

Labor Market Trajectories and Earnings Dynamics in Colombia

Leonardo Fabio Morales
Banco de la República

Sergio Ocampo Díaz
University of Western Ontario

Brenda Samaniego de la Parra
University of Notre Dame

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The Global Repository of Income Dynamics (GRID) Project

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- Four pillars:
 - **Longitudinal**: follow individuals over time.
 - **Administrative**: reduce measurement error and improve coverage.
 - **Granular**: statistics by age, gender, cohort, and income rank.
 - **Harmonized**: comparable definitions and code across countries.
- Original GRID release: 13 countries; new cohort: 25 countries.

grid-database.org

GRID in Colombia

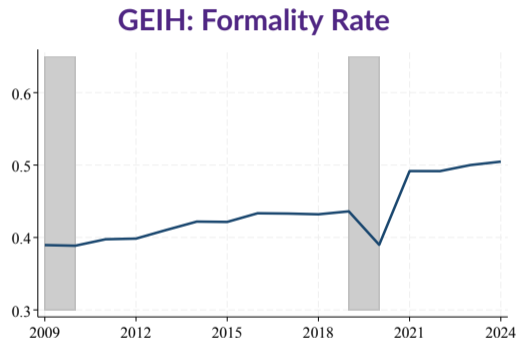
- Extend GRID to Colombia using social security records for *universe of formal workers*.
- Data: *Planilla Integrada de Liquidación de Aportes (PILA)*.

GRID in Colombia

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- The Colombian setting:
 - formal employment accounts for less than half of the workforce;
 - workers move in and out of formal jobs over their careers;
 - administrative records reveal formal *labor market histories*.

Our contribution: Connect earnings dynamics to long-run histories of *formal attachment*.

Formal Attachment in Colombia

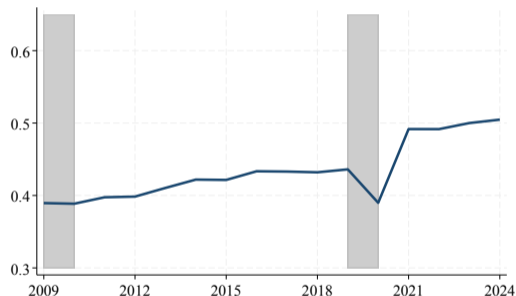


Central labor market challenge: Informality.

- Less than half of workers are formal
- Formality rates are useful snapshots, but miss dynamics.

Formal Attachment in Colombia

GEIH: Formality Rate



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We provide three sets of new results:

1. Earnings statistics for formal workers
2. Characterize formal attachment histories
3. Connect formal attachment to earnings dynamics

Preview of Results: Earnings Dynamics 2009–2024

- Earnings grew across distribution 2009–2024; concentration declined modestly.
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- Formal attachment from labor market histories of 25–30 year olds in 2009
Two thirds of the cohort is either persistently low- or high-attachment.
- Low or falling attachment workers drive earnings dispersion and volatility.
- Formal attachment tied to larger firms, higher earnings, lower earnings risk.

Administrative Data on Formal Workers

PILA: Planilla Integrada de Administración de Aportes

- Administrative registry of mandatory social security contributions.
- Firms and workers report monthly contributions to health and pensions systems.
- The data provide a census of formal employment relationships in Colombia.
- Define a formal worker as someone making social security contributions either as:
 - a wage-earning or salaried employee (80% in 2024), or
 - a registered self-employed worker (20% in 2024).

Earnings Measures

- Main outcome: **real annual labor earnings**, y_{it} , following the GRID framework.
 - Nominal earnings deflated to 2018 COP.
 - Permanent earnings: average real earnings over rolling three-year windows.

