Employed (%)	53.658	-0.382
		<0.497>
Number of Household Members	5.236	0.000
		<0.017>
Lives in Ger (%)	60.463	-0.769*
		<0.447>
Owns Home (%)	96.620	-0.438**
		<0.187>
A Family Member Practices the First Choice Trade (%)	7.781	-0.016
		<0.289>
Monthly Family Income is Below 50,000 MNT (%)	6.880	0.041
		<0.251>
Monthly Family Income is Between 50,000 and 100,000 MNT (%)	16.734	-0.019
		<0.380>
Monthly Family Income is Between 100,000 and 200,000 MNT (%)	29.578	0.163
		<0.471>
Monthly Family Income is Between 200,000 and 300,000 MNT (%)	21.421	0.404
		<0.434>
Monthly Family Income is Between 300,000 and 500,000 MNT (%)	14.796	-0.386
		<0.374>
Monthly Family Income is Over 500,000 MNT (%)	7.962	-0.165
		<0.286>
Expected Monthly Income While in School (MNT 1000s)	44.030	-0.182
		<0.148>
Expected Monthly Income After Graduation if Admitted to First Choice Trade (MNT 1000s)	328.134	-0.670
		<1.590>
Expected Time Spent Searching for a Job After Graduation if Admitted to First Choice Trade	2.483	0.018

		<0.024>
Will Attend Another School if Not Admitted (%)	75.139	-0.442
		<0.426>
Expected Monthly Income After Graduation if Not Admitted (MNT 1000s)	276.564	-1.224
		<2.003>
Expected Time Spent Searching for a Job if Not Admitted (Months)	3.438	0.053
		<0.051>
A Household Member Owns Livestock (%)	44.329	1.146**
		<0.506>
Number of Cows Owned	3.051	0.006
		<0.075>
Number of Goats Owned	34.685	0.082
		<0.682>
Number of Horses Owned	3.543	0.115
		<0.094>
Number of Sheep Owned	29.190	-0.139
		<0.718>
Number of Camels Owned	0.788	0.049
		<0.034>
Owns an Automobile (%)	25.400	0.247
		<0.496>
Owns a Computer (%)	18.057	-0.581
		<0.418>
Owns a Clothes-Washing Machine (%)	45.751	-0.614
		<0.516>
Owns a Motorcycle (%)	34.206	0.791
		<0.504>
Owns a Refrigerator (%)	54.264	-0.465
		<0.505>
Owns a Satellite Dish (%)	32.097	-0.328
		<0.509>
Owns a Television (%)	92.965	0.279
		<0.279>
Owns a Vacuum Cleaner (%)	27.232	-0.441
		<0.481>

Standard errors in parentheses

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

[1] This column shows the average value for the sample of students who were not admitted to improved trades

[2] This column shows the coefficient of the variable for months of exposure to upgraded equipment

N=8,682 students accepted to a TVET school through the lottery who were administered the Graduate Follow Up survey

Table 68. Differential attrition between applicants accepted and not accepted to TVET school

	(1) **All** Accepted to TVET	(2) **2010** Accepted to TVET	(3) **2011** Accepted to TVET	(4) **2012** Accepted to TVET
Interviewed as part of the graduate follow up survey	0.0259***	0.0269**	0.0387**	0.00854
	(0.00768)	(0.0105)	(0.0152)	(0.0155)

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

[1] The coefficients are estimated using the following model:

$GFU_{ijklm} = \beta_0 + \beta_1 TVETaccepted_i + f(p_{ijklm}) + \varepsilon$

Where GFU_i is a binary outcome variable equal to 1 for student i in school k participating in round l of the lottery for cohort m who took the GFU survey and 0 otherwise. $TVETaccepted_i$ is a binary variable equal to 1 for students accepted through the lottery and 0 otherwise $f(p_{ijklm})$ is a polynomial of the probability that each student was assigned to an improved trade given their and their peers' trade preferences.

The coefficients on $TVETaccepted_i$ estimate differences in the attrition of applicants who were admitted and those not-admitted.

Table 69. Differential attrition between applicants admitted and not admitted to upgraded trades

	(1) **All**	(2) **2010**	(3) **2011**	(4) **2012**
Interviewed as part of the graduate follow up survey	-0.00936	0.000607	-0.0311	0.00677
	(0.0109)	(0.0156)	(0.0206)	(0.0204)
Obs	9,470	2,923	2,861	2,686

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

N=9,470 students accepted to a TVET school through the lottery).

Independent variable is an indicator about whether they were administered the Graduate Follow Up survey

Table 70. Differential attrition between students exposed and not exposed to equipment upgrades

	All cohorts (std. error)
Interviewed as part of the graduate follow up survey	0.000587
	(0.00305)
Obs	9,470

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

N=9,470 students accepted to a TVET school through the lottery

Table 71. Attrition analysis: Differences between admitted vs. non-admitted among those not-interviewed

Baseline characteristics	**Accepted to TVET coefficient[1]**	**Standard error**
Age	0.160*	(0.0847)
Male (%)	2.589	(3.406)
Has Prior Work Experience (%)	-0.304	(1.552)
Applicant Years of Schooling	-0.00159	(0.0243)
Applicant GPA (Out of 100)	-0.588	(0.465)
Percent Correct on Entrance Exam (Math section)	-2.321	(1.523)
Percent Correct on Entrance Exam (Logic and Problem Solving section)	1.118	(1.325)

Percent Correct on Entrance Exam (Reading section)	0.0420	(1.825)
Percent Correct on Entrance Exam (Essay section)	0.644	(1.831)
Percent Correct on Entrance Exam (Overall)	-0.226	(1.008)
Head of Household is Applicant's Father (%)	-2.764	(3.069)
Household Head Years of Schooling	-0.0379	(0.164)
Household Head is Employed (%)	-3.374	(3.355)
Number of Household Members	-0.173	(0.112)
Lives in Ger (%)	-2.093	(3.061)
Owns Home (%)	-0.937	(1.265)
A Family Member Practices the First Choice Trade (%)	0.499	(1.937)
Monthly Family Income is Below 50,000 MNT (%)	1.946	(1.647)
Monthly Family Income is Between 50,000 and 100,000 MNT (%)	-0.157	(2.522)
Monthly Family Income is Between 100,000 and 200,000 MNT (%)	0.644	(3.166)
Monthly Family Income is Between 200,000 and 300,000 MNT (%)	1.621	(2.931)
Monthly Family Income is Between 300,000 and 500,000 MNT (%)	-1.102	(2.554)
Monthly Family Income is Over 500,000 MNT (%)	-1.146	(2.005)
Expected Monthly Income While in School (1000's of MNT)	-0.885	(0.997)
Expected Monthly Income After Graduation if Admitted to First Choice Trade (1000's of MNT)	17.92	(11.32)
Expected Time Spent Searching for a Job After Graduation if Admitted to First Choice Trade (Months)	-0.00865	(0.169)
Will Attend Another School if Not Admitted (%)	5.319*	(2.868)
Expected Monthly Income After Graduation if Not Admitted (1000's of MNT)	25.14**	(12.70)
Expected Time Spent Searching for a Job if Not Admitted (Months)	0.255	(0.320)
A Household Member Owns Livestock (%)	0.722	(3.374)
Number of Cows Owned	0.105	(0.520)
Number of Goats Owned	4.268	(4.648)
Number of Horses Owned	0.799	(0.655)
Number of Sheep Owned	2.225	(4.986)
Number of Camels Owned	-0.331	(0.227)
Owns an Automobile (%)	3.682	(3.223)
Owns a Computer (%)	0.882	(2.749)
Owns a Clothes-Washing Machine (%)	1.829	(3.345)
Owns a Motorcycle (%)	2.644	(3.216)
Owns a Refrigerator (%)	-2.226	(3.253)
Owns a Satellite Dish (%)	-3.706	(3.263)
Owns a Television (%)	-0.388	(1.763)
Owns a Vacuum Cleaner (%)	-0.633	(3.145)

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

[1] The coefficients are estimated using the following model:

$$Y_{ijklm} = \beta_0 + \beta_1 TVETaccepted_i + \beta_2 GFU_i + \beta_3 TVETaccepted_i * GFU_i + f(p_{ijklm}) + \varepsilon$$

Where Y_{ijklm} is the baseline outcome for student i in school k participating in round l of the lottery for cohort m. $TVETaccepted_i$ is a binary variable equal to 1 for students accepted through the lottery and 0 otherwise. GFU_i is a binary variable equal to 1 for students who took the GFU survey and 0 otherwise. $TVETaccepted_i * GFU_i$ is an interaction between the two binary variables. $f(p_{ijklm})$ is a polynomial of the probability that each student was assigned to an improved trade given their and their peers' trade preferences.

The coefficients on $TVETaccepted_i$ estimate differences between respondents accepted to TVET through the lottery but not interviewed for the graduate follow up survey, and those not accepted to TVET through the lottery and not interviewed.

