

STEM education to enhance productivity and structural transformation – a reflection from Mozambique

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STEM Education is instrumental to the digital transition

- The world has embarked on a new stage of the digital revolution. Technological change is creating new jobs and bringing others, including added “white-collar” jobs, into redundancy (World Bank 2016).
- Evidence on developed countries stress the key importance of science, technology, engineering, and mathematics (STEM) education to sustain their own path of economic growth (Bacovic, Andrijasevic & Pejovic 2022)
- It is not too early for countries currently emerging into future digital societies, the Least Developed Countries among them, to prepare (World Bank 2016).
- As shown by Mensah, Owusu and Foster-McGregor (2023), it is mainly technology catch-up to drive productivity convergence among African countries. As these and other countries, many of the LDC, emerge, transition and eventually transform into digital societies, they need to advance ICT and STEM skills and lifelong learning (World Bank 2016).

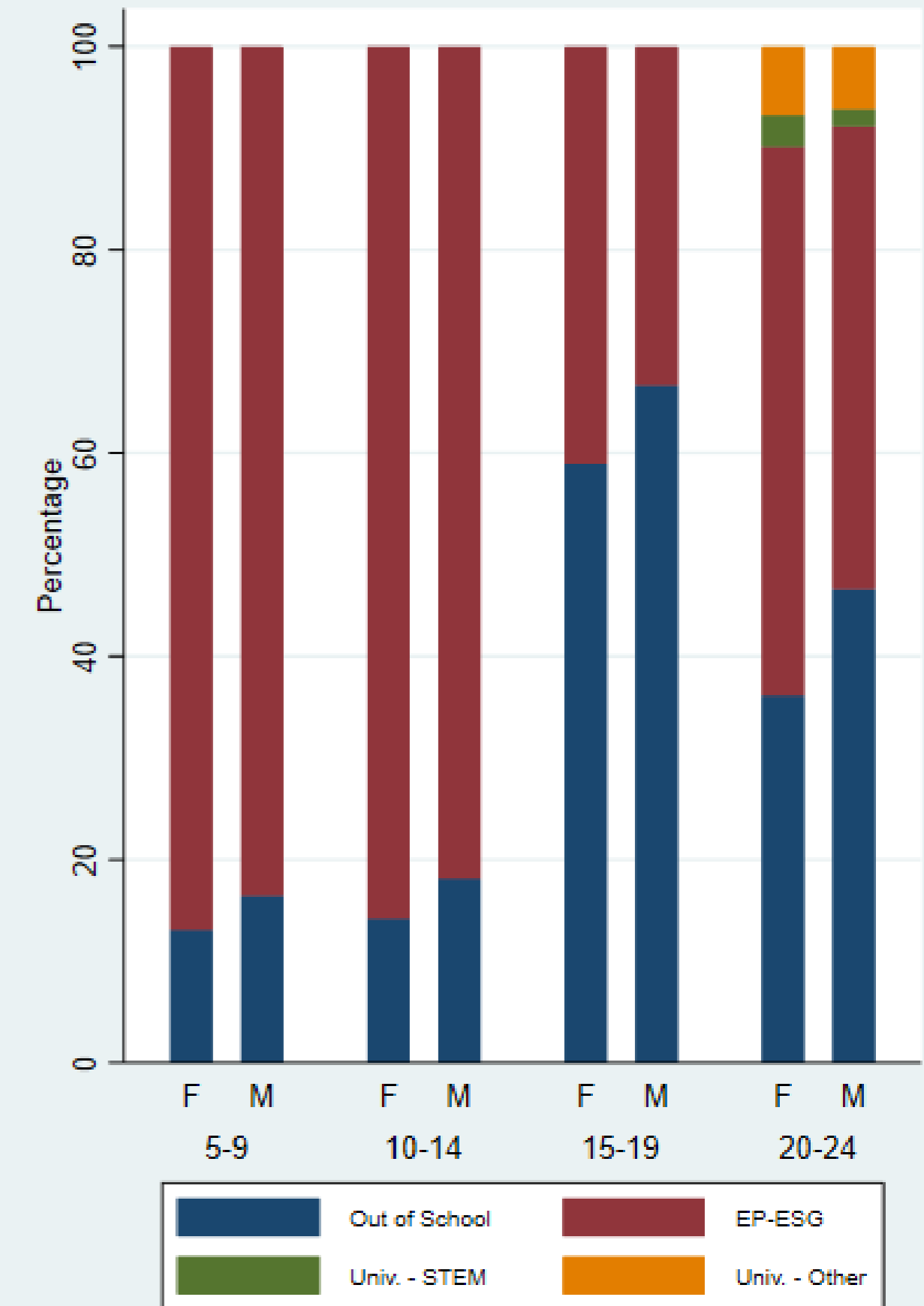
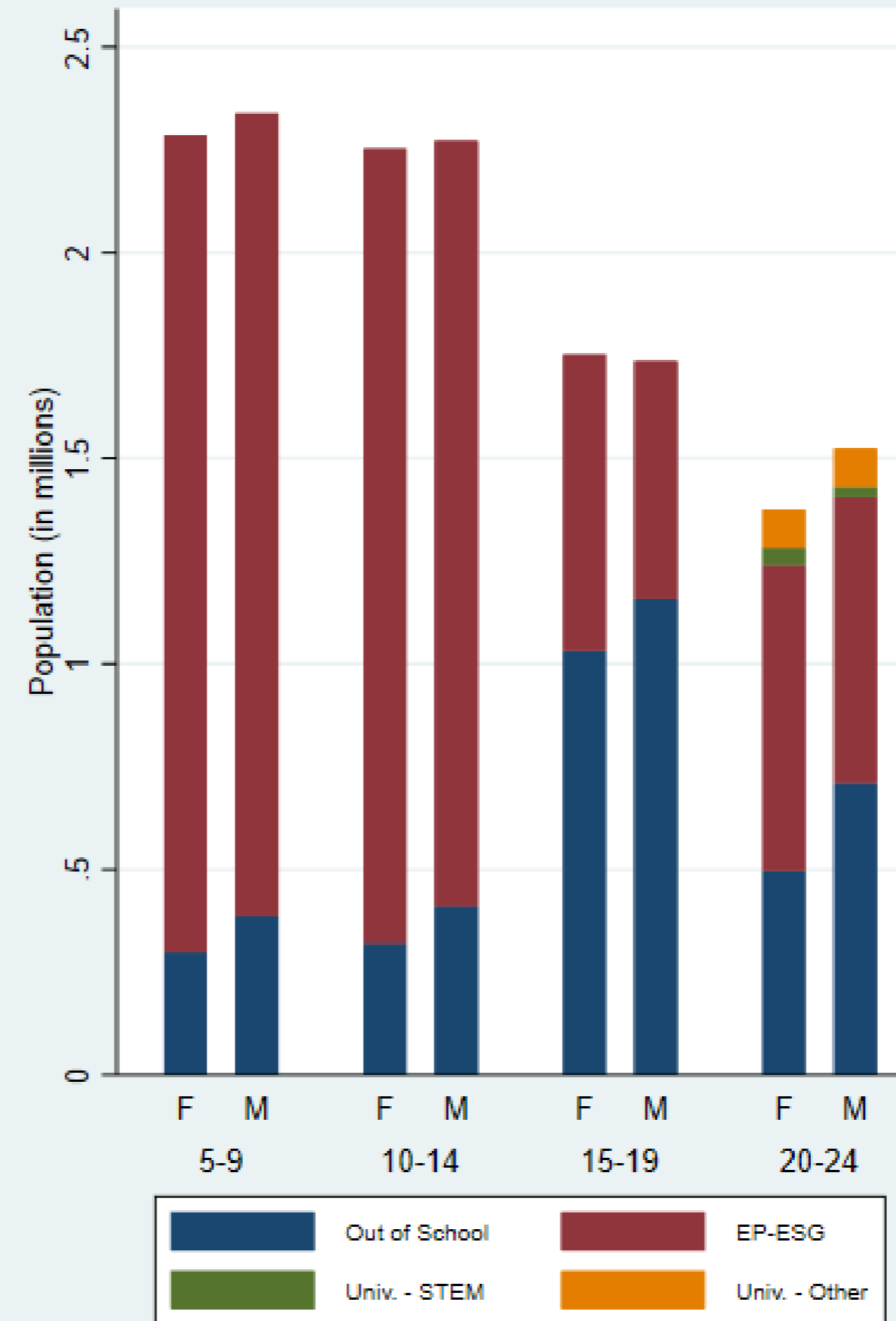


