

Linking CGE and Microsimulation Models for Distributional Policy Analysis

A macro–micro framework with twin applications to trade liberalization and carbon pricing

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Aggregate welfare is not enough

- Trade shocks and carbon pricing both raise the same question: **who** gains and loses, not just how much in aggregate.
 - Standard CGE models answer with a few representative households — within-group distribution is fixed by construction.
 - Microsimulation keeps household detail but lacks a general-equilibrium account of the shock.
- ⇒ Link the two — transparently — and the incidence falls out.

What this paper does

1. Specifies the **ENVISAGE-GIDD** macro-micro linkage as a reusable, auditable spine (full algorithm in the appendix + replication code).
2. Holds that spine **fixed** across two contrasting policies:
 - trade liberalization & supply-chain reorganization
 - global carbon pricing & its distributional incidence
3. Shows the incidence is a property of the policy — recovered by the linkage, invisible to representative-agent CGE.

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The ENVISAGE-GIDD linkage



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One spine, top-down and transparent

ENVISAGE (global CGE)

recursive-dynamic, multi-region,
GTAP-calibrated

- consumption prices by bundle
- wage premia by skill $\times$ sector
- employment / sector shifts
- macro per-capita growth

GIDD (microsimulation)

harmonized surveys; 11.6M person records,
89% of world population

- reweight to demographic margins
- reallocate by skill $\times$ gender $\times$ sector
- reconcile relative wage premia
- deflate by household price index

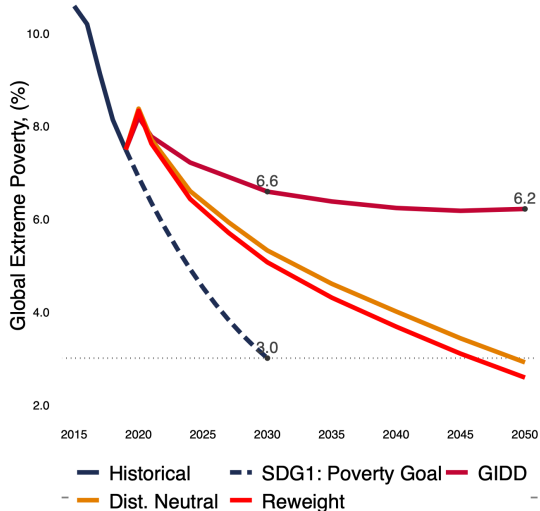
Predominantly top-down — this paper's configuration; demographics/education originate in the micro.

The microsimulation pipeline



- Workers classified by **skill** × **gender**, reallocated across **sectors**.
- Labor income updated on relative premia; **non-labor income moves only with λ**.
- Full equations & Stata code shipped with the paper (Appendix A).

The baseline is not neutral



Same macro projection, three microsimulation treatments:

- reweight only (margins)
- distribution-neutral growth
- full GIDD (wage + price effects)

Visibly different 2050 poverty paths $\Rightarrow$ **how** you treat household heterogeneity drives the result.

02

Application I — Trade



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Reshoring vs. liberalization

- **Reshoring Leading / Reshoring All:** high-income (then all) economies subsidize domestic production, raise import barriers.
- **GVC-friendly** (global value chains): developing economies cut input tariffs, ease standards, facilitate trade.
- A Thailand electronics supply-chain shock tests exposure under each.

Poverty at the \$1.90 line; results from Chepeliev et al. (2025).

Reshoring is contractionary and regressive

+51.8M

more extreme poor by 2030
(Reshoring All)

~80%

of the new poor in
Sub-Saharan Africa (SSA)

−8.8%

income, bottom 40%
Europe & Central Asia (ECA)

−1.7%

income, top 60% (ECA)

World real income −2.2%; losses concentrated in trade-dependent developing economies.

Liberalization is pro-poor — and less exposed

—21.5M

extreme poor by 2030

(GVC-friendly)

+3.9%

income, ECA bottom 40%

Shock exposure. Thailand's loss from the supply-chain shock is ~**26% smaller** under GVC-friendly than under Reshoring All.