Table 72. Compliance by school among all 10,950 Graduate Follow Up respondents

Samples	(1) **Graduated from assigned TVET school**	(2) **Enrolled in TVET assigned school**	(3) **Enrolled in evaluation school**	(4) **Graduated from evaluation school**	(5) N
1 year students	0.229***	0.110*	0.116*	0.0679	1,072
	(0.0387)	(0.0631)	(0.0629)	(0.0618)	
2 year students	0.504***	0.312***	0.266***	0.268***	9,878
	(0.00911)	(0.0137)	(0.0139)	(0.0139)	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 73. Compliance by trade among all 10,950 Graduate Follow Up respondents

Samples	(1) **Studied first ranked trade**	(2) **Studied second ranked trade**	(3) **Graduated from first ranked trade**	(4) **Graduated from second ranked trade**	(5) N
1 year students	0.148***	0.0541**	0.129***	0.0417**	1,072
	(0.0449)	(0.0213)	(0.0446)	(0.0184)	
2 year students	0.270***	0.0321***	0.251***	0.0334***	9,878
	(0.0125)	(0.00735)	(0.0121)	(0.00678)	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

E. Effects of Admission to a TVET school

Given the research design utilized for this project, which used lotteries to determine admission to trades and schools, it is also possible to evaluate the impact of admission to a TVET school. This is an important parameter for assessing the value of technical and vocational education in Mongolia. To the extent that TVET schools provide valuable skills that are desired by employers in the labor market, those who are admitted are more likely to be employed and to receive higher earnings.

This secondary research question has been relegated to the appendix because measuring the overall effects of attending a TVET school does not isolate the impact of MCC's investments in the sector. Below we discuss the evaluation strategy, estimation techniques and for the analysis of the effects of being admitted to TVET schools on employment, earnings and other outcomes.

1. Evaluation strategy

One of the key components of the TVET impact evaluation design is the random assignment of students to trades that do and do not receive equipment upgrades. To achieve this, IPA partnered with 10 oversubscribed TVET schools who allowed us to replace their own admissions systems with an admissions lottery run by MCA-M and IPA.[87] For each school, we allocated offers of admission to seats in individual trades amongst eligible students via a public lottery process. Students provided a list of up to ten ranked preferences amongst the available trades. Students were then randomly selected and placed into their most preferred trade for which seats were still available. If none of the trades with open spaces were

[87] A total of 23 schools received equipment upgrades. 12 of those 23 schools were oversubscribed, receiving more applicants than they could accept each year. Of those 12, 10 agreed to participate.

among the trades that a student indicated they would be willing to study, the student was not admitted to any trade. Similarly, once all the positions at a school were filled, the remaining students were not admitted to any trade.

Due to the randomized assignment of students to the trades they had selected, this evaluation also enables us to estimate the impact of admission to a TVET school on subsequent outcomes. We exploit the fact that out of about 12,000 initial applicants, 5,397 were randomly accepted to TVET schools through the admissions lotteries and 2,541 were rejected.[88] The rest of the applicants were guaranteed admission or guaranteed rejection because of school admissions criteria and the trades to which they chose to apply.

The admission to TVET schools should lead to impacts on academic and labor-market outcomes according to a straightforward theory of change: Admission to TVET schools should increase students' factual understanding of trades and familiarize the students with the tools used by employers. Employers should then find students more productive than they otherwise would, making it more likely that students will be able to find employment and increasing the wages that employers are willing to pay them.

2. Estimation techniques

a) Effect of admission

We estimate the impact of admission to a TVET school using the following regression model estimated via ordinary least squares (OLS):

$$y_{ijlm} = \beta' X_i + \alpha AdmittedTVET_i + f\left(p_i^{TVET}\right) + \mu_{jlm} + \varepsilon_{ijlm} \quad (3)$$

The variable y_{ijlm} is an outcome such as employment or earnings for student i in school j participating in round l of the lottery for cohort m. $AdmittedTVET_i$ is an indicator variable for whether or not a student i was admitted to a TVET school through the lottery. The coefficient of interest in this regression is α which captures the difference in outcomes for students who were admitted to a TVET school compared to those students who were not admitted, after controlling for the probability of admission to a TVET school and the fixed effects for each lottery round by school and cohort. This is the causal impact of being admitted to a TVET school on outcome y. Insofar as treatment with a 1 year program is likely to be different from the treatment with a 2 or 2.5 year program, we will generally estimate the impact of admission to a TVET school separately by program.

$f\left(p_i^{TVET}\right)$ is a polynomial function of the probability that student i was admitted to a TVET school given their and their peers preferences across trade. This function effectively controls for any differences in student characteristics associated with different preferences among trades as expressed in the rankings submitted during the application process. For this analysis, we use a cubic polynomial but the results are robust to using alternative polynomial functions.[89] The probabilities were estimated empirically based on 10,000 iterations of the actual lottery algorithms used to assign students in the admissions process.[90] The

[88] Most of the analysis is focused on 10,950 individuals who responded to the Graduate Follow-Up (GFU) survey, this study's main survey instrument.

[89] This is the same polynomial function used in the baseline report. Our results are essentially unchanged when using linear, quadratic, and 10th order polynomial functions of the probability of admission. We have also considered specifications which interact this polynomial function with indicators for cohort or program and the results are similar.

[90] Abdulkadiroglu et al. (2015) discuss the use of lotteries within school assignment procedures to estimate causal impacts and consider alternative approaches for estimating probabilities of admission to schools.

function also includes indicator variables for students who were guaranteed admissions (either because their most preferred trade was not oversubscribed or because they met schools criteria for preferential treatment) and for students who had no chance of being admitted (because they did not meet the minimum requirements for any of the trades to which they applied).[91]

μ_{jlm} represents fixed effects for each round of the lottery by school and cohort. Each lottery represents a separate randomized experiment. The inclusion of the fixed effects enables us to estimate the treatment effects for each lottery and then average these effects across the different lotteries. We implement these fixed effects by including indicator variables for each round of the lottery.

Finally, X_i is a vector of baseline controls that includes a constant and can also include demographic information and baseline test scores from the admissions survey. In our preferred specifications, we do not include any baseline controls for the sake of parsimony. However, because our baseline controls are balanced between students admitted and not admitted to TVET schools, the inclusion or exclusion of baseline controls does not affect the magnitude of our estimates.

The standard errors in these and all subsequent regressions are adjusted for heteroscedasticity, following Abdulkadiroglu et al. (2015) as well as studies utilizing charter school lotteries for estimating causal impacts (e.g. Dobbie and Fryer, 2015; Hoxby and Rockoff, 2004).[92]

b) Effect of graduation

We can also estimate the impact of graduation from a TVET school using the following regression model estimated with two-stage least squares (2SLS):

$$y_{ijlm} = \beta' X_i + \lambda \widehat{GraduatedTVET}_i + f\left(p_i^{TVET}\right) + \mu_{jlm} + \varepsilon_{ijlm} \quad (4)$$

where $\widehat{GraduatedTVET}_i$ is an indicator for whether student i graduated from a TVET school as predicted in the following first-stage regression model: $GraduatedTVET_i = \beta' X_i + \alpha AdmittedTVET_i + f\left(p_i^{TVET}\right) + \mu_{jlm} + \varepsilon_{ijlm}$. This regression specification isolates the random component of graduation associated with the admission to TVET schools. Again, the variable y_{ijkl} is an outcome such as employment or earnings and all of the other control variables are defined as before.

The coefficient of interest in this regression is λ which captures the causal effect of graduation from a TVET school under further assumptions. In particular, we need to assume that the effect of admission to a TVET school on any outcome such as employment or earnings operates solely through the graduation from a TVET school (also known as the "exclusion restriction"). This assumption may not hold if there are other channels through which admission to a TVET school could affect outcomes. For example, to the extent that admission to a TVET school leads some students to enroll but not to graduation, such enrollment could still affect subsequent outcomes. In this case, we would mistakenly attribute the impact of enrollment to the impact of graduation. Nevertheless, it can be useful to express impact in terms of graduation from a TVET school.

[91] Our results are unchanged if we omit students guaranteed admission and those with no chance of admission.
[92] Most of our results remain significant if we cluster our standard errors at the level of each lottery (i.e. lottery round by school by cohort) with the exception of the impact on women's earnings in the first year following completion of TVET education. The impacts on women's earning in the second year remain significant.

c) *Effect of exposure*

In a similar fashion, we can estimate the impact of exposure to vocational education using the following regression model estimated with two-stage least squares (2SLS):

$$y_{ijlm} = \beta' X_i + \gamma \widehat{ExposureTVET_i} + f\left(p_i^{TVET}\right) + \mu_{jlm} + \varepsilon_{ijlm} \quad (5)$$

where $\widehat{ExposureTVET_i}$ is the number of months of vocational training received by student i as predicted in the following first-stage regression model: $ExposureTVET_i = \beta' X_i + \alpha AdmittedTVET_i + f\left(p_i^{TVET}\right) + \mu_{jlm} + \varepsilon_{ijlm}$. This regression specification isolates the random component of exposure to vocational education associated with the admission to TVET schools. Again, the variable y_{ijkl} is an outcome such as employment or earnings and all of the other control variables are defined as before.