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- Earnings growth:

$$g_{i,t}^h = \varepsilon_{i,t+h} - \varepsilon_{i,t}, \quad h \in \{1, 5\}.$$

Sample Overview – Formal Workers aged 25 to 55

Year		2009	2015	2018	2024
Workers	(M)	7.03	9.39	10.24	11.48
Annual Earnings (\$M 2018 COP)	P10 P50 P90				
Age Share	25–35 36–45 45–55				

Sample Overview – Formal Workers aged 25 to 55

Year		2009	2015	2018	2024
Workers	(M)	7.03	9.39	10.24	11.48
Annual Earnings (\$M 2018 COP)	P10	1.38	2.24	2.34	2.71
	P50	7.61	8.95	9.37	10.82
	P90	17.91	23.08	24.16	27.11
Age Share	25–35				
	36–45				
	45–55				

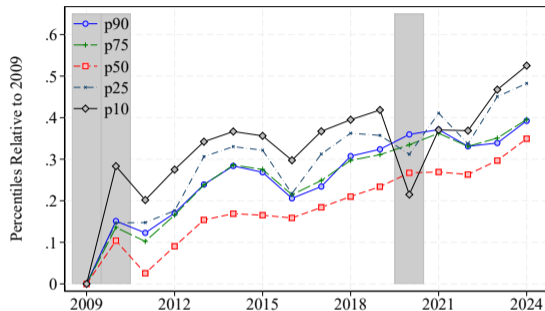
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Age Share	25–35	46.5	46.9	46.4	45.7
	36–45	32.7	31.1	32.1	33.5
	45–55	20.7	22.0	21.5	20.8

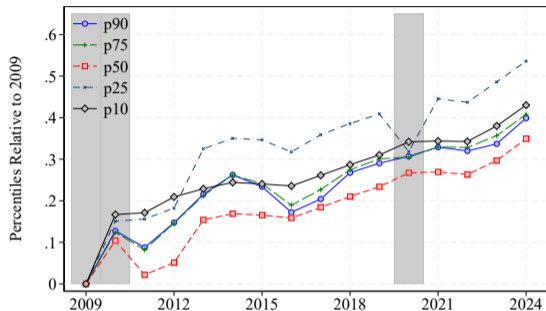
Earnings Inequality

Growth of Earnings Percentiles 2009–2024

Women



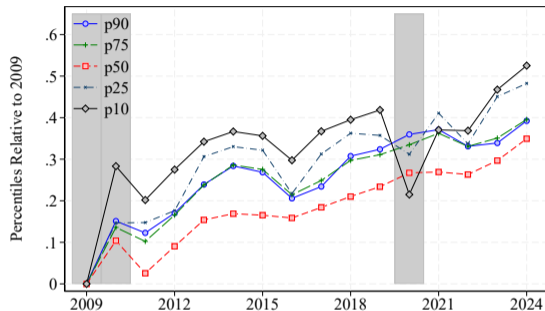
Men



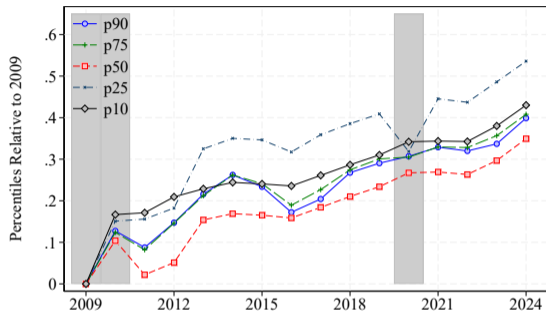
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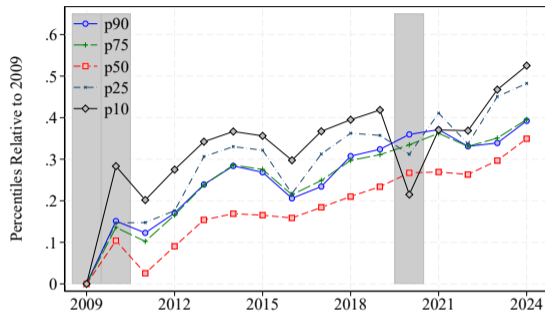


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- Growth inside the top 1% is similar but slightly lower.