STEM Education and its enablers in Mozambique

- Mozambique, a low-income country, finds itself at the beginning of its emergence into the digital transition.
- Clear challenges in meeting the ideal preconditions to STEM education and learning.
- High levels of enrolment in primary and secondary school (EP-ESG), in earlier ages.
- Significant drop of and late enrolment in higher grades of secondary education.
- Very low enrolment in STEM for both young men and women.

| 2022 | Urban | Rural |
|-----------------------------|-------|-------|
| Population (%) | 33,8% | 66,2% |
| Share of households with... | | |
| Electricity for light | 75,3% | 12,8% |
| Computers and laptops | 8,3% | 0,8% |
| Mobile phones | 73,4% | 46,5% |

Source: IOF 2022, Mozambique

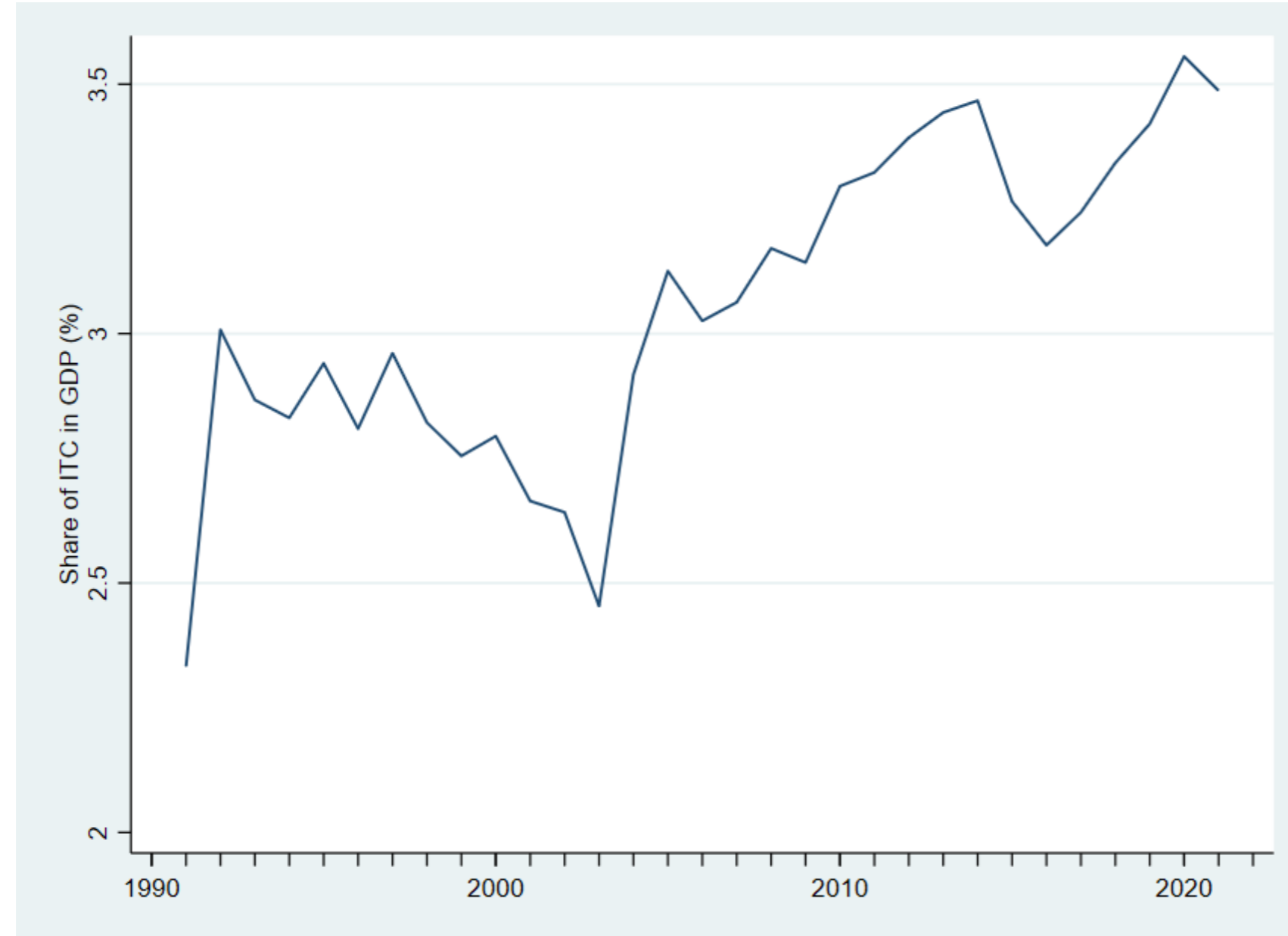


Note: EP-ESG = Primary and Secondary School

Source: authors calculations using Ed. Stats2022 (Min. Education Moz) and H.Ed. Stats 2022 (Min Higher Education Moz)

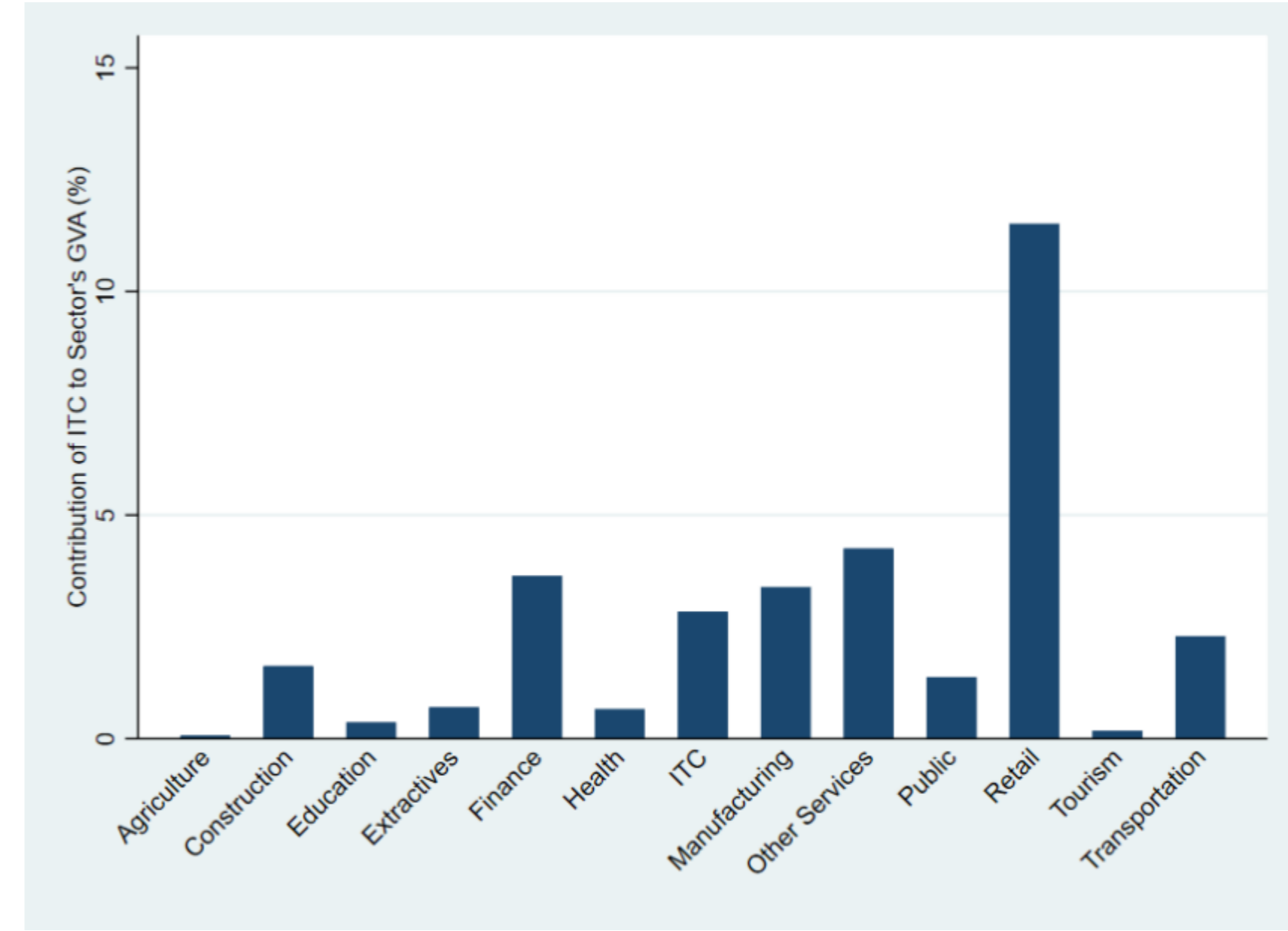
The role of ICT and STEM in the Mozambican economy

Share of ICT in GDP



Source: INE (Bureau of Statistics), Mozambique

Share of ICT in other sectors
GVA



Source: Mozambique 2015 SAM

- Mozambique's Information & Communication Technologies sector is arguably still in its early stages.
- The share of ICT in the country's GDP is rising from 2.5 to 3.5% (still significantly below, for instance, the European Union's 5.2%, US's 6%, or Korea's 13%)
- Furthermore, ICT's biggest contribution in Mozambique accrues to the retail sector and, in a much lower rate, Finance, Manufacturing and the ICT sector itself.
- In 2022, ICT (together with Transports) was the occupation of 1.4% of employed Mozambicans (2.9% among men; 0.1% among women)
- In a recent survey of manufacturing enterprises, in 2022, we find the vast majority are carrying out very simple, manual activities that do not appear to require STEM skills

How are Mozambican STEM graduates transitioning into the labour market?