The coefficient of interest in this regression is γ which captures the causal effect of an additional month of vocational training under further assumptions. In this case, the "exclusion restriction" requires we assume that the effect of admission to a TVET school on any outcome such as employment or earnings operates solely through the exposure to vocational education. Again, this assumption may not hold if there are other channels through which admission to a TVET school could affect outcomes. For example, it is possible that admission to a TVET school affects outcomes because students receive a stipend upon admission to a TVET school. In this case, we would mistakenly attribute the impact of the stipend to the impact of vocational training itself. Nevertheless, it can also be useful to express impact in terms of the months of exposure to vocational training.

d) *Threats to validity*

We conducted a series of statistical tests on the key socioeconomic and demographic variables collected in the admissions survey to test whether the lottery process was successful in producing a group of admitted students who look similar, on average, to those who were rejected. Specifically, we estimated equations (3) and (5) by replacing the outcome variables with baseline characteristics instead. After adjusting for the probability of admission related to the rankings submitted during the application process and including fixed effects, we found little evidence that students who were admitted had significantly different characteristics from those students who were not admitted. These results imply that the lotteries were successful, and that comparing across this group of applicants allows for a causal estimate of the impact of attending an evaluation school.

We also examined the possibility of differential attrition between students who were admitted and those who were not admitted to a TVET school after adjusting for the probability of admission. We find that students who were admitted to a TVET school were about 2.6 percentage points more likely to respond to the GFU survey. While these differences are significant, they are not particularly large in magnitude. Moreover, as confirmed in the "balance tests" described above, this differential attrition did not lead to any major differences in the baseline characteristics of students who were admitted and not admitted to a TVET school.

Finally, we conducted a formal analysis of compliance with the lottery results. We observe that students admitted to a TVET school are 50 percentage points more likely to graduate from their assigned school than those not admitted, and 25 percentage points more likely to graduate from their first ranked trade. These results indicate that, while compliance with the lotteries was not perfect, there are sufficient differences between groups enable compelling estimation of impacts.

3. Effects of admission to a TVET school on education

We consider the impact of admission to a TVET evaluation school on four main educational outcomes: (1) studying at a TVET school, (2) graduating from any TVET school, (3) months enrolled in any TVET school, and (4) months enrolled in any educational program.[93] All of these educational outcomes are derived from the GFU survey which took place in the year following the expected graduation of students from their TVET programs.

a) Estimates by program

Table 74 below shows the impact of admission to a TVET evaluation school on education overall and by type of program (1 year or 2-2.5 year).[94] Applicants to 2-2.5 year programs who were admitted to a TVET evaluation school were significantly more likely to enroll and graduate from a TVET school. Applicants who were admitted to 2-2.5 year programs were 19 percent more likely to enroll in a TVET school and 29 percent more likely to graduate from a TVET school compared to those who were not admitted. On average, they also received 3 additional months of vocational training over those who were not admitted. The differences in the number of months enrolled in any educational program was substantially lower at only 0.6 months because many of those not admitted did enroll in other programs.

Table 74. Impact of admission to TVET evaluation school on education by program (GFU survey)

Samples	(1) **Enrolled at a vocational school**	(2) **Graduated from vocational school**	(3) **Months enrolled in vocational school**	(4) **Months enrolled in any educ. program**	(5) N
All	0.126***	0.150***	2.945***		10,950
	(0.0128)	(0.0137)	(0.277)		
Percentage impact	**19.8%**	**28.6%**	**23.6%**		
2-2.5 year	0.127***	0.153***	3.005***		9,878
	(0.0130)	(0.0140)	(0.285)		
Percentage impact	**19.3%**	**28.5%**	**23.4%**		
1 year	0.118*	0.0696	1.284*		1,072
	(0.0628)	(0.0618)	(0.779)		
Percentage impact	40.4%	25.7%	33.2%		

The educational impacts for applicants to 1 year programs are mostly smaller and insignificant, although the effect on enrollment is not substantially different. The absence of significant effects for 1 year programs is a direct consequence of the smaller samples sizes which makes it more difficult to ascertain program impacts with confidence. Moreover, the impacts for the full sample are extremely similar to those for 2-2.5 year programs because the sample size is substantially larger than for 1 year programs.

[93] Note that these outcomes are distinct from measures of compliance that are focused on the likelihood of enrolling and graduating from the *assigned* TVET evaluation school. Even if there was perfect compliance with the lottery such that all applicants admitted to their assigned TVET evaluation school also enrolled and graduated from these schools, those rejected by the lottery may have enrolled and graduated from other (non-evaluation) TVET schools.

[94] All of the subsequent tables show standard errors in parentheses and use the usual notation to indicate significance at the corresponding levels of the p-values: *** p<0.001, ** p<0.05, * p<0.01.

Consequently, in the subsequent tables which consider impacts separately by cohort and gender, we focus only on applicants to 2-2.5 year programs.

b) Estimates by cohort

We considered the differential impacts of admission to 2-2.5 year programs (available by request). The impacts are fairly similar across cohorts, albeit slightly smaller for the 2010 cohort. In Figure 34 and Figure 35 below, we show the cumulative enrollment and graduation rates from vocational schools at 6-month intervals by cohort for applicants who were admitted and rejected by the lottery:

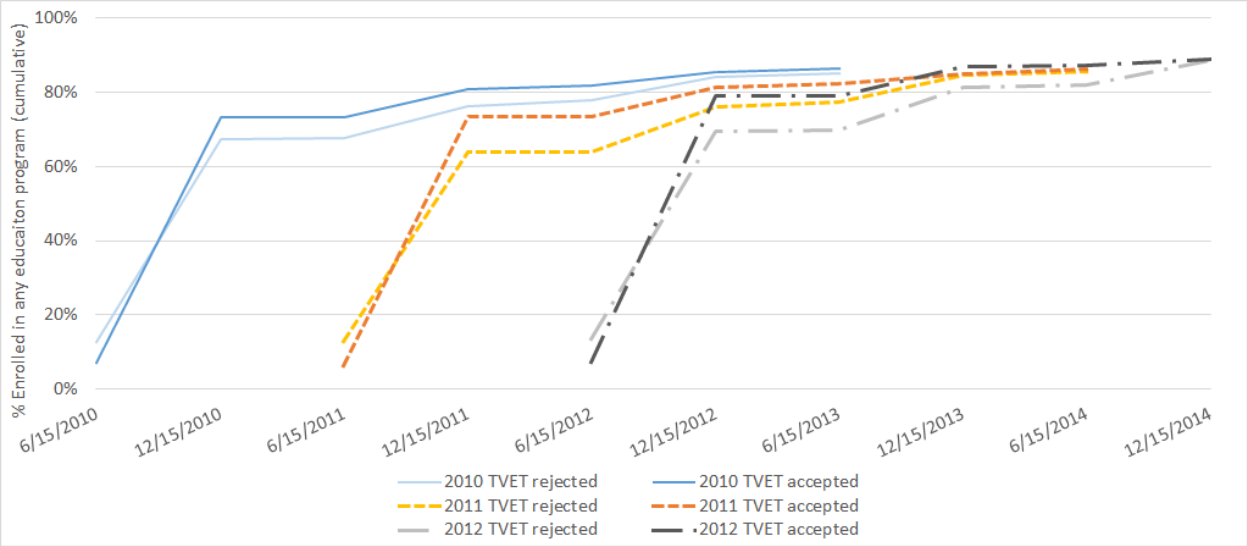
Figure 34. Cumulative enrollment rates in vocational school over time by cohort (2-2.5 year programs only)

Figure 35. Cumulative graduation rates in vocational school over time by cohort (2-2.5 year programs only)

We observe the increase in enrollment in vocational schools almost immediately after admission to TVET programs while the increase in graduation appears about two years after admission. For both measures, there are clear and persistent differences between applicants admitted and rejected by the lottery in subsequent months.