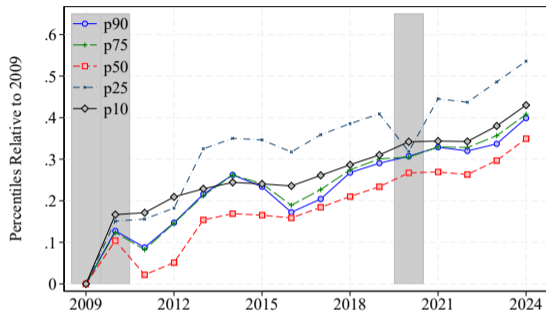
Top percentiles

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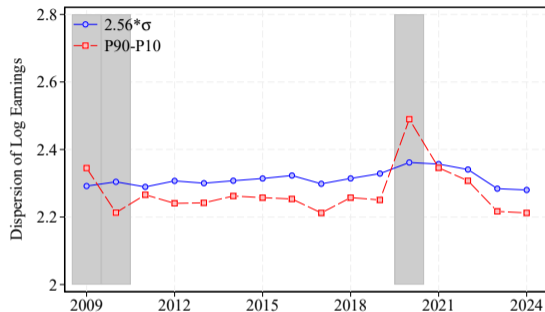
- Growth across the distribution; median 0.3 log points above 2009 levels by 2024.
- Growth inside the top 1% is similar but slightly lower.
- Growth has not meaningfully changed earnings concentration despite modest increase in bottom 50% share.

Top percentiles

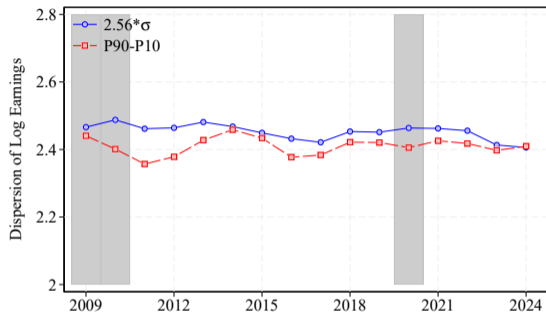
Earnings shares

Earnings Dispersion

Women



Men

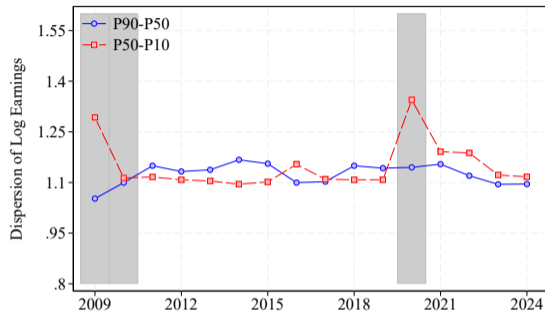


- Earnings dispersion remarkably stable; men's earnings slightly more dispersed.
- The main visible break is a temporary widening of women's earnings distribution during the pandemic.

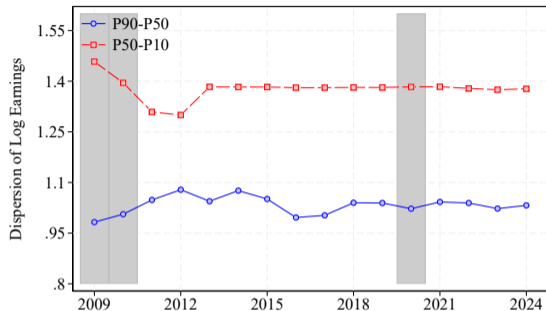
Earnings Dispersion Above and Below Median

International Comparison

Women



Men

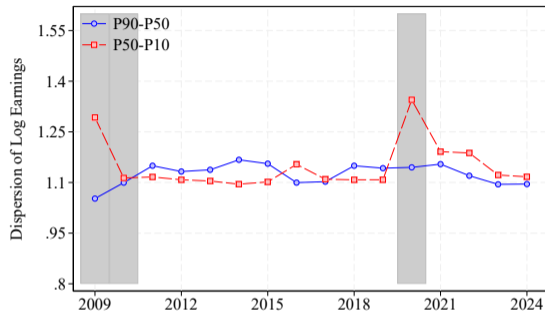


- Dispersion above and below the median is also stable (much higher for market entrants).