- From 2017 to 2019, we conducted a School-to-Work longitudinal survey of university students.
 - This study was led by the Inclusive Growth in Mozambique partnership, joining the Ministry of Economics and Finance of Mozambique, the Faculty of Economics of Eduardo Mondlane University, the University of Copenhagen and UNU-WIDER,
- Around 2,100 final-year students were interviewed from 6 of the seven largest universities in Mozambique, in Maputo and Beira.
- The sample of the population surveyed is statistically representative of gender and field of study.
 - For this analysis, we join them in two groups: STEM, encompassing Natural Sciences, Engineering and Health; and Other fields, encompassing Education, Humanities, Social Sciences, Agriculture and Services.
- Women represent 44% of students, on average, in both STEM and other fields.
- We found no specific differences in most of the characteristics of the two groups of students

| Personal characteristics | STEM | Other | F-test |
|--------------------------|-----------------|-----------------|------------|
| Age | 26.00 (0.11) | 25.70 (0.13) | 0.001 . |
| Female | 44.10 (0.87) | 44.02 (1.04) | 0.002 . |
| Married | 14.33 (0.62) | 13.10 (0.71) | 0.163 . |
| Has children | 29.82 (0.80) | 28.65 (0.95) | 0.000 . |
| Had job before | 60.20 (0.86) | 60.74 (1.02) | 0.176 . |
| Had interns. before | 50.21 (0.88) | 48.96 (1.05) | 0.041 . |
| Had a job waiting | 13.10 (0.59) | 11.71 (0.67) | 0.000 . |

N = 1874

Note: F-tests report the probability that means differ by groups.

Source: authors' calculations based on survey responses.

Different academic experience

| Academic experience and skills | STEM | Other | F-test |
|--------------------------------|-----------------|-----------------|------------|
| <i>Maputo Cidade</i> | | | |
| UEM | 34.98 (0.84) | 35.89 (1.01) | 0.053 . |
| USTM | 5.26 (0.39) | 4.49 (0.43) | 0.000 . |
| UP | 34.97 (0.84) | 32.56 (0.98) | 0.000 . |
| APOLITECNICA | 5.86 (0.41) | 6.19 (0.51) | 0.001 . |
| <i>Beira - Sofala</i> | | | |
| UCM | 8.32 (0.48) | 10.14 (0.63) | 0.000 . |
| UNIZAMBEZE | 10.61 (0.54) | 10.73 (0.65) | 0.000 . |

N = 1874

Note: F-tests report the probability that means differ by groups.

Source: authors' calculations based on survey responses.

| Skills and locus of control tests | STEM | Other | F-test |
|-----------------------------------|----------------|----------------|------------|
| Raven test score | 3.93 (0.05) | 4.05 (0.06) | 0.000 . |
| Verbal test score | 1.81 (0.01) | 1.77 (0.02) | 0.000 . |
| Numerical test score | 1.83 (0.02) | 1.71 (0.03) | 0.000 . |
| Locus of control score | 7.75 (0.03) | 7.71 (0.03) | 0.011 . |