The patterns of enrollment in any educational program differ from those in vocational schools. We show these below:

Figure 36. Cumulative enrollment rate from any program over time by cohort (2-2.5 year programs only)



c) Estimates by gender

As shown in Table 75 below, the impact of admission to 2-2.5 year programs is almost twice as large for females as for males across all our educational outcomes:

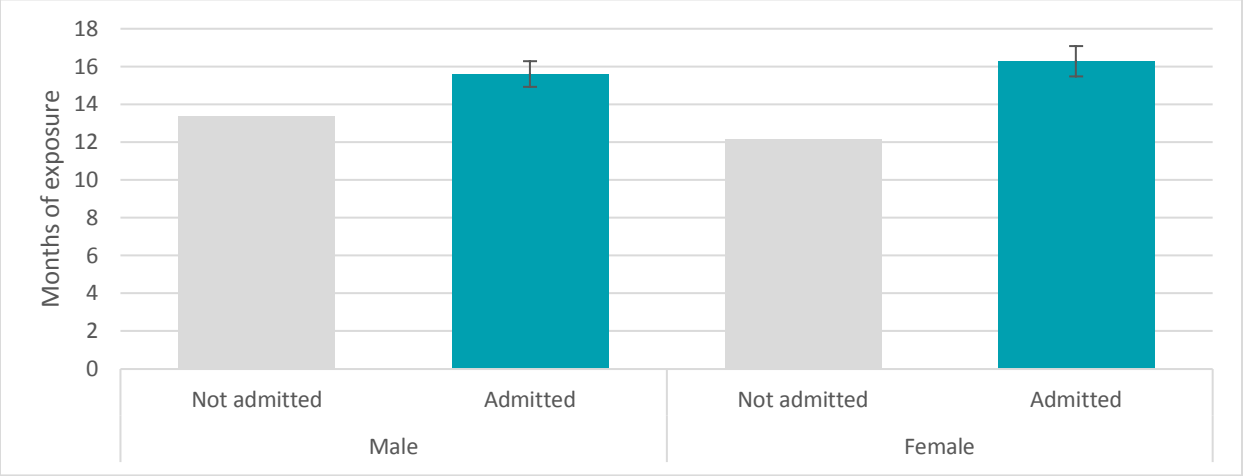
Table 75. Impact of admission to 2-2.5 year TVET programs on education by gender (GFU survey)

Samples	(1) **Enrolled in a vocational school**	(2) **Graduated from vocational school**	(3) **Months enrolled in vocational school**	(4) **Months enrolled in any educ. program**	(5) N
Males	0.0945***	0.118***	2.221***		5,995
	(0.0170)	(0.0185)	(0.374)		
Percentage impact	**13.9%**	**21.1%**	**16.6%**		
Female	0.174***	0.204***	4.152***		3,883
	(0.0203)	(0.0215)	(0.441)		
Percentage impact	**28.1%**	**40.1%**	**34.2%**		

For example, female applicants who were admitted to 2-2.5 year programs were exposed to 4.2 additional months of vocational training compared to only 2.2 additional months for their male counterparts. These

patterns are also apparent in Figure 37 below which plots the impact of admission to 2-2.5 year programs on months of exposure to a vocational training program:[95]

Figure 37. Impact of admission to 2-2.5 year TVET programs on exposure to TVET schooling (GFU survey)



To summarize our results from this section, we find strong evidence that admission to TVET evaluation schools led to significant increases in enrollment, graduation, and months of exposure to vocational education. The impacts are substantially larger for females than for males but similar across cohorts.

4. Effects of admission to a TVET evaluation school on employment

We next consider the impact of admission to a TVET evaluation school on four alternative measures of employment: (1) currently employed in a paid job longer than 1 month, (2) ever employed in a paid job longer than 1 month, (3) ever employed in a paid job longer of any length, and (4) ever employed in a paid or unpaid job of any length.[96] Employment in paid jobs that last longer than 1 month are likely to represent more stable attachments to the labor market. Therefore, we view these outcomes as more valuable ones. However, there is also value in employment more generally, whether paid or unpaid, so we present these broader measures of labor market participation as well.

A challenge in examining early labor market outcomes for this population is that some individuals may still be enrolled in educational programs at the time of the survey. For example, if individuals who were admitted to vocational schools are less likely to be enrolled in an(y) educational program than those who were not admitted, we might expect to see higher employment rates among admitted students. When we compare enrollment rates for admitted and non-admitted individuals over time in Figure 38, we see that admitted students are more likely to be enrolled during the 2.5 years following admission, at which point the pattern reverses with those non-admitted more likely to be enrolled subsequently. Eventually, the enrollment rates converge and the differences become small. If we calculate cumulative enrollment rates as in Figure 39, we see that admitted students are always more likely to be enrolled than those non-admitted but essentially convergence by the third year following admission.

[95] The error bars in these figures, and those that follow, represent 95% confidence intervals of the estimates.
[96] All these outcomes are based on employment questions pertaining to the 18-22 months prior to the GFU survey.

Figure 38. Current enrollment in any education program at intervals (2-2.5 year programs only)

Figure 39. Cumulative enrollment in any education program over time (2-2.5 year programs only)

At the time of the GFU survey, those individuals who were admitted to vocational schools are less likely to be enrolled in an educational program than those who were not admitted. Consequently, we need to be careful when interpreting estimates of current employment. As a possible robustness check for this measure, we also estimate the impact on employment for the subsample of individuals who are not currently enrolled.[97] However, given that cumulative enrollment rates are very similar for admitted and non-admitted individuals at the time of the GFU survey, the measures of ever being employed are likely to be more reliable. Indeed, the number of months enrolled in any education program is even higher for

[97] This sample restriction suffers from the problem of non-random selection into who chooses to enroll in an educational program.

admitted students than those not admitted suggesting we might have expected to observe lower employment rates among admitted students for the likelihood of being employed. Estimates using the subsequent tracking surveys for the 2010 and 2011 cohorts are generally less affected by this issue.

a) Estimates by program

Table 76 below shows the impacts of admissions to a TVET evaluation school for the whole sample and by program at the time of the GFU survey. Admission has a significant effect on employment for 2-2.5 year participants. Those admitted through the lottery were 13 percent more likely to be employed in a paid job and 9 percent more likely to have held a paid job lasting longer than one month.

Table 76. Impact of admission to TVET school on employment by program in GFU survey

Samples	(1) **Currently employed in paid job (>1 month)**	(2) **Ever employed in paid job (>1 month)**	(3) **Ever employed in paid job (any)**	(4) **Ever employed in paid or unpaid job (any)**	(5) N
All	0.0357***	0.0480***	0.0292**	0.0601***	10,950
	(0.0124)	(0.0138)	(0.0125)	(0.0105)	
Percentage impact	**14.3%**	**8.9%**	**4.1%**	**7.4%**	
2-2.5 year	0.0332***	0.0486***	0.0303**	0.0607***	9,878
	(0.0126)	(0.0140)	(0.0128)	(0.0107)	
Percentage impact	**13.2%**	**8.9%**	**4.2%**	**7.5%**	
1 year	0.106	0.0337	0.00825	0.0595	1,072
	(0.0651)	(0.0730)	(0.0655)	(0.0565)	
Percentage impact	46.4%	7.0%	1.3%	7.5%	

The impacts for applicants to 1 year programs are positive, with a surprisingly large magnitude for current employment in a paid job lasting longer than one month. However, as with the results for education outcomes, none of the estimates for applicants to 1 year programs are significant. As a result, all the tables that follow focus on applicants to 2-2.5 year programs.

b) Estimates by cohort

We considered the differential impacts of admission to 2-2.5 year programs by cohort but, again, these are available by request. It is worth noting that the impacts on employment are large and significant for the 2010 and 2011 cohorts but essentially zero for the 2012 cohort (except for ever having been employed in a paid or unpaid job of any duration). In Figure 40 below, we show the cumulative employment rates at 6-month intervals by cohort for applicants who were admitted and rejected by the lottery:

Figure 40. Cumulative impact of admission to TVET school on employment over time (2-2.5 year programs only)
logarithmic

The patterns above depict a gradual increase in employment up to one year after admission to TVET programs with differences between admitted and rejected applicants appearing by the end of the period.

c) Estimates by gender

Table 77 below shows the effects on employment for the 2-2.5 year program by gender. The positive impacts of being admitted to an evaluation school through the lottery are substantially stronger for female applicants. Those admitted are 15 percent more likely to have ever been gainfully employed for longer than 1 month. The (statistically marginally significant) difference for males is just 5 percent.

