Measuring Equity in Resource Allocation
An Output-Based Approach
Carina Omoeva, Nina Cunha, Wael Moussa (FHI 360)
Basic premise

• Public education systems serve to expand and equalize opportunity to acquire knowledge and skills

• This is achieved through an equitable distribution of resources, where more resources are directed to address greater need
Indicators of equity at the global level (UIS)

4.5.3 Extent to which explicit formula-based policies allocate resources towards disadvantaged populations

4.5.4 Education expenditure per student by level of education and source of funding
Indicators of equity at the global level (UIS)

4.5.3 Extent to which explicit formula-based policies allocate resources towards disadvantaged populations

4.5.4 Education expenditure per student by level of education and source of funding

Not defined

Approved for 2017 reporting
Challenges with measuring equity in resource allocation

• Data availability on education finance
Coverage of education finance data (Source: UIS)
Challenges with measuring equity in resource allocation

- Complexity in the composition of education funding flows; difficulty of identifying sources and intended recipients
SOURCE AND FLOWS OF FUNDING FOR A PRIMARY SCHOOL IN GHANA

**Government of Ghana**
- Ghana Education Services
- Ghana Education Trust Fund
- HIPC fund
- Ministry of Finance
- Ministry of Manpower, Youth and Employment
- Social Investment Fund

**External partners**
- Personnel, supplies
- Construction, equipment

**District assemblies**
- Construction, equipment

**NGOs**

**Local resources**

**Regional District Direction**
- Subsidy per pupil
- Contributions
- Associations
- Direct expenses uniforms stationeries

**Public Primary Schools**

**Source:** UIS 2011 p.62 / data UNESCO-IIEP
SOURCE AND FLOWS OF FUNDING FOR A PRIMARY SCHOOL IN BENIN

External partners → Ministry of Pre-primary and Primary Education

Communes:
- Goods and services, construction

NGOs:
- Construction

School Districts:
- Personnel PSA, ACE equipment, construction
- Subsidies for school fees

Public Primary Schools

Local contracts → Parents’ associations

Local contracts → Parents’ contributions

Parents

Direct expenses: uniforms, books, school supplies

Source: UIS 2011 p.63 / data UNESCO-IIEP
Challenges with measuring equity in resource allocation

• Data availability on education finance
• Complexity in the composition of education funding flows; difficulty of identifying sources and intended recipients
• Intent does not equal implementation of policy around equity
Are resources meeting the needs?  
- an output-based approach to measuring equity
Output-based resource allocation analysis

<table>
<thead>
<tr>
<th>Step</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td>• Construct <strong>Needs Index</strong> and define <strong>High Need</strong> and <strong>Low Need</strong> benchmarks</td>
</tr>
<tr>
<td>Step 2</td>
<td>• Construct <strong>Resource Indices</strong> of key inputs</td>
</tr>
<tr>
<td>Step 3</td>
<td>• Observe the <strong>disparities</strong> in resource distribution between High- and Low-Need students</td>
</tr>
<tr>
<td>Step 4</td>
<td>• Obtain a <strong>summary measure of resource inequity</strong> across all resource domains</td>
</tr>
</tbody>
</table>
Step 1. Construct Need Index

• Vector of demographic and socioeconomic characteristics of the student that strongly predict or determine access and learning outcomes
Needs Index construction

• Principal Components Analysis to build composite Need Index
• Identify students at the top 20% (High Need) and bottom (Low Need) 20% of the Need Index
  • For system-driven indicators of need, high and low benchmarks can be set based on other defined criteria
• Identify schools with a high proportion of High Needs students (empirically determined at 40% and above)
Need Index can be empirically defined (recommended for comparative analyses) or system-driven

<table>
<thead>
<tr>
<th>Example</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil (National data)</td>
<td>Wealth assets + parents’ educational attainment</td>
</tr>
<tr>
<td>Pakistan (ASER data)</td>
<td>Wealth assets + parents’ educational attainment</td>
</tr>
<tr>
<td>New York State (NY Dept of Education)</td>
<td>Existing system indicator: means-tested eligibility for free and reduced price lunch + disability</td>
</tr>
<tr>
<td>OECD: Economic, Social and Cultural Status (ESCS)</td>
<td>Composite variable of proxies of possessions, parent’s education and cultural markers of status, used in PISA</td>
</tr>
</tbody>
</table>
Step 2: Construct Resource Indices

• We identify relevant variables within the three key resource categories: teacher quality, instructional environment and physical environment.
Step 2: Construct Resource Indices

- We identify relevant variables within the three key resource categories: teacher quality, instructional environment, and physical environment.
- Resource elements within each category are combined into a composite index.
- Each resource index has a distribution.