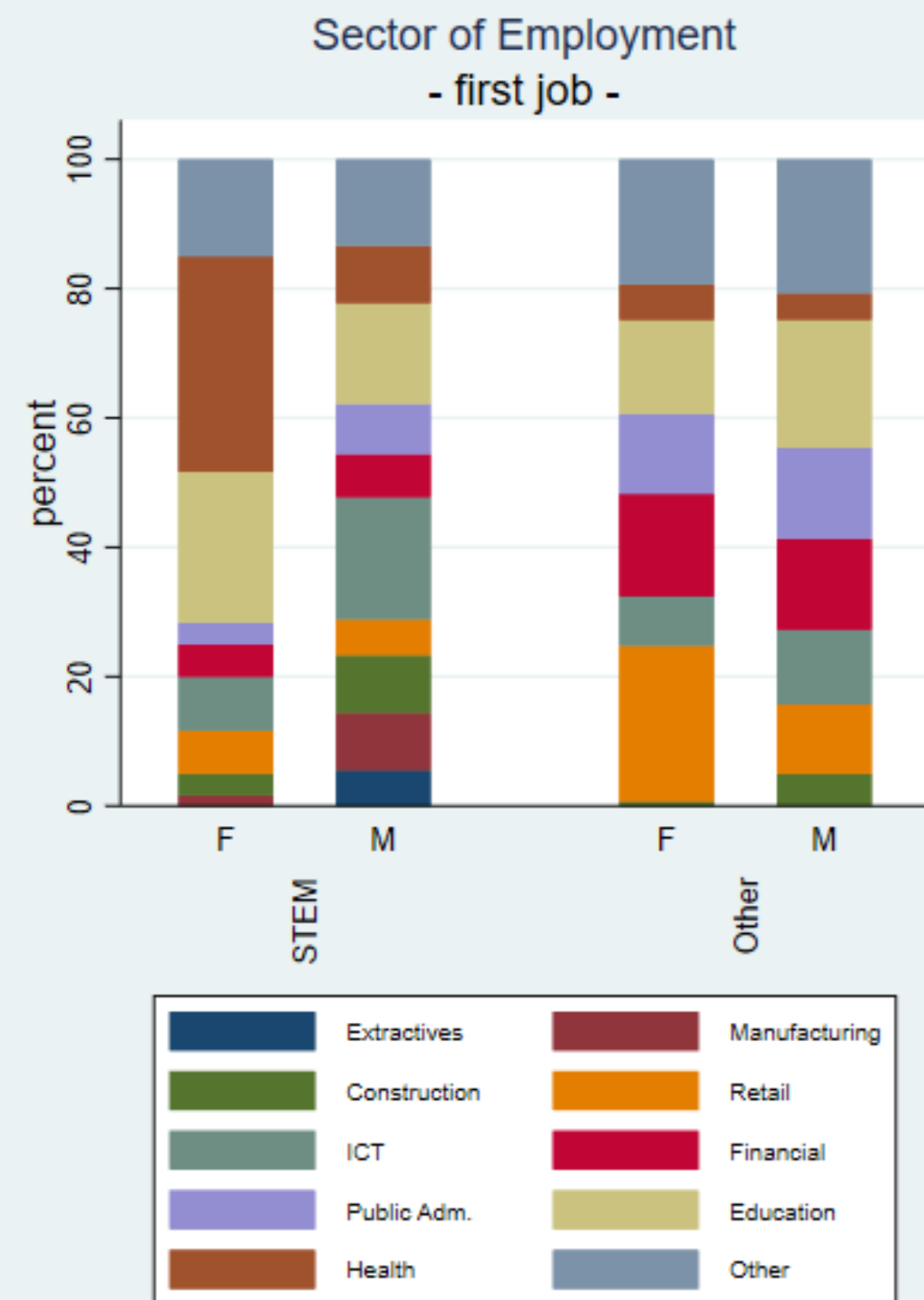
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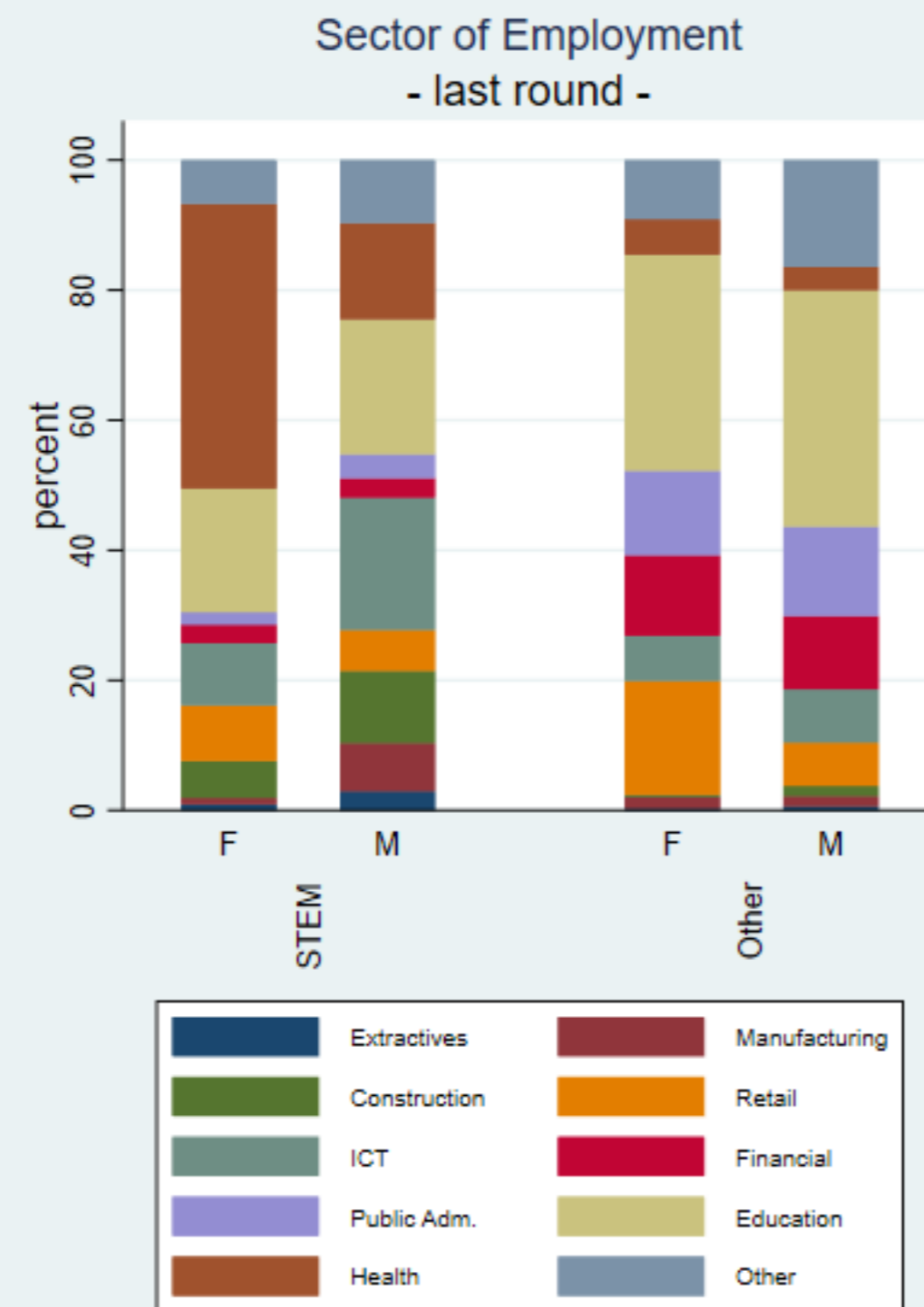
Source: authors' calculations based on survey responses.

- We find significant differences in the academic experience of university graduates
- STEM study opportunities are significantly lower outside Maputo
- While we find no significant cognitive or locus of control differences, STEM students appear significantly better in numerical skills, indicating some selection.