Table 77. Impact of admission to TVET school on employment by gender in GFU survey (2-2.5 year programs only)

Samples	(1) **Currently employed in paid job (>1 month)**	(2) **Ever employed in paid job (>1 month)**	(3) **Ever employed in paid job (any)**	(4) **Ever employed in paid or unpaid job (any)**	(5) N
Males	0.0221	0.0340*	0.0264*	0.0502***	5,995
	(0.0170)	(0.0183)	(0.0154)	(0.0126)	
Percentage impact	7.7%	5.5%	3.4%	**5.8%**	
Female	0.0472**	0.0681***	0.0363*	0.0764***	3,883
	(0.0185)	(0.0217)	(0.0214)	(0.0184)	
Percentage impact	**23.3%**	**15.4%**	5.9%	**10.3%**	

We also examined impacts using the Tracking survey in subsequent years for applicants from the 2010 and 2011 cohorts. Table 78 below shows employment outcomes from the 2014 tracking survey for the 2010 cohort and the 2015 tracking survey for the 2011 cohort, to show employment outcomes one year after their respective GFU surveys:

Table 78. Impact of admission to a TVET school on employment in later Tracking surveys (2-2.5 year programs only)

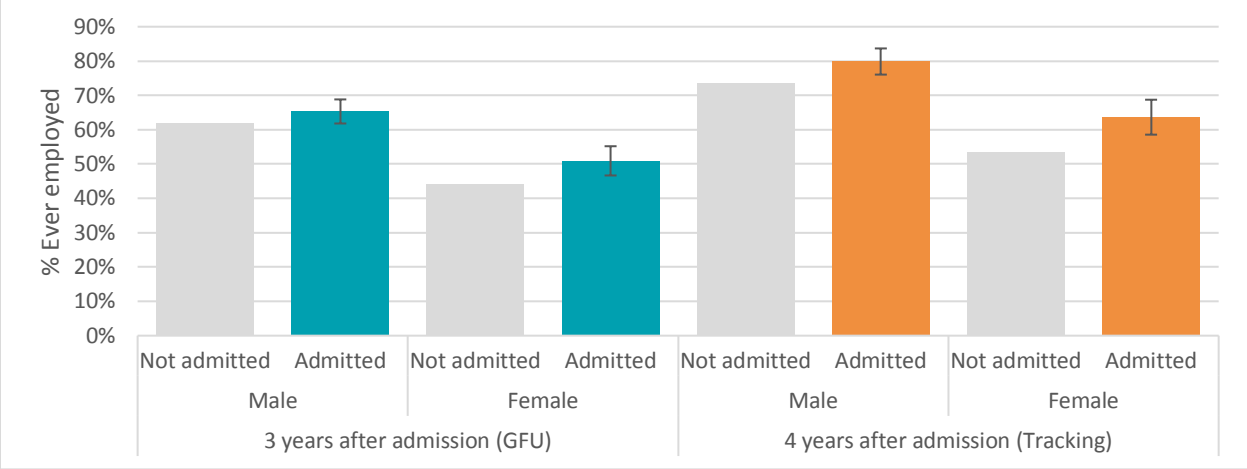
Samples	(1) **Currently employed in paid job (>1 month)**	(2) **Ever employed in paid job (>1 month)**	(3) **Ever employed in paid job (any)**	(4) **Ever employed in paid or unpaid job (any)**[i]	(5) N
All: Two years out 2010 & 2011	0.0404**	0.0801***	0.0747***	-	6,583
	(0.0165)	(0.0166)	(0.0152)	-	
Percentage impact	**13.1%**	**12.4%**	**10.3%**		
Male: Two years out 2010 & 2011	0.0342	0.0635***	0.0624***	-	3,855
	(0.0230)	(0.0204)	(0.0179)	-	
Percentage impact	9.5%	**8.6%**	**7.7%**		
Female: Two years out 2010 & 2011	0.0462**	0.102***	0.0911***	-	2,728
	(0.0232)	(0.0264)	(0.0253)	-	
Percentage impact	**19.3%**	**19.1%**	**14.7%**		

[i] Tracking surveys did not ask about unpaid employment

The effects of being admitted to an evaluation school on employment remain large and significant one year after the GFU survey, especially for females. Women were 19 percent more likely to ever have been gainfully employed for longer than 1 month, compared with 8 percent for males. Overall, applicants admitted to TVET schools were 13 percent more likely to be currently employed than those not admitted.

Figure 41 below illustrates these patterns graphically. It plots the impact of admission to 2-2.5 year programs on the likelihood of being ever employed in a paid job of 1 month or longer. The four column bars on the left show the differences in employment between those admitted and not-admitted, by gender, from the GFU survey. The four bars on the right show the same comparison for the results of the Tracking survey for the 2010 and 2011 cohorts one year after their GFU survey.

Figure 41. Impact of admission to 2-2.5 year programs on employment by gender



To summarize, there is strong evidence that admission to a TVET school leads to higher employment. While these impacts are significant for both men and women, the magnitudes substantially larger for

women, both in absolute levels and in terms of percentage impacts. There is also some evidence that these impacts on employment grow over time.

5. Effects of admission to a TVET school on earnings

We estimate the impact of admission to a TVET evaluation school on four measures of earnings: (1) monthly earnings if currently employed, (2) monthly earnings in most recent job, (3) average monthly earnings to date, and (4) total earnings to date.[98] These are all measures of earnings associated with stable paid jobs of one month and longer (including earnings from jobs of less than one month makes almost no difference to any of our resulting estimates). There are advantages and disadvantages to each measure. For example, one's monthly earnings if currently employed reflects the most up-to-date earnings at the time of the survey but also incorporate differences in current employment rates across respondents. On the other hand, total earnings includes all earnings to date but may be less informative about future prospects because they can be unduly influenced by past earnings. We consider the monthly earnings in the most recent job and the average monthly earnings as likely the most informative outcomes, but we show impacts on them all.[99]

As with our estimates of employment, our estimates of earnings are likely to be affected by differences in enrollment rates between individuals who were and were not admitted to vocational schools. Again, we need to be careful when interpreting estimates of current earnings using the GFU survey so we also consider estimating the impact on earnings for the subsample of individuals who are not currently enrolled. The measures of total earnings to date and average monthly earnings to date are probably less affected and the estimates using the subsequent tracking surveys for the 2010 and 2011 cohorts are also much less affected.

[98] All earnings measures are expressed in 2015 MNT to make them comparable across cohorts and over time. We winsorize earnings by censoring observations in the top 1 percent of the earnings distribution for each cohort. Our findings are qualitative unchanged if we include all earnings observations.

[99] Note that we do not estimate log earnings regression as our main specification because there is a large fraction of individuals with zero earnings (which would be dropped from the sample when applying logarithms). We have estimated log earnings regression conditional on having positive earnings as well as log earnings regressions where we arbitrarily assign a 1 to observations with 0 earnings, and these results are available by request.

a) Estimates by program

We begin by presenting the impact of admission to a TVET school on earnings, overall and by program:

Table 79. Impact of admission to TVET school on earnings by program in GFU survey

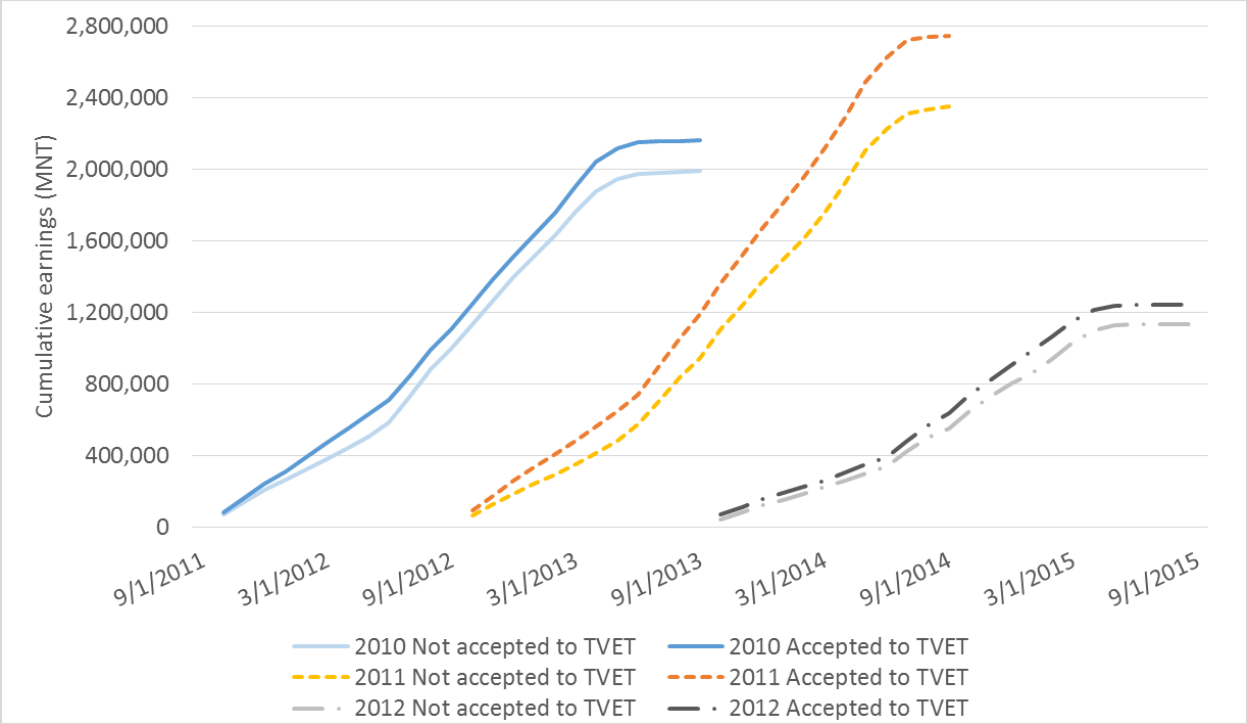
Samples	(1) **Monthly earnings if currently employed**	(2) **Most recent monthly earnings**	(3) **Average earnings per month**	(4) **Total earnings**	N
All	19,678*	11,909	12,479	54,136	10,950
	(10,359)	(12,296)	(11,969)	(113,602)	
Percentage impact	12.1%	3.4%	3.6%	2.5%	
2-2.5 year	17,162	10,333	10,709	35,681	9,878
	(10,666)	(12,652)	(12,312)	(115,706)	
Percentage impact	10.5%	2.9%	3.1%	1.7%	
1 year	90,854***	59,841	66,142	659,687	1,072
	(34,264)	(42,277)	(41,299)	(574,713)	
Percentage impact	**64.5%**	23.2%	26.5%	24.5%	