Recurring maintenance
Teacher quality
Physical Environment
Teacher quality
Experience
Training
Performance

Condition of the school building, types of facilities
Library resources
Laboratories
Instructional Environment
Learning materials and equipment, labs

Electricity, water and sanitation
Step 3: Observe the disparities

- Each Resource Inputs index is transformed into a continuous scale
- We observe the percentile ranks of High Needs and Low Needs schools on the distribution of each Resource Inputs Index
Bringing the three factors together, we observe relative access to resources across each of the three dimensions, and determine magnitude of equity.
Step 4: Obtain a Summary Measure

- Summary index of equity in access to resources: sum of distances in percentile rank between High Needs and Low Needs schools

<table>
<thead>
<tr>
<th></th>
<th>Teacher Quality</th>
<th>School Instructional Environment</th>
<th>School Physical Environment</th>
<th>Summary Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>13.53</td>
<td>14.77</td>
<td>26.47</td>
<td>54.77</td>
</tr>
<tr>
<td>Province 1</td>
<td>10.39</td>
<td>15.64</td>
<td>11.42</td>
<td>37.45</td>
</tr>
<tr>
<td>Province 2</td>
<td>2.57</td>
<td>3.29</td>
<td>14.22</td>
<td>20.07</td>
</tr>
<tr>
<td>Province 3</td>
<td>3.61</td>
<td>9.75</td>
<td>30.56</td>
<td>43.92</td>
</tr>
<tr>
<td>Province 4</td>
<td>10.39</td>
<td>17.78</td>
<td>20.97</td>
<td>49.14</td>
</tr>
</tbody>
</table>
Model Application: Country-level measurement
Data description

**Brazil – Prova Brasil**
- School-based survey
- Grades 5 and 9
- Ages 10-12 and 14-16
- 50% girls 50% boys
- Nationally representative
- Around 53,000 schools, 5 million students

**Pakistan - ASER**
- Household based survey
- Ages 3-16 surveyed, ages 5-16 assessed
- 39% girls 61% boys
- Representative at the district level
- 144 districts, 5,540 schools, around 335,000 children surveyed
- 97,268 children linked to surveyed schools
Resource distribution: Brazil vs. Pakistan

**Brazil**
Teacher Quality

Inequity Score
Brazil: 45.51

School Physical Environment
School Instructional Environment

**Pakistan**
Teacher Quality

Inequity Score
Pakistan: 54.77

School Physical Environment
School Instructional Environment

More Equitable Redistribution
Subnational analysis
Brazil

More Equitable Redistribution

North
Teacher Quality

Inequity Score
North: 58.7

South
Teacher Quality

Inequity Score
South: 15.32

Northeast
Teacher Quality

Inequity Score
Northeast: 23.67

Southeast
Teacher Quality

Inequity Score
Southeast: 32.94
Pakistan

**Punjab**
Teacher Quality

Inequity Score
Punjab: 37.45

School Physical Environment
School Instructional Environment

**Sindh**
Teacher Quality

Inequity Score
Sindh: 20.07

School Physical Environment
School Instructional Environment

**Gilgit-Baltistan**
Teacher Quality

Inequity Score
Gilgit-Baltistan: 88.88

School Physical Environment
School Instructional Environment

**Azad Jammu and Kashmir**
Teacher Quality

Inequity Score

School Physical Environment
School Instructional Environment

More Equitable Redistribution
### Summary Scores: Magnitude of Inequity of Resource Distribution

<table>
<thead>
<tr>
<th></th>
<th>Teacher Quality</th>
<th>School Instructional Environment</th>
<th>School Physical Environment</th>
<th>Summary Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brazil</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>National</td>
<td>10.56</td>
<td>26.33</td>
<td>8.62</td>
<td>45.51</td>
</tr>
<tr>
<td>Northeast</td>
<td>13.04</td>
<td>9.24</td>
<td>1.39</td>
<td>23.67</td>
</tr>
<tr>
<td>North</td>
<td>14.27</td>
<td>27.91</td>
<td>16.51</td>
<td>58.69</td>
</tr>
<tr>
<td>Southeast</td>
<td>7.74</td>
<td>11.89</td>
<td>13.31</td>
<td>32.94</td>
</tr>
<tr>
<td>South</td>
<td>0.55</td>
<td>14.78</td>
<td>-0.00</td>
<td>15.32</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Teacher Quality</th>
<th>School Instructional Environment</th>
<th>School Physical Environment</th>
<th>Summary Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pakistan</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>National</td>
<td>13.53</td>
<td>14.77</td>
<td>26.47</td>
<td>54.77</td>
</tr>
<tr>
<td>Punjab</td>
<td>10.39</td>
<td>15.64</td>
<td>11.42</td>
<td>37.45</td>
</tr>
<tr>
<td>Sindh</td>
<td>2.57</td>
<td>3.29</td>
<td>14.22</td>
<td>20.07</td>
</tr>
<tr>
<td>Gilgit-Baltistan</td>
<td>25.22</td>
<td>29.87</td>
<td>33.79</td>
<td>88.88</td>
</tr>
<tr>
<td>Azad Jammu and Kashmir</td>
<td>-0.88</td>
<td>-5.32</td>
<td>-5.12</td>
<td>-11.33</td>
</tr>
</tbody>
</table>
Practical example: Spatial analysis
Spatial distribution of needs and resources: Brazil