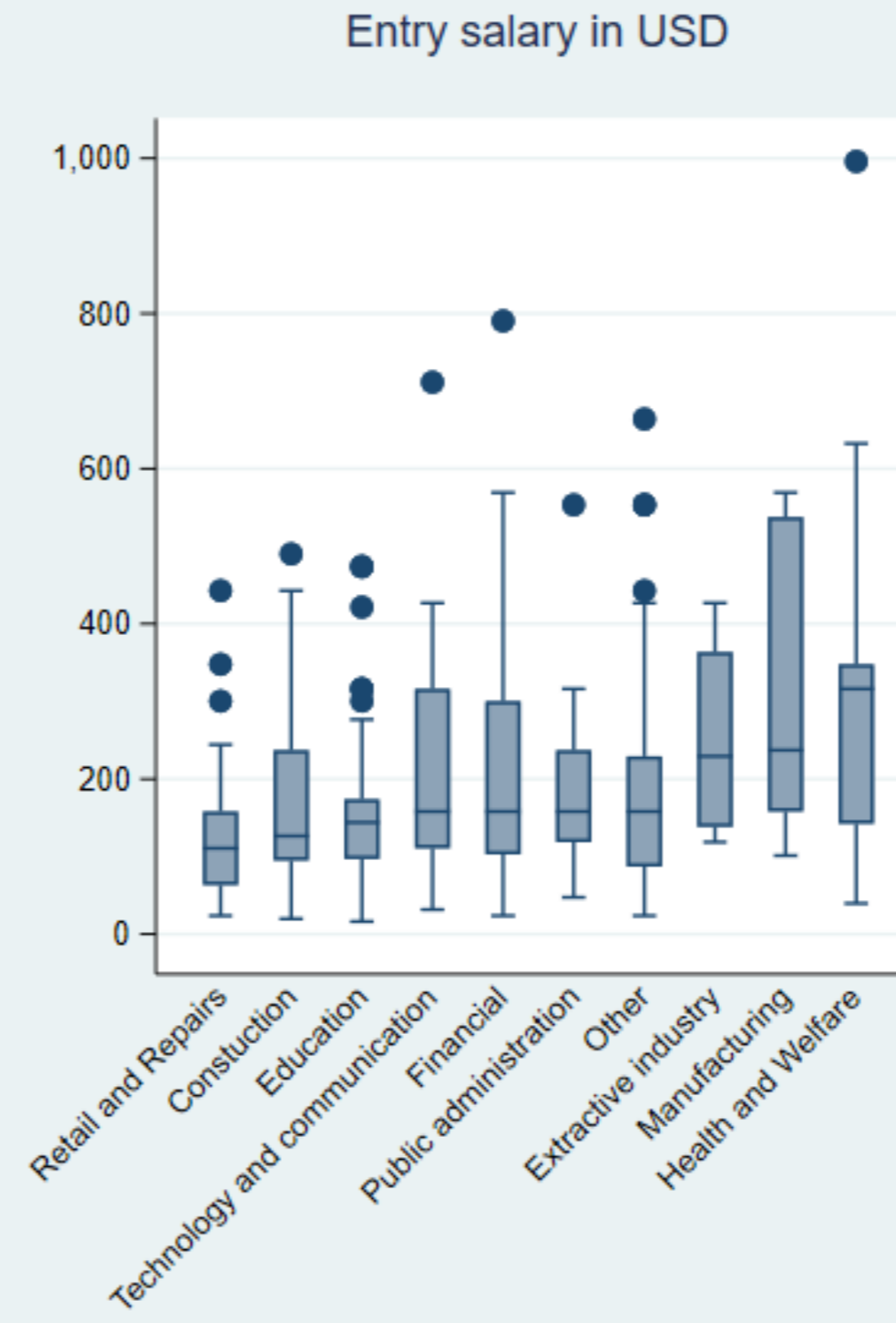
STEM graduates' entry sectors and wages



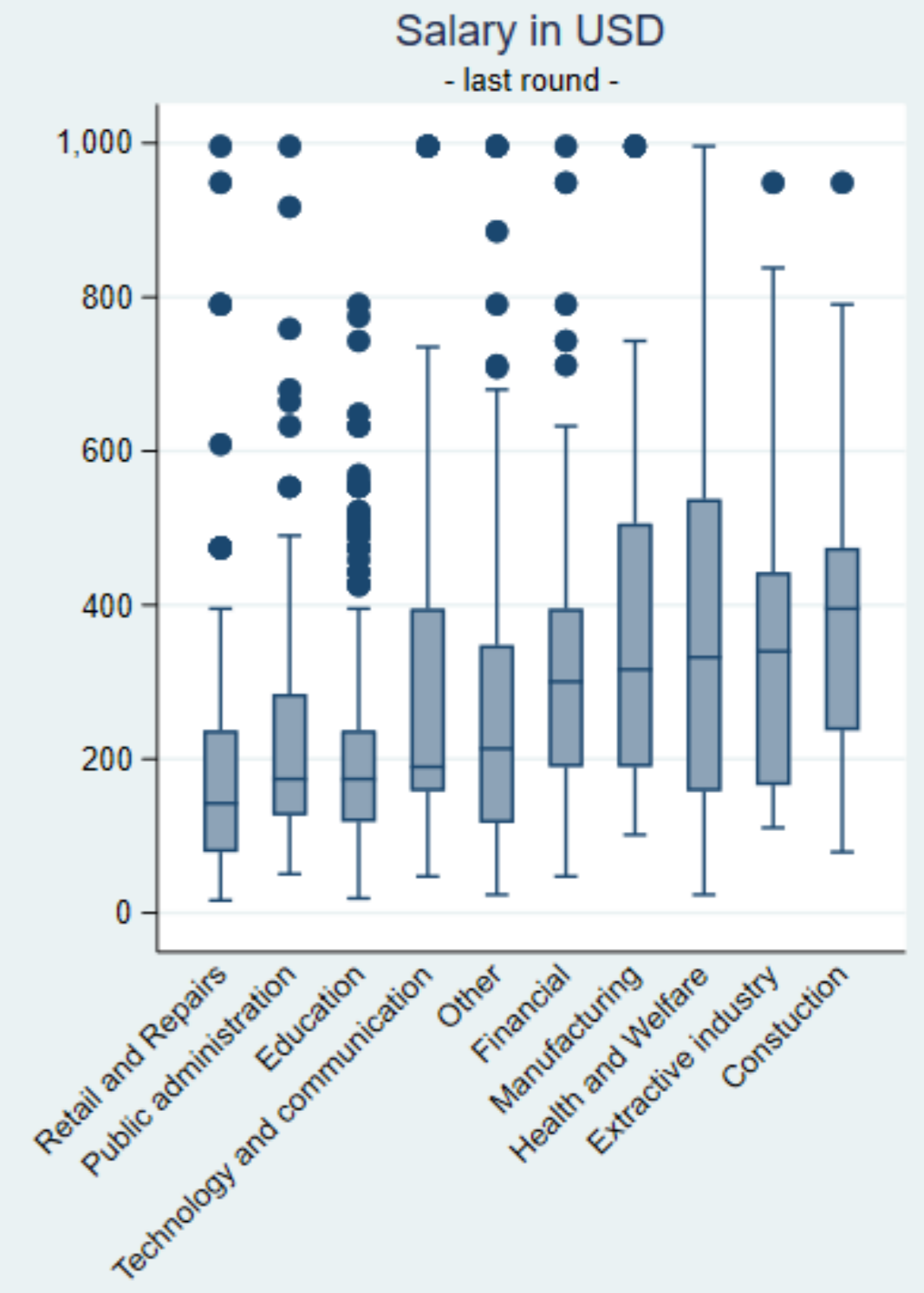
Source: School-to-work survey of Mozambican University Students; excludes internships