The magnitudes of the impacts are all positive, and especially large for the impacts associated with the 1 year programs. However, none of the coefficients is significant, with the exception of marginal significance for monthly earnings if currently employed. Thus, it is important to be cautious when interpreting these results

b) Estimates by cohort

We have also examined the differential impacts by cohort for applicants to 2-2.5 year programs but none of the coefficients are significant. Nevertheless, in Figure 42 below, we still observe evidence of differences in cumulative earnings at 6-month intervals by cohort for applicants who were admitted and rejected by the lottery:

Figure 42. Cumulative impact of admission to TVET school on earnings over time (2-2.5 year programs only)



c) Estimates by gender

We examine the impact of admission to 2-2.5 year programs separately for males and females in Table 80 below. None of the estimates for men are significant and most are close to zero in terms of percentage impacts. However, the impacts are large and significant for women for the various measures of monthly earnings. Those who were admitted to a 2-2.5 year TVET program earned approximately 27,000-30,000 MNT per month compared to their counterparts who were not admitted. These are also substantial in percentage terms, with 13-14% higher monthly earnings in their most recent job and on average, and 27% higher monthly earnings if currently employed.

Table 80. Impact of admission to TVET school on earnings by gender in GFU survey (2-2.5 year programs only)

Samples	(1) **Monthly earnings if currently employed**	(2) **Most recent monthly earnings**	(3) **Average earnings per month**	(4) **Total earnings**	N
Males	9,752	-3,034	-2,973	3,314	5,995
	(16,142)	(18,512)	(17,975)	(176,543)	
Percentage impact	4.7%	-0.7%	-0.7%	0.1%	
Female	27,456**	29,210**	29,777**	74,637	3,883
	(11,572)	(14,737)	(14,339)	(119,908)	
Percentage impact	**27.6%**	**13.3%**	**13.9%**	6.1%	

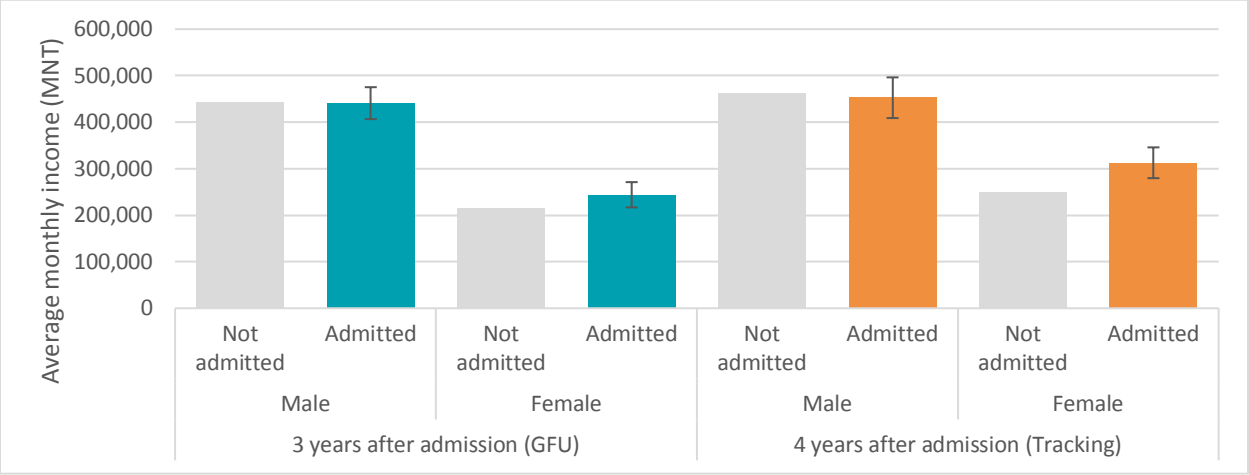
We also examine earnings outcomes from the tracking survey for the 2010 and 2011 applicants to 2-2.5 year programs, overall and by gender. As with employment, these outcomes are constructed from the 2014 tracking survey for the 2010 cohort and the 2015 tracking survey for the 2011 cohort, to show earnings one year after their respective GFU surveys.

Table 81. Impact of admission to TVET school on earnings in later Tracking surveys (2-2.5 year programs)

Samples	(1) **Monthly earnings if currently employed**	(2) **Most recent monthly earnings**	(3) **Average earnings per month**	(4) **Total earnings**	(5) N
All: Two years out 2010 & 2011	17,826	34,602**	23,333	140,987	6,583
	(13,457)	(15,634)	(15,045)	(194,084)	
Percentage impact	9.1%	**9.3%**	6.3%	4.0%	
Male: Two years out 2010 & 2011	5,831	9,116	-8,787	-178,954	3,855
	(21,055)	(23,989)	(23,034)	(300,980)	
Percentage impact	2.3%	2.0%	-1.9%	-3.9%	
Female: Two years out 2010 & 2011	30,934**	66,586***	64,196***	551,269***	2,728
	(14,378)	(17,038)	(16,438)	(207,597)	
Percentage impact	**25.6%**	**26.2%**	**25.8%**	**26.3%**	

Looking one year after the GFU survey and approximately two years after students would have graduated from their 2-2.5 year programs, we see further evidence of significant impacts on earnings for females. Women who were admitted to a 2-2.5 year TVET program earned approximately 65,000 MNT per month more in their most recent job and on average as compared to those who were not admitted. The difference in total earnings at the point of the tracking survey is over 550,000 MNT and highly significant. These impacts are remarkably consistent in percentage terms, ranging from 25% to 26% across all four outcomes. As before, the estimates for men are not significant and close to zero. These patterns by gender can also be seen in Figure 43 below, which plots the impact of admission to 2-2.5 year programs on average monthly earning:

Figure 43. Impact of admission to TVET school on earnings (2-2.5 year programs only)



The four column bars on the left show the differences in average monthly earnings between treatment and control groups, by gender, from the GFU survey. The four bars on the right show the same comparison for the results of the Tracking survey for the 2010 and 2011 cohorts one year after their GFU survey.

To summarize, we find strong evidence that admission to TVET schooling increases earnings for women in 2 and 2.5 year programs, and these impacts appear to increase over time. There is no evidence that admission to a TVET school improved earnings for men.

6. Effects of admission to TVET schools on intermediate outcomes

We investigated a number of intermediate outcomes to better understand the mechanisms underlying the impacts on employment and earnings. All of the outcomes were reported in the GFU survey in the year after expected graduation and, for simplicity, these analyses are restricted to individuals who applied to 2-2.5 year programs (estimates are similar when including applicants to 1 year programs).

We begin by examining four outcomes related to the trades that individuals studied in TVET schools: (1) their standardized scores on a test of trade-related knowledge in their top-ranked trade, (2) their standardized scores on a test of trade-related knowledge in their 2nd-ranked trade, (3) whether individuals were currently employed in a paid job of longer than 1 month related to their TVET trade, and (4) whether individuals were ever employed in a paid job of longer than 1 month related to their TVET trade. The impacts of admission to a TVET school on these outcomes are presented below:

Table 9. Impact of admission to a TVET school on trade-related outcomes (2-2.5 year programs only)

Samples	(1) **Test of knowledge (1st ranked trade)[i]**	(2) **Test of knowledge (2nd ranked trade)[i]**	(3) **Currently employed in trade**	(4) **Ever employed in trade**	(5) N
All	0.207***	0.000998	0.00920	0.0324***	Up to
	(0.0311)	(0.0320)	(0.00715)	(0.0121)	9,878
Percentage impact	-	-	15.5%	**15.3%**	
Male	0.230***	-0.0341	0.00162	0.0182	Up to
	(0.0406)	(0.0404)	(0.00921)	(0.0166)	5,995
Percentage impact	-	-	2.7%	7.8%	
Female	0.184***	0.0651	0.0195*	0.0531***	Up to
	(0.0485)	(0.0522)	(0.0112)	(0.0177)	3,883
Percentage impact	-	-	33.5%	**29.1%**	

[i] Tests of knowledge in the 1st and 2nd ranked trades are standardized to mean 0, standard deviation 1

We see clear evidence that males and females who gained admission to a TVET school showed increased knowledge in their 1st ranked trade, with impacts of approximately 0.2 standard deviation units. The absence of impacts for knowledge in the 2nd ranked trade are not surprising given that much fewer students ended up studying them. On the other hand, only females were significantly more likely to be employed in fields related to the trade they studied in a TVET school. While the impacts are not significant for current employment, the percentage impacts are similar in magnitude to those associated with being ever employed.