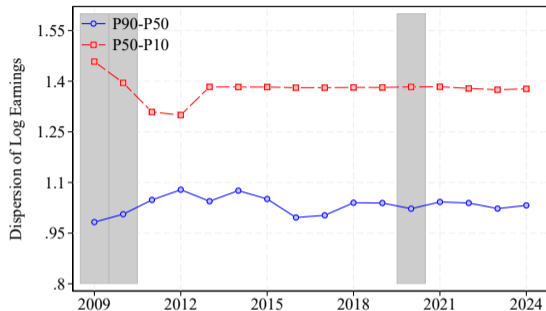
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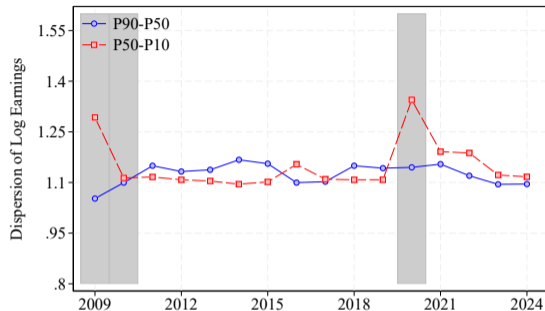


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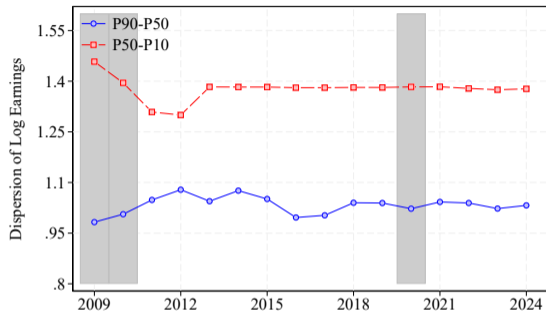
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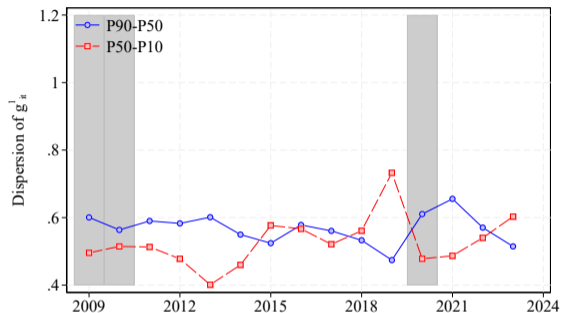


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- Women's distribution close to symmetric; pandemic spike from lower half.
- Men's distribution is markedly left-skewed (different from other GRID countries).

