Defining and Measuring Technical, Cognitive and Non-Cognitive Skills

David N. MARGOLIS
Labor Markets Team, HDNSP
Why should we care?

- Education and training have been shown to be important for growth
- Current education and training systems may not always provide marketable skills
- Commonly used measures of education and training are only a small part of what makes an individual’s human capital
- Other cognitive and non-cognitive skills matter greatly in determining labor market outcomes
Today’s Talk

- **Background**
  - What are the skills that we need to measure?
  - Why is a new instrument needed?

- **The StEP Skills Measurement Surveys**
  - The household survey
    - Skills Measures
    - Outcome measures
    - Background characteristics
    - Instruments
  - The employer survey
    - Skills currently being used
    - Skills needed
    - The role of skills in earnings determination and promotions
We often use education and training received or completed
  ◦ Is it just a signal of things the person already knows? (Spence 1973)
  ◦ One hopes that education teaches people new things.
  ◦ In that case, why measure education and not the things people know and can use to improve their welfare?

Using education and training to proxy for skills doesn’t work well
  ◦ Most statistical analyses show, for example, that education and training explain at best 50% of variation in earnings (Bowles, Gintis, and Osborne, 2001)
  ◦ Not surprising if these are muddled, partial measures of skills that people really have
  ◦ Measuring the skills directly can better capture what people know (not just the part they learned in school)
  ◦ We can see which skills actually matter most
Beyond technical skills, there is evidence that cognitive and non-cognitive skills affect labor market outcomes (Heckman, Stixrud, and Urzua (2006))

- **Cognitive skills**: “ability to understand complex ideas, to adapt effectively to the environment, to learn from experience, to engage in various forms of reasoning, to overcome obstacles by taking thought”
  - Literacy
  - Numeracy
  - Ability to solve abstract problems

- **Non-cognitive skills**: characteristics across multiple domains (social, emotional, personality, behaviors, attitudes, etc.) not included under cognitive skills
  - Work habits (effort, discipline, determination)
  - Behavioral traits (self-confidence, sociability, emotional stability)
  - Physical characteristics (strength, dexterity, endurance)

- **Technical skills**: Combinations of cognitive and non-cognitive skills used to accomplish specific tasks
What skills do we need to measure?

How do these skills affect outcomes?

- Can influence success in education
- Can affect career opportunities and choices
- Can determine ability to find and perform different types of jobs
- Employers hiring, promotion, and wage setting decisions depend on these skills (Borghans, Duckworth, Heckman, and ter Weel (2008); Cunha (2008); and Heckman, Stixrud, and Urzua (2006))
Background

Why is a new instrument needed?

- There are important knowledge gaps
  - Which skills matter?
  - How do they matter?
  - How do people obtain needed skills?
  - How do skills enter into employer decisions?

- Existing surveys don’t collect the necessary information all in one place
  - Skills
  - Labor market outcomes
  - Instrumental variables

- Policy makers need information to make good decisions
  - Restructuring curricula and changing standards
  - Where to invest
  - Improving matching
Background

Why is a new instrument needed?

- The vast majority of household surveys only ask about education
  - Some ask about training (but rarely specific technical skills)
  - A very limited subset will ask about IQ or other specific proxies for cognitive or non-cognitive skills

- Psychological studies that measure these skills almost never look at labor market outcomes

- Almost no employer surveys ask for any measure of skills beyond education
  - Some specifically designed surveys may ask about ICT use, but rarely anything else
There are a few recent initiatives to address this gap

- PIAAC (Programme for the International Assessment of Adult Competencies) by OECD
  - Computer-assisted administration
  - Designed for developed (OECD) countries
- LAMP (Literacy Assessment and Monitoring Programme) by UNESCO–UIS
  - Designed for eligible developing countries
  - Paper administration
  - Limited background questionnaire
  - No instrumental variables

- Limited non-cognitive modules
What are the objectives

- Propose an instrument that can be used in developing countries
  - Technology limitations
  - Significant share of illiterate respondents
  - Complicated sampling issues

- Ensure that the instrument is complete enough to permit reliable, detailed analyses

- Support proposals from qualified teams to adapt and implement the survey
Cognitive, non-cognitive and technical skills
- Mostly self-reported
- Direct cognitive measures in a limited number of countries

Education and training
- Adapt for developing countries (can be administered to illiterate populations)

Labor market outcomes
- Employment status
- Earnings
- Consumption

Relevant background characteristics
- Need to be able to calculate weights, establish representativity
- Include control variables for subsequent analysis

Instrumental variables
- Necessary for subsequent analysis of the role of skills on outcomes

Variables needed to link to employer survey
Developing countries often lack recent censuses upon which to base sampling

Solution: Enumeration
  ◦ Randomly select “enumeration areas”
  ◦ Go door-to-door to enumerate all households
  ◦ Randomly select households from among those enumerated
    • Can use the most recent census
    • Can use “local knowledge” if there have been major population shifts since most recent survey