We also examine several factors related to employment and work intensity: (1) whether individuals applied for or were offered job, (2) total months employed in paid jobs of longer than one month, (3) average number of days worked per month, and (4) average number of hours worked per day. The impacts of admission to a TVET school on these outcomes are presented below:

Table 10. Impact of admission to a TVET school on work intensity (2-2.5 year programs only)

Samples	(1) **Applied for or was offered a job**	(2) **Total months employed (>1 month)**	(3) **Average days / month worked**	(4) **Average hours / day worked**	(5) N
All	0.0579***	0.110	1.258***	0.392***	9,878
	(0.0133)	(0.134)	(0.378)	(0.148)	
Percentage impact	**8.6%**	3.4%	**8.9%**	**7.3%**	
Male	0.0614***	0.179	0.922*	0.146	5,995
	(0.0169)	(0.191)	(0.494)	(0.194)	
Percentage impact	**8.5%**	4.6%	5.7%	2.4%	
Female	0.0546**	0.0116	1.721***	0.732***	3,883
	(0.0215)	(0.175)	(0.582)	(0.227)	
Percentage impact	**8.9%**	0.5%	**15.0%**	**16.9%**	

Males and females who were admitted to a 2-2.5 year TVET program were more significantly more likely to apply for a job or receive a job offer, with similar percentage impacts. Furthermore, females also worked significantly more days per month and hours per day relative to their counterparts who were not admitted to these TVET programs. While the impacts for men are positive and marginally significant for number of days worked, they are substantially smaller in magnitude and percentage impacts. These

patterns may partially explain why only women saw higher earnings as a consequence of admission to TVET schools.

Finally, we examine the type and sector of employment in more detail by considering the following outcomes: (1) whether individuals are employed in in internships, (2) whether individuals are self-employed, (3) whether individuals are employed in the government sector, and (4) whether individuals are employed in the private sector.[100] The impacts of admission to a TVET school on these outcomes are presented in the table below:

Table 82. Impact of admission to a TVET school on employment type and sector (2-2.5 year programs only)

Samples	(1) **Employment type: Internship**	(2) **Employment type: Self-employed**	(3) **Employed in Government sector**	(4) **Employed in private sector**	(5) N
All	0.0279**	0.0126**	0.00974*	0.0236*	9,878
	(0.0111)	(0.00532)	(0.00539)	(0.0140)	
Percentage impact	**16.8%**	**34.6%**	31.1%	4.9%	
Male	0.0376**	0.0110	0.00668	0.00899	5,995
	(0.0154)	(0.00715)	(0.00770)	(0.0186)	
Percentage impact	**21.0%**	27.2%	17.9%	1.7%	
Female	0.0151	0.0146*	0.0136*	0.0438**	3,883
	(0.0157)	(0.00806)	(0.00711)	(0.0214)	
Percentage impact	10.3%	47.3%	59.0%	**11.0%**	

While male applicants are much more likely to have an internship, female applicants are more likely to be employed in the government sector, the private sector, or to be self-employed. Because internships are unlikely to pay as well as government and private sector jobs, these differences by gender may further explain why men did not experience the same earnings gains as women.

7. Effects of admission to TVET schools on other outcomes

Admission to a TVET school may also have impacts beyond the labor market. We consider impacts on future expectations, household assets, and expenditures. These outcomes were reported in the GFU survey in the year after expected graduation. As before, our analyses are restricted to individuals who applied to 2-2.5 year programs, though estimates are similar when including applicants to 1 year programs.

We begin by considering future expectations on several dimensions: (1) expected number of weeks to find next job, (2) expected number of months employed in the following year, (3) expected monthly earnings one year from now, and (4) future plans to enroll in any education program. The impacts of admission to a TVET school on these outcomes are presented in the table below:

[100] There are additional employment types and employment sectors (e.g. military, non-profits) but these represent a very small fraction of overall employment.

Table 83. Impact of admission to a TVET school on future expectations (2-2.5 year programs only)

Samples	(1) **Weeks to find next job**	(2) **Months employed, 1 year from now**	(3) **Monthly earnings, 1 year from now**	(4) **Plans to enroll in education program**	(5) N
All	0.0960*	0.328***	-18,522	0.0107	9,655+
	(0.0496)	(0.101)	(24,961)	(0.0141)	
Percentage impact	4.5%	**4.0%**	-2.3%	2.9%	
Male	0.0966	0.268**	-38,493	0.00862	5,845+
	(0.0666)	(0.130)	(38,335)	(0.0181)	
Percentage impact	4.5%	**3.2%**	-4.1%	2.5%	
Female	0.103	0.414**	6,953	0.0141	3,795+
	(0.0753)	(0.161)	(26,735)	(0.0222)	
Percentage impact	4.9%	**5.1%**	1.1%	3.5%	

We see the strongest impacts on expectations of future employment which are highly significant for both males and females. This is consistent with the impacts on actual employment in the tracking survey that takes place one year after the GFU survey. While there are positive impacts on the number of weeks to find the next job and plans to enroll in a future education, these are not significant. Expectations of future earnings are actually negative for male, but these are not significant either.

We collected detailed information about household assets in the GFU survey. However, for the analysis here, we constructed standardized indices of assets in several broad categories: (1) an index of ownership of utilities such as fridges, stoves, TVs, etc., (2) an index of transportation assets such as cars, trucks, tractors, etc., (3) and an index of livestock assets such as cattle, horse, sheep, etc., and (4) total financial assets.[101] These estimated impacts for these outcomes are presented in Table 84 below:

Table 84. Impact of admission to a TVET school on household assets (2-2.5 year programs only)

Samples	(1) **Utility ownership index**	(2) **Transportation assets index**	(3) **Livestock assets index**	(4) **Total financial assets (MNT)**	(5) N
All	-0.0838***	-0.0494*	-0.0159	0.000132	9,878
	(0.0276)	(0.0284)	(0.0290)	(0.0358)	
Male	-0.0964***	-0.0738*	-0.00788	0.0121	5,995
	(0.0365)	(0.0398)	(0.0386)	(0.0592)	
Female	-0.0649	-0.0157	-0.0264	-0.0112	3,883
	(0.0413)	(0.0387)	(0.0432)	(0.0201)	

Interestingly, we observe negative and significant effects of admission to a TVET school on ownership of utilities. Looking at more disaggregated specifications (not shown here), this seems to be driven by negative impacts on number of generators, as well as the number of TVs, cellphones, and radios. There is

[101] The first three indices were constructed by standardizing the sum of the standardized number of each asset. We have estimated impacts on each specific asset but these need to be interpreted with care because there is potential for spurious significance due to multiple hypothesis testing.

also some evidence of negative impacts on ownership of transportation assets. However, these patterns may be due to changes in the types of households in which applicants are living.

Finally, we examine the impacts of standardized indices of expenditures in several categories: (1) an index of expenditures on frequent consumed items such as food, alcohol, and entertainment, over the past 30 days (2) an index of expenditures on less frequently consumed items such as shoes, clothes, and jewelry, over the past 12 months, (3) an index of transfer to friends and family over the past 12 months, and (4) an index of expenditure on education over the past 12 months. These outcomes are presented in the table below:

Table 85. Impact of admission to a TVET school on expenditures (2-2.5 year programs only)

Samples	(1) **Expenditures (30day) index**	(2) **Expenditures (12month) index**	(3) **Transfers index**	(4) **Education expenditure index**	(5) N
All	0.0257	0.0519*	0.0438	-0.0641**	9,878
	(0.0292)	(0.0284)	(0.0287)	(0.0284)	
Male	0.0376	0.0481	0.0707	-0.0888**	5,995
	(0.0403)	(0.0412)	(0.0441)	(0.0401)	
Female	0.00703	0.0595*	0.00778	-0.0253	3,883
	(0.0418)	(0.0347)	(0.0297)	(0.0385)	

The estimated impacts on most categories of expenditure are positive, and marginally significant on the less frequently consumed items. On the other hand, there are negative and significant impacts on educational expenditures, especially for males. This may reflect the fact that applicants who were admitted to TVET programs, and subsequently completed their schooling, do not need to spend as much on educational programs in the future.