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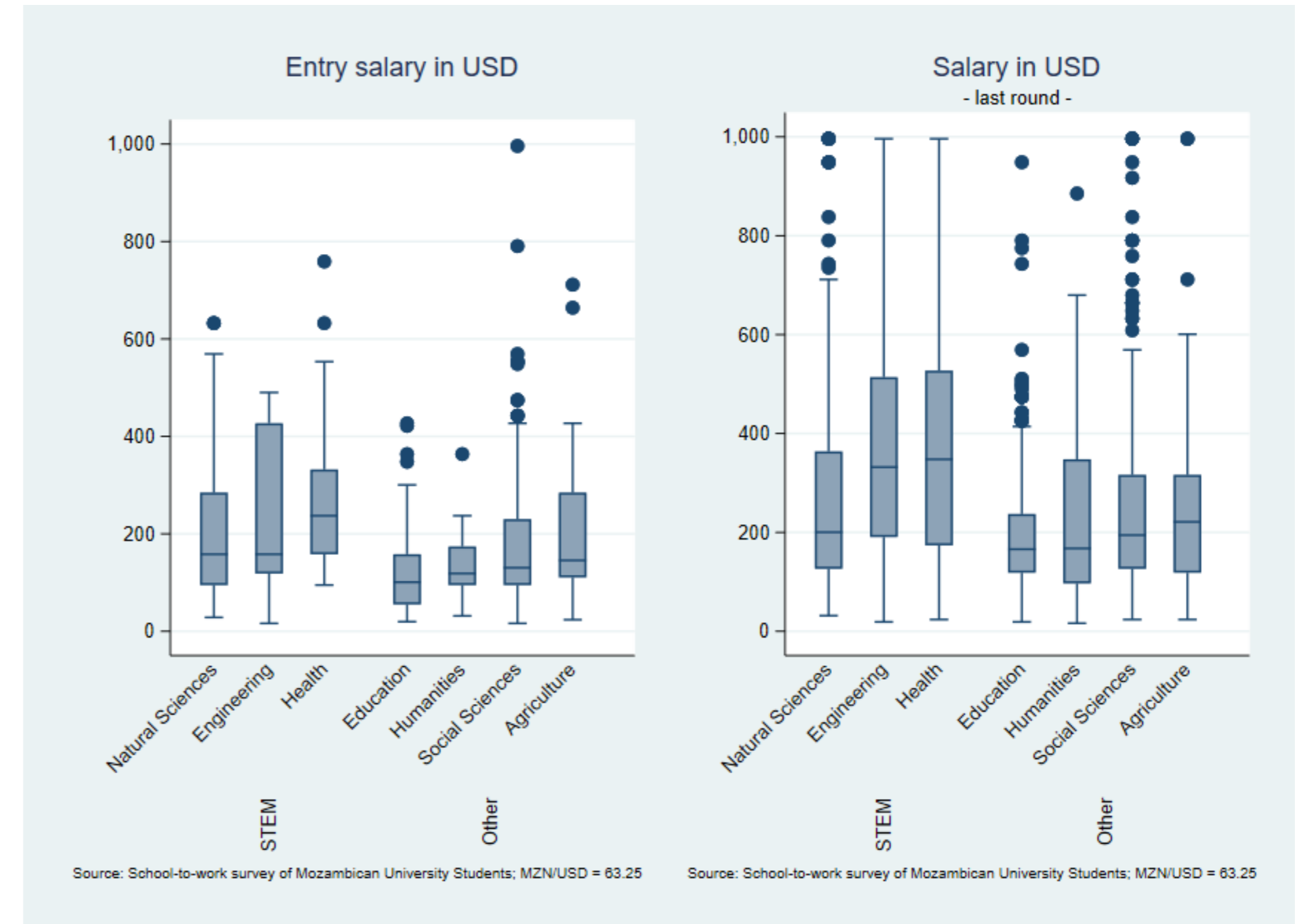
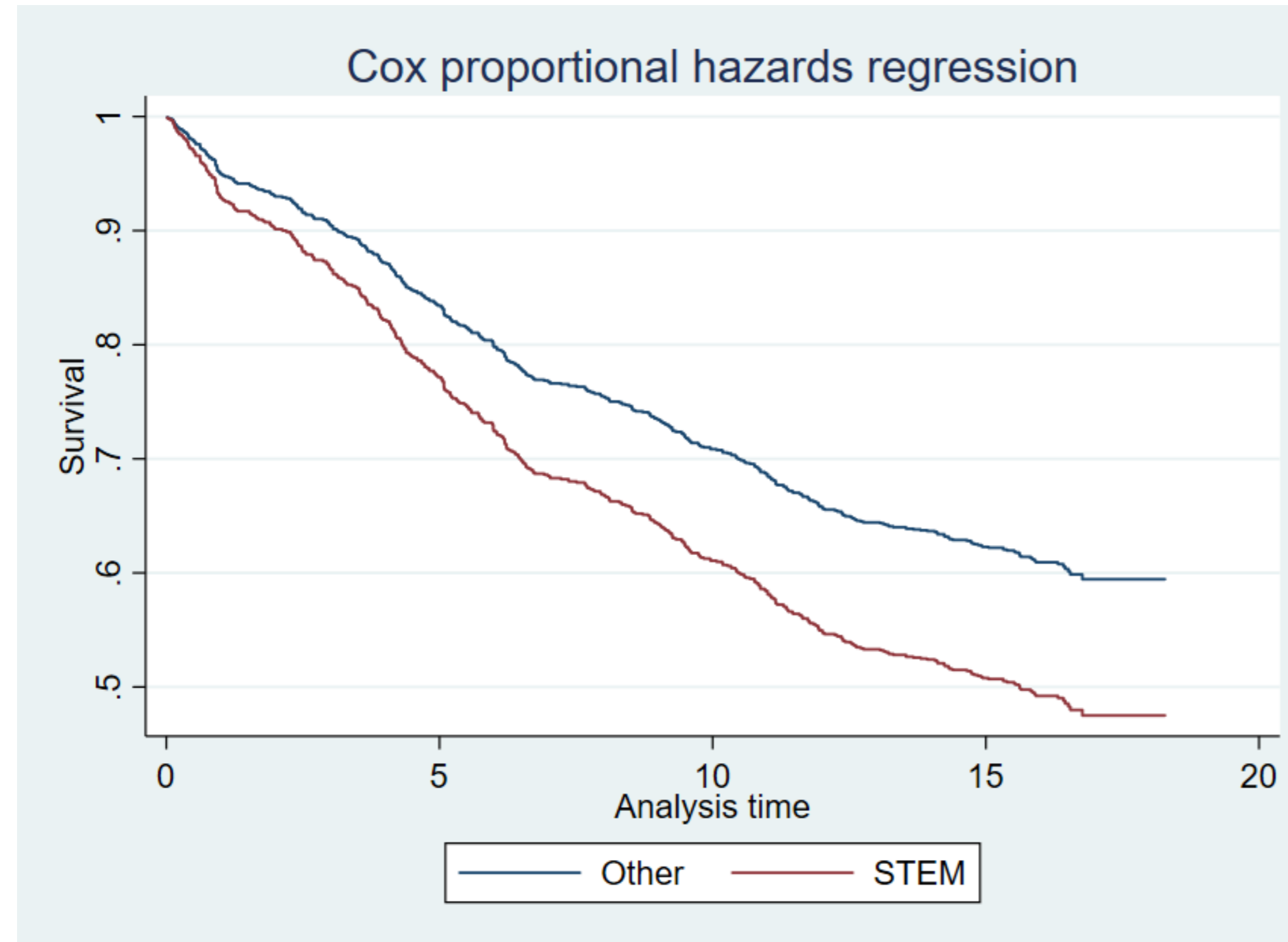
Source: School-to-work survey of Mozambican University Students; MZN/USD = 63.25