Full enumeration can be costly, so “urban only” surveys are sometimes administered
  ◦ Depends on population density
  ◦ Depends on ease of access to rural areas
  ◦ Will not give a complete picture of skills available, since (unsampled) rural residents can move to fill job openings in urban areas
The StEP Household Survey
Survey flow

Basic background questionnaire
- Household roster
- Household composition
- Basic demographics
- Dwelling (household consumption proxy)

Filter
- Randomly choose a single person
- Set up an appointment to administer the detailed individual questionnaire

Detailed individual questionnaire
- Family
- Education
- Labor market
- Time allocation
- Health
- Migration
- Risk and time preference
- Skills
The StEP Household Survey
Background questionnaire

- Household roster
  - Lists all household members
  - Basic demographics
    - Sex
    - Relationship to household head
    - Marital status
    - Date of birth
    - Ethnic group
    - Education (years, completed degree, basic literacy)
    - Languages spoken at home
    - Employment status
The StEP Household Survey
Background questionnaire

- Dwelling questionnaire
  - Rooms
  - Water sources and treatment
  - Cooking
  - Waste disposal
  - Telephone and electricity
  - Appliances
  - Other consumption goods
  - Land
  - Animals
  - Construction materials
  - Countryside / village / town / city
The StEP Household Survey Filter

- Random selection of household member age 15+
  - Can limit upper bound of age (65) to exclude retirees
  - On-site randomization mechanism proposed

- Scheduling a time for administration of detailed individual questionnaire
  - Selected respondent may not be present
    - Reduces risk of oversampling housewives
  - Background questionnaire can be answered by anyone (preferably household head)
  - Survey length is an issue
    - Background and dwelling questionnaires can take an hour
    - Detailed individual questionnaire can take 2 hours
    - Respondents would be too tired mentally to complete the entire survey in a single sitting
The StEP Household Survey Cognitive Skills – Measured

- **Prose Items** – Read the label on a medicine bottle and answer “What is the maximum number of days you should take this medicine?” and “List three situations for which you should consult a doctor.”

- **Document Items** – Two graphs are shown for years between 1980 and 2000: 1) Sales of fireworks in a country and 2) victims from fireworks. Questions are “In what year were the fewest number of people injured?”, “Describe the relationship between sales of fireworks & injuries caused”.

- **Numeracy** –
  - A picture of two cases of bottles is shown. The person needs to respond “In total, how many bottles are in the two full cases?”
  - A picture of a car gas tank level is shown. The question is “The gas tank in this truck holds 48 gallons. About how many gallons remain?”
The StEP Household Survey
Cognitive Skills – Self-reported

- Frequency of Skills Use at Work or in Daily Life

  - Do you ever have to read anything, even very short notes or instructions that are only a few sentences long?
  - Do you have to read bills, financial statements, or forms?
  - Do you have to measure or estimate sizes, weights, distances, etc.?
  - Do you ever use or calculate fractions, decimals or percentages?
  - Do you ever use more advanced math, such as complex algebra, geometry, trigonometry, calculus, or inferential statistics?
The StEP Household Survey Non-cognitive Skills

- Big Five Inventory, Self-Control, Core Self-Evaluation, GRIT, Decision-Making, Aggressive Behavior

- Questions on a scale of 1 to 5: “I see myself as someone who:
  - …sometimes can’t stop myself from doing something, even if I know it is wrong”
  - …pursues my goals in spite of setbacks”
  - …is almost certain to make my plans work.”
  - …can be somewhat careless.”
  - …is inventive.”
  - …starts quarrels with others.”
The StEP Household Survey
Technical Skills

“How much of your workday (involves/involved) doing physical tasks such as standing, handling objects, operating machinery or vehicles, or making or fixing things with your hands?”

“As part of your work do you have any contact with people other than co-workers, for example with customers, clients, students, or the public?”

“As a part of your work do you regularly supervise the work of other employees?”

“As part of your work, do you use a computer to do data entry or fill out forms?”
The StEP Household Survey
Education questions

- Separate early childhood component
- Educational attainment component
  - Includes training
  - Includes literacy programs outside of the education system
- Performance and instruments component
  - Questions for primary and secondary school
  - Relative ranking
  - Distance to school
  - Effort devoted to studies
  - Parental influence
    - Supervision
    - Information
    - Time management
Detailed questions about employment status
- Uses ILO definitions
- Many questions about self employment and household enterprises
  - Separate household enterprise module to measure income for people who are not wage or salary workers

For those not working
- Detailed questions on job search
  - Methods
  - Length of time
- Questions about job sought
  - Formality
  - Wage
  - Self employed/wage work
For the employed