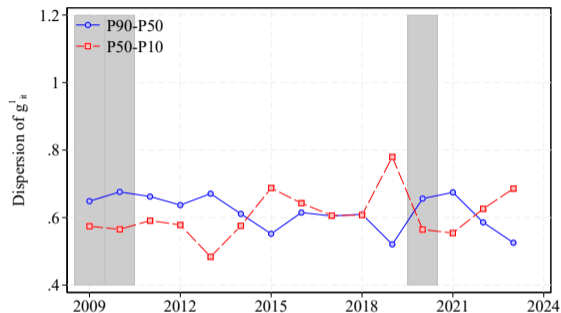
Earnings Growth

(Residualized) Earnings Growth Dispersion

Women



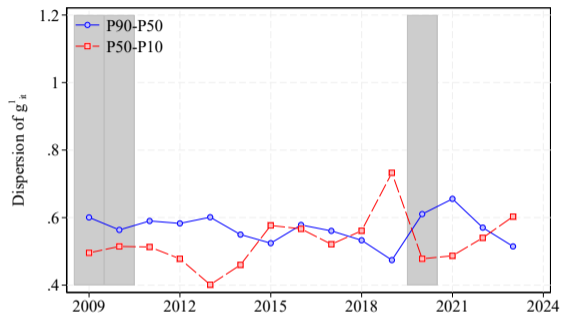
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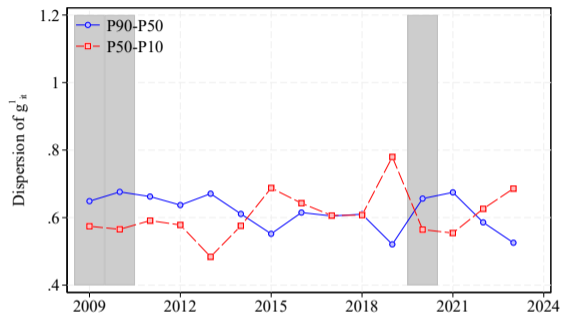
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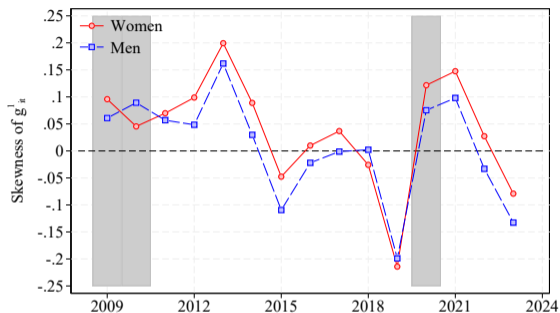
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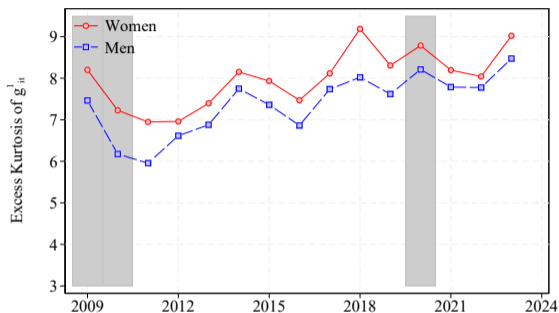
- Distribution is nearly symmetric; women have slightly lower dispersion.
- Below-median growth dispersion rises after 2012.
- The pandemic and recovery periods again make downside growth risk more salient.

Earnings Growth: Skewness and Kurtosis

Skewness



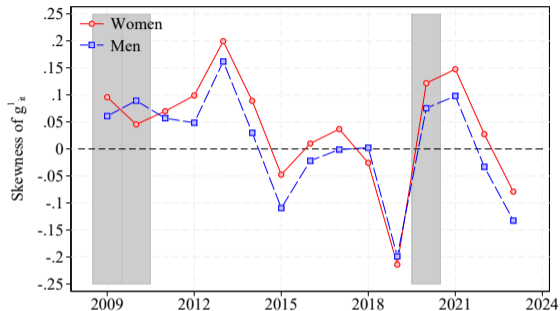
Kurtosis



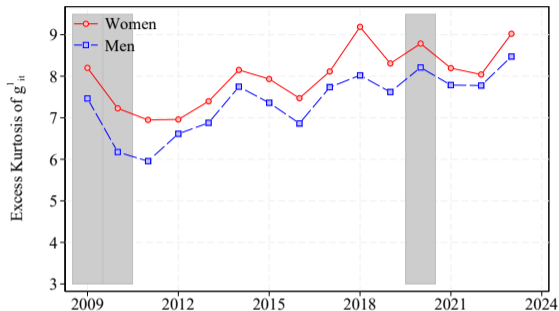
- Skewness turns negative after 2012, dips around pandemic, rebounds afterwards.
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Earnings Growth: Skewness and Kurtosis

Skewness



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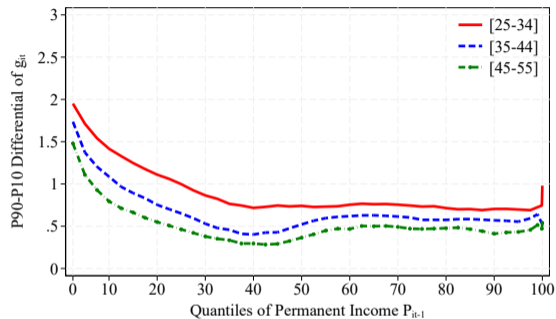


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- Women have consistently higher skewness and kurtosis than men in the sample.