The aggregate gap is a CGE outcome; the linkage adds who bears it.

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Application II — Carbon pricing



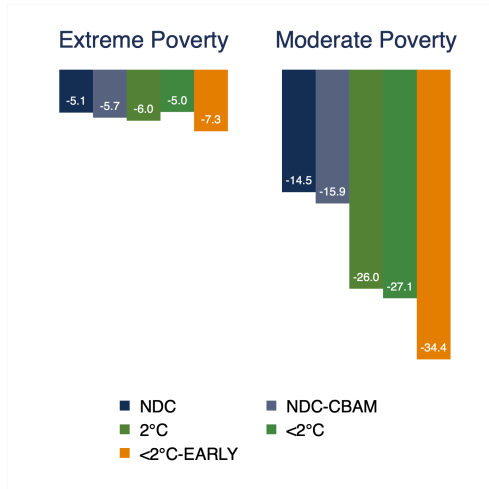
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Seven carbon-pricing scenarios

- Five carbon-price paths, rising ambition: NDC • NDC-CBAM (carbon border adjustment) • 2°C • <2°C • <2°C-Early.
- Two co-benefit variants (NDC-CO, 2°C-CO) add monetized health gains from cleaner air — seven scenarios in total.
- Revenues recycled domestically as lump-sum transfers.

Poverty at the \$2.15 line; results from Osorio-Rodarte et al. (2025).

Carbon pricing: a small, front-loaded, concentrated cost

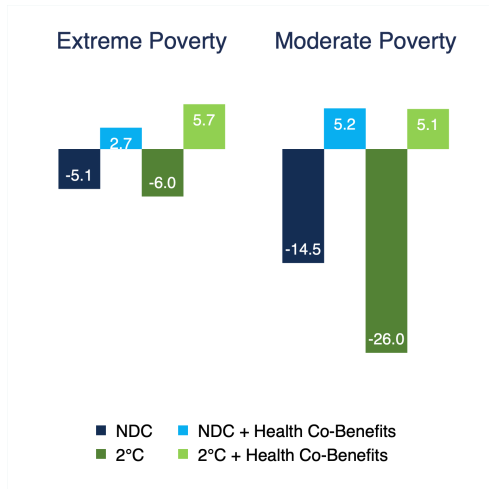


By 2050, the extreme poor (\$2.15) rise by **5.1M** (NDC) to **7.3M** (<2°C-Early).

- Front-loaded: 2°C peaks at **11.3M** in 2040, eases to 6.0M by 2050.
- Concentrated: India & Sub-Saharan Africa drive most of the rise.

Two panels: extreme (\$2.15) and moderate (\$3.65) poverty. Bars: downward = more poverty. Source:

Health co-benefits reverse the sign



Valuing avoided air-pollution mortality flips the result:

- NDC: +5.1M $\rightarrow$ -2.7M (net reduction)
- 2°C: +6.0M $\rightarrow$ -5.7M

Caveat: the sign flip is mechanical once a uniform transfer exceeds the poverty rise — the substance is its magnitude, and it mixes market income with welfare-monetized health. Reported separately.

Bars: downward = more poverty. Source:

Osorio-Rodarte et al. (2025).

Inequality: small, with one regressive exception

- Global Gini essentially unchanged (66.06 under 2°C, 2045): between-country rises slightly, within-country roughly neutral.
- Most regions flat-to-progressive — EU, US, China, Indonesia: top quintiles absorb larger proportional losses.
- **India is the exception**: lower quintiles bear proportionally more under 2°C / <2°C-Early — and India is a top contributor to the poverty rise.

04

Reading across the two



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One spine, two very different incidence patterns

Trade liberalization

broad-based, mildly pro-poor;
bottom 40% gain most;
open chains less shock-exposed

Carbon pricing

small, front-loaded cost;
India/SSA concentrated;
sign depends on co-benefits

Neither pattern is visible in aggregate welfare numbers.

Same linkage; the incidence is a property of the policy.