- Allows for multiple job holding
- Measures of formality
  - Social security contributions
  - Written contract
  - Day labor
  - Structure of employer (household enterprise, self employed, public/private ownership, public works)
- Structure (cash, in kind, benefits), frequency and amount of compensation
- Wage arrears
Please tell me in what months of what years, starting in [MONTH/YEAR], you were carrying out the following activities:

**MARK EACH MONTH IN WHICH THE RESPONDENT SAYS THE ACTIVITY WAS DONE. MARK ALL ACTIVITIES UNDERTAKEN IN EACH MONTH.**

<table>
<thead>
<tr>
<th>Activity</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working in main job in [CURRENT COUNTRY]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working in main job abroad</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working in secondary job</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not working and looking for a job</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not working and not looking for a job</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participating in formal educational program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participating in training program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participating in literacy program</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Two parts

- Questions about respondent’s family structure, parents’ education, transfers/remittances
- Questions about extended family, parents’ occupation when respondent was a child, socioeconomic status, decision making within the household at age 15, traumatic events during childhood, first job (including child labor)

Many questions provide potentially useful instruments

Careful to ask about family not just today, but when the respondent was at key ages in the education system
The StEP Employer Survey

Measurement Objectives

- Structure of the labor force
- Skills currently being used
- Skills looked for in hiring
- Training
- How skills affect compensation and promotion
- Relevant background characteristics
- Keep entire survey under 45 minutes
Complicated in countries with large informal sectors
- Register data does not cover these employers
- They can make up a very large share of employment
- If you do not cover informal employers, you get a biased picture

Three options for sampling
- Employers mentioned in HH survey
  - Reporting errors
  - Extra complexity for sampling (not necessarily contiguous)
  - Questionnaire must be modified slightly to obtain necessary information
- Register data
  - If number of unregistered employers is small (unlikely in most developing countries)
- Door-to-door
  - Can use the HH enumeration if the enumeration areas are randomly chosen (not focusing on residential areas)
  - Otherwise can be costly: Urban only?
### The StEP Employer Survey

#### Structure of the workforce

<table>
<thead>
<tr>
<th></th>
<th>(A) Number of current employees</th>
<th>(B) Number of employees 12 months ago</th>
<th>(C) Projected number 12 months from now</th>
<th>Problems encountered hiring (mark all that apply)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(D) No or few applicants</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(E) Applicants lack required skills</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(F) Applicants expect wages higher than we can offer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(G) Applicants do not like working conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(H) Other (specify)</td>
</tr>
<tr>
<td>Managers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professionals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technicians and associate professionals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clerical support workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skilled agricultural, forestry and fishery workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Craft and related trades workers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant and machine operators, and assemblers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary occupations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cognitive skills
- “Does their job ever involve reading?”
- “Does their job ever involve writing using correct spelling and grammar?”
- “Does their job ever involve maths, that is, adding, subtracting, multiplying or dividing numbers – using a calculator or computer if necessary?”
- “Does their job ever involve solving problems that take 30 minutes or more of thinking time to find a good solution?”

Technical skills
- “What is the highest level of computer use is needed in this job?”

Non-cognitive skills
- “Does their job ever involve speaking of a language other than [OFFICIAL LANGUAGE OF AREA IN WHICH WORKPLACE IS BASED]?”
- “Does the job ever require presenting logical arguments?”
- “Does their job ever involve interacting with a team of co-workers?”
- “What percentage of the days in a month does the worker arrive at work on time (within 15 minutes?)”
“Please indicate the importance you attach to the following ____ when deciding which new employees should be retained after an initial trial period”

- Characteristics (Age, gender, appearance)
- Skills (Various cognitive and technical skills)
- Attitudes (Big-5 non-cognitive skills)

Description of hiring procedures

- Geographic scope of hiring
- Days of post-hiring training required
- Number of days a vacancy remains open
- Number of offers needed to hire one worker
- Are skills shortages filled by contractors?
- Is salary negotiable?
The StEP Employer Survey
Training and compensation

- Training questions
  - Contact with educational and training institutions
  - Share of employees who received training
  - Spending on training
  - Employee hours devoted to on-the-job training

- Employer’s suggestions for improving educational and training systems

- Characteristics that affect compensation or chances of promotion
  - Same cognitive, technical and non-cognitive skills as in hiring module
The StEP Employer Survey

Background

- Characteristics of the establishment
  - Sector
  - Ownership
  - Age
  - Part of a larger company

- Competition faced on labor market

- International exposure

- Labor-side constraints to growth

- Basic financial information
StEP Skills Measurement Surveys
Countries in the project

- Latin America (El Salvador, Colombia, Bolivia)
- East Asia (China (Yunnan), Lao, Vietnam, Malaysia)
- South Asia (Sri Lanka)
- Africa (Rwanda, Ghana, Burkina Faso)
- Europe/Central Asia (Ukraine)
- Middle East and North Africa (Egypt, Morocco)
Good luck, and good measurement

Thank you for your attention