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- Preferential sectors for STEM graduates were: (1st) Health, (2nd) Education, (3rd) ICT for women; (1st) ICT, (2nd) Education; (3rd) Manufacturing, and; (4th) Construction, for men. Extractives only recruited a very small share of male STEM graduates.
- Notably, entry salaries are significantly higher in those sectors.
- Also notable, is the relatively small share of STEM graduates recruited into ICT.

Salary and early entry premium for STEM graduates



- STEM graduates, on average, entered the labour market significantly sooner than graduates from other fields of study.
- Nevertheless, by 15 months after graduation, only 50% had found employment.
- Evidence from the School-to-Work survey suggests significantly higher average entry wages offered to Engineering and Health.
- There is also some suggestion of earlier salary progression for those graduates.

Small, albeit unequal, steps, towards transition



- Mozambique's economy is slowly emerging into the digital era. Its backbone industry, ICT, still represents a very small share of employment and GDP and accrues a minimal share of value to the other productive sectors.
- Yet:
 - The Mozambican education system is already selecting students for STEM (albeit with minimal numbers and proportions)
 - The labour market absorbs STEM students :
 - quicker (albeit with evident limits in the economy's absorption capacity), and,
 - with a wage premium (reflective of recruitment into more productive sectors)
- Two worrying signals:
 - Less access to STEM education outside of Maputo
 - Job segmentation of (STEM) graduates along gender.These need to be addressed as they increase inequality and reduce the opportunities for innovation-induced productivity due to the loss of diversity of the STEM-trained labour pool in the digital economy.

- UNU-WIDER led research found evidence that:
 - Information-based solutions can efficiently lead Mozambican job-entrants to correct wage expectations and quicken their job entry, without loss of job quality (Jones and Santos 2023; and Santos, Jones and Xirinda, forthcoming).
 - Electronic job matching platforms may still only have a mitigated contribution to employability in Mozambique (Jones and Sen 2022)

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