What it can't (yet) do

- This configuration runs top-down: no micro→macro feedback here (bounded; second-order).
- Frictionless labor reallocation; non-labor income not micro-updated.
- Co-benefit incidence is a uniform transfer, not household-specific exposure.

Frontier: systematic assumption-bounds; channel decompositions; AI-assisted, provenance-tracked tooling for reproducible macro–micro analysis.

Takeaways

1. A transparent, replicable macro-micro spine — equations + code shipped.
2. Held fixed across trade and carbon, it recovers incidence a representative-agent CGE cannot represent.
3. Trade: reshoring regressive, liberalization pro-poor & less shock-exposed.
4. Carbon: small front-loaded cost, sign conditional on health co-benefits.

Paper, appendix, and replication code:
github.com/iosorio/Y2026-GTAP-Conference

Thank you

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Backup — for Q&A



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Backup: the GIDD update, in four equations

1. Wage-premium reconciliation. CGE gap $g_s = y_s/y_0 - 1$ (numeraire y_0 = unskilled agric.); survey premium g'_s . Pass the proportional change through:

$$\hat{g}'_s = g'_s \frac{\hat{g}_s}{g_s}$$

2. Income scaling to macro. One scalar λ restores the aggregate:

$$\lambda \sum_h \omega_h \hat{y}_h = Y' \frac{\hat{Y}}{Y}$$

3. Engel food share (estimated): $\alpha_h = \beta_0 + \beta_1 \ln y_h + e_h$. **4. Real income:**

$$y_h^c = \frac{y_h}{\alpha_h P_f + (1 - \alpha_h) P_{nf}}.$$

Full derivation + Stata code: Appendix A and `gidd/` in the repo. After Bussolo et al. (2010); Maliszewska et al. (2020).

Backup: carbon-pricing scenarios

Scenario	Definition
Baseline	Current policies only; no new coordinated carbon price.
NDC	2030 NDC targets met; moderate pricing thereafter.
NDC-CBAM	NDC + EU carbon border adjustment on carbon-intensive imports.
2°C	Harmonized global price post-2030 on a 2°C budget.
<2°C	Steeper pricing, tighter budget (~1.8°C by 2100).
<2°C-Early	Coordinated pricing begun in the 2020s; 1.5°C-consistent.
NDC-CO, 2°C-CO	As NDC / 2°C, plus monetized health co-benefits by 2050.

Revenues recycled domestically as lump-sum transfers. Source: Osorio-Rodarte et al. (2025).

Backup: where the carbon poverty rise lands (\$2.15, 2050)

	Extreme poor, millions	Headcount, p.p.
India — NDC	+3.0	+0.19
India — 2°C	+6.3	+0.40
India — <2°C-Early	+7.9	+0.50
Brazil — 2°C	+0.03	+0.01
Indonesia — 2°C	−0.32	−0.10
China — all scenarios	≈ 0	≈ 0

India and Sub-Saharan Africa account for most of the global rise; China is near-zero (strong baseline growth). Source: Osorio-Rodarte et al. (2025).

Backup: between- vs within-country inequality (GE(1), 2045)

	Baseline	2°C	<2°C-Early
Total GE(1)	88.33	88.31	88.21
Between-country	36.40	36.58	36.68
Within-country	51.93	51.73	51.53
Global Gini	66.04	66.06	66.05

Carbon pricing nudges between-country inequality up (poorer countries lose proportionally more) and within-country down — offsetting, so the Gini barely moves. Source: Osorio-Rodarte et al. (2025).

Backup: assumptions and how they bound the results

Assumption	Direction of likely bias
No micro→macro feedback	second-order here; would matter with large transfers
Frictionless labor reallocation	understates short-run transition costs
Non-labor income not micro-updated	error rises up the distribution (poor hold little capital)
Lump-sum revenue recycling	alternative recycling could change the carbon sign
Co-benefit = uniform transfer	misses household-specific pollution exposure

Systematic sensitivity sweeps are the next step (and a [refine.ink](#) request we are taking up).