Heat stress and gendered labour market outcome in Ethiopia's manufacturing sector

Yohannes Ayele, Habtamu Edjigu, Tewolde Girma, Adamsu Maruta, Solomon Zena Walelig

- Heat stress reshapes employment within Ethiopian manufacturing firms rather than reducing labour demand uniformly across all workers.
- The study shows that higher heat exposure is associated with lower male employment and higher female employment, with the adjustment concentrated among production workers. Wage effects are more limited overall.
- Many firms are already adapting through ventilation, shading, cooling equipment, water breaks, and schedule adjustments, but adaptation remains partial and uneven.
- As heat stress can also be a source of labour reallocation within firms, recognising these internal distributional effects is essential for understanding how climate change may interact with industrialisation and employment transformation in low-income countries.

POLICY BRIEF ETH-24326

MARCH 2026

This project was funded by the IGC

theigc.org

DIRECTED BY

FUNDED BY

Introduction

Rising climate change is often discussed in relation to agriculture or infrastructure, but it is also becoming an industrial and labour-market issue. In Ethiopia, manufacturing is expected to support structural transformation and job creation. If rising heat alters how firms organise work and adjust their workforce, then climate adaptation has implications not only for productivity but also for employment patterns, job quality, and gender outcomes within firms.

Climate change is increasing the frequency and intensity of heat stress worldwide. While its impacts are well documented in agriculture, its consequences for industry and labour markets are less well understood. Rising temperatures and more frequent extreme heat events are reshaping how firms operate, reducing worker productivity, and altering hiring decisions and wage outcomes. In Ethiopia, where manufacturing is expected to play a central role in structural transformation and job creation, these dynamics are particularly relevant. This brief examines how heat stress affects labour market outcomes in Ethiopia's manufacturing sector, with particular attention to heterogeneity by gender and skill.

The data

The analysis draws on three main data sources. The firm-level data come from the annual census of large and medium manufacturing establishments conducted by the Ethiopian Statistical Service, covering all firms employing ten or more persons and using power-driven machinery. We use the census rounds from 1996 to 2018. It provides establishment-level information on employment and wages disaggregated by gender and by skill. To measure heat stress, we use the Universal Thermal Climate Index (UTCI). The UTCI captures the physiological experience of heat by combining air temperature, humidity, wind speed, and mean radiant temperature into a single equivalent temperature index that reflects actual thermal stress on the human body. From the hourly UTCI values, we classify each day into one of seven thermal stress categories ranging from no stress (below 18°C) to extreme stress (above 33°C) based on whether the UTCI reaches a given threshold at any hour of that day, and sum these into annual counts of days in each bin within each woreda boundary to produce a district-by-year panel of heat stress measures, which we merge to the firm census using the woreda identifier and survey year. Third, it uses a survey of manufacturing firms on the operational effects of heat stress, adaptation practices, and policy support needs.

The descriptive evidence also shows that gender gaps are already present in manufacturing firms. Women make up roughly 37% of permanent employment in the sample, and female wages average about 77% of male wages.

Empirical evidence

We estimate the effect of heat stress on firm-level labour market outcomes using a panel regression with firm fixed effects. Identification comes from within-firm variation over time, specifically, year-to-year fluctuations in district-level heat stress driven by plausibly exogenous meteorological conditions. We examine whether the same firm employs more or fewer women and pays higher or lower wages in years when its district experiences more days of heat stress than its long-run average.

Results

Heat stress changes the composition of employment within firms: The main result is that heat stress reshapes employment within manufacturing firms rather than lowering labour demand evenly across all workers. The study shows that higher heat exposure is associated with lower male employment and higher female employment, which increases the female share of total employment. This pattern is driven mainly by the production workforce. Female production employment rises, while male production employment does not show a comparable significant response. By contrast, the gender composition of administrative employment changes little. The wage effects of heat stress are more limited but vary meaningfully across skill groups. At the aggregate level, heat stress does not significantly affect female or male wage rates. Production worker wages of both genders are unchanged. However, female administrative wages rise under heat stress

The employment response is consistent with two complementary mechanisms. Firms facing heat-induced productivity losses have an incentive to shift toward cheaper female labour, since female workers earn systematically lower wages in Ethiopian manufacturing. At the same time, male workers concentrated in physically demanding production roles are likely to experience larger productivity losses under heat, making female workers a more attractive margin of adjustment

Firms are already adapting, but the response is incomplete: The survey evidence shows that heat stress is already a practical business challenge for manufacturing firms in Ethiopia. Firms report that very hot periods reduce machinery efficiency, increase spoilage and quality deterioration, and raise electricity or fuel use for cooling. Many firms have already adopted coping measures such as improved ventilation and fans, shading and roof insulation, cooling equipment, water breaks, and schedule adjustments. More than half of surveyed firms report some investment to reduce heat exposure or improve cooling conditions. At the same time, adaptation remains incomplete. Organisational and worker-centred responses, such as awareness programs or gender-specific protective measures, are less common. Few firms report receiving meaningful government support related to workplace safety, climate, or

heat stress. Firms identify the high cost of cooling technologies, unreliable electricity, limited access to finance, and weak access to affordable technologies as major constraints.

Policy implications

The results suggest that heat stress in manufacturing is also a labour-market and issue. The finding has several implications.

First, as heat stress intensifies, it alters workforce composition in ways that differ across workers and skills. Adaptation policy should pay closer attention to distributional effects within firms. The findings suggest that heat stress may affect women and men differently, and that these differences also vary across production and administrative occupations.

- Second, policies that reduce the cost of workplace adaptation could help firms respond to rising heat more effectively. Firms themselves point to tax incentives, subsidised finance, and better access to cooling and ventilation technologies as important forms of support.
- Third, electricity reliability is central. Cooling and ventilation technologies are only effective if firms can use them consistently. Improving the reliability and affordability of electricity would strengthen firms' capacity to manage heat stress.
- Fourth, occupational heat-safety standards and practical guidance on workplace heat management could play a more important role. The survey points to demand for stronger workplace standards, training, and awareness.

Policy design should therefore consider not only average firm resilience but also who bears the adjustment burden within the workforce.

Conclusion

Using firm-level panel data from Ethiopia's Large and Medium Manufacturing Industry Survey, this paper shows that heat stress reshapes employment composition within firms, generates differentiated effects across worker groups, and creates new pressures for workplace adaptation. Firms are already responding, but current adaptation remains partial and uneven, with important constraints related to finance, technology, and electricity.

For policymakers, the message is that climate adaptation in manufacturing needs to be integrated into labour and industrial policy. Measures that support cooling, ventilation, reliable power, workplace standards, and firm adaptation can help protect both productivity and worker wellbeing as temperatures rise.

References

Ayele, Y., Edjigu, H., Girma, T., Maruta, A., & Walelign, S. Z. (2026). Heat stress and gendered labor market outcomes: Evidence from the Ethiopia manufacturing firms. Policy Studies Institute-Ethiopia.

Costa, D., Deschenes, O., Greenstone, M., & Ranish, B. (2024). Temperature and labor productivity. Annual Review of Economics, 16, 511-538.

Deschênes, O. (2023). Temperature, human health, and adaptation: A review of the empirical literature. Annual Review of Resource Economics, 15, 295-319.

Dell, M., Jones, B. F., & Olken, B. A. (2012). Temperature shocks and economic growth: Evidence from the last half century. American Economic Journal: Macroeconomics, 4(3), 66-95.