8. Effects of exposure to a TVET schooling

Thus far, we have focused on the impacts of admission to a TVET evaluation school on education, employment and earnings. However, because not everyone who is admitted to a TVET school necessarily enrolls and graduates from a TVET school, and individuals who are not admitted to a TVET school can enroll and graduate from other TVET schools, these impacts can be difficult to interpret. Consequently, as explained in the section on estimation techniques, we also derive the impact of an additional month of exposure to a TVET education on employment and earnings. Table 86 and Table 87 below present the impacts of exposure to such vocational education in 2-2.5 year programs using the GFU and tracking surveys:

Table 86. Impact of exposure to TVET education on employment (2-2.5 year programs only)

Samples	(1) **Currently employed in paid job (>1 month)**	(2) **Ever employed in paid job (>1 month)**	(3) **Ever employed in paid job (any)**	(4) **Ever employed in paid or unpaid job (any)[i]**	(5) N
GFU Males	0.00995	0.0153*	0.0119*	0.0226***	5,995
	(0.00781)	(0.00828)	(0.00695)	(0.00613)	
GFU Females	0.0114**	0.0164***	0.00874*	0.0184***	3,883
	(0.00444)	(0.00518)	(0.00502)	(0.00408)	
Tracking 2010/11 Males	0.0128	0.0238***	0.0234***	-	3,855
	(0.00882)	(0.00855)	(0.00767)	-	
Tracking 2010/11 Females	0.0109**	0.0242***	0.0215***	-	2,728
	(0.00551)	(0.00650)	(0.00619)	-	

[i] The tracking survey did not ask about unpaid employment

Table 87. Impact of exposure to TVET education on earnings (2-2.5 year programs only)

Samples	(1) **Monthly earnings if currently employed**	(2) **Most recent monthly earnings**	(3) **Average earnings per month**	(4) **Total earnings**	(5) N
GFU Males	4,391	-1,366	-1,339	1,492	5,995
	(7,269)	(8,313)	(8,071)	(79,140)	
GFU Females	6,613**	7,036**	7,172**	17,977	3,883
	(2,798)	(3,541)	(3,445)	(28,732)	
Tracking 2010/11 Males	2,188	3,421	-3,297	-67,153	3,855
	(7,868)	(8,954)	(8,645)	(113,066)	
Tracking 2010/11 Females	7,316**	15,747***	15,182***	130,372***	2,728
	(3,449)	(4,301)	(4,163)	(49,971)	

The impacts associated with an additional month of exposure to vocational training are approximately 1/2 and 1/4 the magnitude of the impacts of admission for males and female respectively. This simply reflects the fact that admission to a TVET school is associated with about 2 additional months of exposure to vocational training for males and 4 additional months of exposure for females. Similarly, if we wish to calculate the impacts of graduation from a TVET school, we would need to scale up our estimates for the impact of admission by a factor of approximately 8 for males and 5 for females (because the estimated difference in graduation rates between those admitted and not admitted is about 0.11 for males and 0.21 for females).

9. Conclusion

We find that admission and graduation from oversubscribed TVET schools leads to significant improvements in employment and earnings, especially for women. These improvements are likely due to the acquisition of more skills in specific trades, greater work intensity, and increased employment opportunities in high-paying sectors. The impacts are mostly driven by students in early cohorts and disappear for the latest cohort which entered the labor market during an economic downturn. Nevertheless, these findings are consistent with the presence of a shortage of vocational students in Mongolia—one of the key assumptions underpinning the choice of the TVET sector as a focus of the

Mongolia Compact. Moreover, they suggest that expanding access to TVET schools would have large benefits for prospective students, and for women in particular.

F. Additional results

Table 88. Impact of exposure to equipment upgrades on logged earnings by gender (GFU, 2 year programs, earnings = 0 replaced by 1 before taking logs)

Samples	(1) **Monthly earnings if currently employed**	(2) **Most recent monthly earnings**	(3) **Average earnings per month**	(4) **Total earnings**	(5) N
All	0.0633	-0.0344	-0.0495	-0.0518	7,706
	(0.0611)	(0.0693)	(0.0692)	(0.0758)	
Males	0.0630	-0.0550	-0.0750	-0.0769	4,732
	(0.0702)	(0.0784)	(0.0780)	(0.0858)	
Females	0.239	0.125	0.116	0.122	2,974
	(0.184)	(0.203)	(0.203)	(0.218)	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 89. Impact of exposure to equipment upgrades on logged earnings by gender (GFU, 2 year programs, earnings = 0 not replaced before taking logs)

Samples	(1) **Monthly earnings if currently employed**	(2) **Most recent monthly earnings**	(3) **Average earnings per month**	(4) **Total earnings**	(5) N
All	-0.0197	-0.00494	0.00297	0.00671	4,311
	(0.0258)	(0.0129)	(0.0122)	(0.0153)	
Males	-0.00688	0.000390	0.00928	0.0170	2,889
	(0.0260)	(0.0145)	(0.0137)	(0.0170)	
Females	0.0865	-0.0121	-0.0131	-0.0209	1,422
	(0.140)	(0.0319)	(0.0312)	(0.0434)	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

G. Changes to the Econometric Specification for Estimating the Impact of Exposure to Equipment Upgrades

1. Original specification

In the Evaluation Design Report (IPA, 2014), footnote 8 described the specifics of the empirical strategy as follows:

"Specifically, we plan to estimate the effects of the upgrades using the following model to be estimated via ordinary least squares:

$$y_{ijklm} = \tau Exposed_i * Admitted + \partial Exposed_i + \phi Admitted_i + \beta' X_{ijklm} + f(p_{ijklm}) + \varepsilon_i$$

The variable y_{ijk} is the outcome of interest for student i in school k participating in round l of the lottery for cohort m. The number of months students are exposed to the equipment upgrades given their enrollment decisions is $Exposed_i$, and $Admitted_i$ is an indicator variable for whether or not a student was admitted to an improved trade by the lottery. The coefficient of interest is the coefficient on the interaction of the two — the difference in treatment effects for admitted students based on the number of months they were exposed to the equipment upgrades. Finally, X_{jklm} is a vector of baseline controls including demographic information and the baseline test scores from the admissions survey as well as fixed effects for the students' school and program type, while $f(p_{jklm})$ is a polynomial of the probability that each student was assigned to an improved trade given their and their peers trade preferences."

This original econometric specification did not accurately capture the relevant impacts of equipment upgrades as described in the evaluation strategy within the report mentioned above. Consequently, the econometric specification was revised as follows:

2. Revised specification

The follow-up report estimates the impact of exposure to equipment upgrades using the following regression model estimated via two-stage least squares (2SLS):

$$y_{ijlm} = \beta' X_i + \delta \widehat{ExposureUpgrades_\iota} + f\left(p_i^{Upgrd}\right) + \mu_{jlm} + \varepsilon_{ijlm} \quad (6)$$

where $\widehat{ExposureUpgrades_\iota}$ is the number of months of exposure to equipment upgrades experienced by student i as predicted in a first stage regression:

$$ExposureUpgrades_i = \beta' X_i + \alpha AdmittedUpgraded_i * Cohort_m + AdmittedUpgraded_i + f\left(p_i^{Upgrd}\right) + \mu_{jlm} + \varepsilon_{ijlm}.$$

As explained in the analysis section of this report, the first stage regression predicts the exposure to equipment upgrades with the *interaction* between an indicator for whether student i was admitted or not to a TVET school and a set of indicators for each cohort represented by $Cohort_m$.[102] In essence, the first stage regression is a generalized difference-in-difference estimate for the impact of exposure to equipment upgrades on the number of months of exposure associated with different cohorts.[103] The

[102] The main effects of the indicators for each cohort are also included in this regression but they are subsumed in the fixed effects for each round of the lottery by school and cohort.

[103] A similar 2SLS model incorporating a difference-in-difference framework is used in Duflo (2001) and Field (2007)

second-stage regression then uses this variation in exposure across cohorts to estimate the impact of upgraded equipment on subsequent outcomes. The coefficient of interest here is δ which captures the causal effect of an additional month of exposure to equipment upgrades on outcome y.

We also examine the impact of equipment upgrades using an alternative approach that first estimates the impact of admission to trades that were affected by equipment upgrades (an "upgraded trade") separately by cohort using the following regression model estimated via ordinary least squares (OLS):

$$y_{ijl} = \beta' X_i + \tau AdmittedUpgraded_i + f\left(p_i^{Upgrd}\right) + \mu_{jl} + \varepsilon_{ijl} \quad (7)$$

where $AdmittedUpgraded_i$ is an indicator variable for whether or not a student i was admitted to a trade affected by equipment upgrades through the lottery. The coefficient of interest in these regressions is τ which captures the difference in outcomes for students who were admitted to an upgraded trade and those students who were not admitted to an upgraded trade, after controlling for the probability of admission to an upgraded trade and fixed effects for each lottery round. We estimate this coefficient for each cohort separately to obtain τ_{2010}, τ_{2011}, and τ_{2012}. The difference in the impact of being admitted to an upgraded trade between earlier and later cohorts provides an estimate for the impact of exposure to upgraded equipment. For example, the difference-in-difference estimate would represent the difference between τ_{2011}, the difference in outcomes between those individuals admitted and not admitted to upgraded trades in 2011, and τ_{2010}, the difference in outcomes between those individuals admitted and not admitted to upgraded trades in 2010. This difference-in-difference estimate of $\tau_{2011} - \tau_{2010}$ captures the causal impact of the differential exposure to equipment upgrades in 2011 vs. 2010 under the assumption that there are no confounding factors that affect upgraded trades differentially in 2011 compared to 2010.