% High Needs School by Micro-Regions

Distribution of School Physical Environment by Micro-Regions
Spatial distribution of needs and resources: Pakistan

% High Needs School by District

Distribution of School Physical Environment by District
Key takeaways

• Our approach allows for a cross-system measurement of equity in access to crucial resources, such as teacher quality, instructional environment, and physical environment
  • Number of dimensions can be determined locally

• Both parts of the measure: the Need Index and Resource Indices can be adapted for context

• The measure is rank-order based and therefore, independent of the underlying distribution
Next Steps

➢ Continued analysis and replication with national datasets
➢ In-depth subnational analysis with a selection of national datasets
➢ Paper out for comment May/June 2019
THANK YOU!

comoeva@fhi360.org
ncunha@fhi360.org
wmoussa@fhi360.org

LEARN MORE
www.educationequity2030.org

FOLLOW US
@equity2030 | #equity2030

SUPPORT US
educationequity@fhi360.org
## Composition resources and needs indexes: Brazil

<table>
<thead>
<tr>
<th>Index / Factor</th>
<th>Variable Composition</th>
</tr>
</thead>
</table>
| Needs Index                           | Assets in the home & maid:  
|                                       | - Tv, home stereo, DVD, fridge, washer, car, computer, bathroom, bedroom, maid  
|                                       | Parent's education: dummy – primary or higher  
| Teacher Quality Factor                | 1) Teacher experience (dummy for > 20 years)*  
|                                       | 2) Teacher education (dummy for graduate degree)*  
| School Instructional Environment Factor| Factor using the following variables, which contain the "condition/quality" of infrastructure items (good, regular, bad, nonexistent):  
|                                       | - Computer, internet, copy machine, printer, projector, datashow, DVD, TV, broadband, landline, stereo, library, reading room, sports court, computer lab, sciences lab, auditorium, music room, arts lab  
| School Physical Environment Factor    | Factor using the following variables, which contain the "condition/quality" of infrastructure items (good, regular, bad, nonexistent):  
|                                       | - Roof, wall, floor, building entrance, schoolyard, halls/corridors; classrooms, doors, windows, bathroom, kitchen, hydraulic, electrical  

* Variables standardized by student enrolment
## Composition resources and needs indexes: Pakistan

<table>
<thead>
<tr>
<th>Index / Factor</th>
<th>Variable Composition</th>
</tr>
</thead>
</table>
| Needs Index                       | **Assets in the home:**  
- Electricity, TV, mobile phone, car, motorcycle/bike, computer, solar panel  
- Ownership of home  
- Type of household: dummy – brick or stone house  
- Mother’s and father’s education: dummy – primary or higher |
| Teacher Quality Factor            | 1) Score for average teacher education level:  
- Each attainment level assigned an ascending ordinal score (Less than Prim 1, Prim 2, HS 3, etc.)  
- Sum scores for teachers at each school, standardizing by student enrolment  
2) Score for average teacher professional qualification level:  
- Each qualification level assigned an ascending ordinal score  
- Sum scores for teachers at each school, standardizing by student enrolment |
| School Instructional Environment Factor | 1) Library has books  
2) Science Lab  
3) Computer Lab  
4) Internet  
5) Usable Blackboard  
6) Most students have test books |
| School Physical Environment Factor | 1) Fence/boundary wall  
2) Toilet  
3) Solar Panels  
4) Drinking water  
5) # Rooms *  
6) # Classrooms *  
7) Electricity |

* Counts variables standardized by student enrolment
Resource distribution: ASER Pakistan 2016 – Government vs Private
More Equitable Redistribution

Resource distribution: ASER Pakistan 2016 – Government vs Private