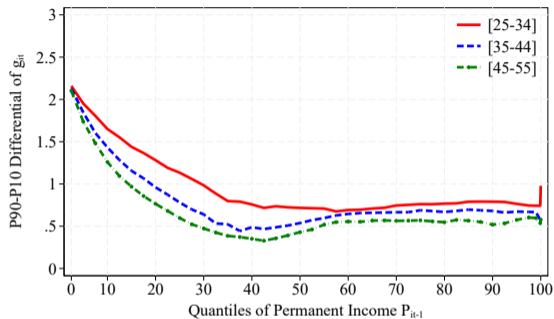
Earnings Growth by Permanent Income

International Comparison

Women



Men



- Earnings growth volatility is largest among young workers and at the bottom of the permanent income distribution.
- Volatility falls through percentile 40 and is flatter through most of the distribution.

Histories of Formal Attachment

Measuring Formal Attachment

- **Objective:** How persistent is formality over work life?
- Track histories of *formal attachment* for a cohort of workers:
 - Workers aged 25–30 in 2009 who appear at least once in PILA between 2009 and 2024.

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- Each worker is represented by a 16-year vector:

$$F_i = [f_{i,2009}, f_{i,2010}, \dots, f_{i,2024}].$$

- Order matters: formal early and informal later \neq informal early and formal later.

1. Start with each worker as a separate cluster.
2. Merge the two clusters with the closest formal-attachment histories.
3. Replace the merged clusters with their average trajectory.
4. Repeat until all workers are in one group.

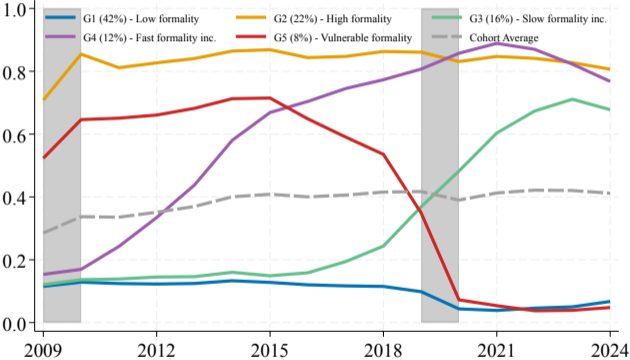
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Implementation:

$$\arg \min_{g,g'} \sqrt{\frac{2N_g N_{g'}}{N_g + N_{g'}}} \left\| \bar{\mathbf{F}}^g - \bar{\mathbf{F}}^{g'} \right\|_2$$

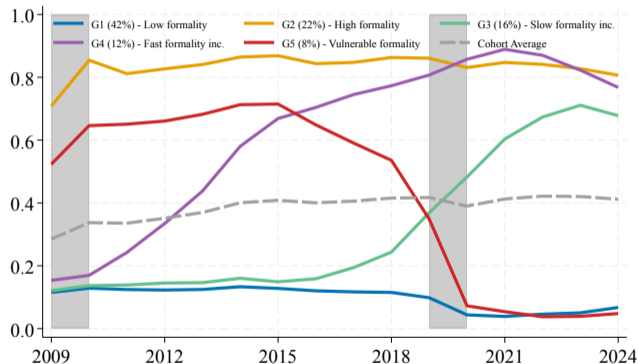
- Ward's method minimizes within-cluster variance.
- We select **five groups** explaining 60 percent of total variation.

Groups of Formal Attachment



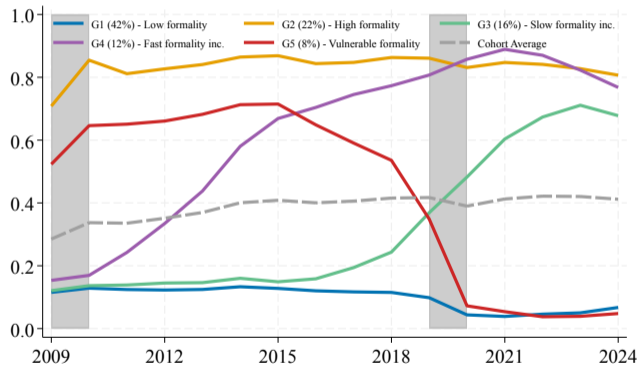
- G1 (42 percent): persistently low attachment (≈ 1 month/year).

Groups of Formal Attachment



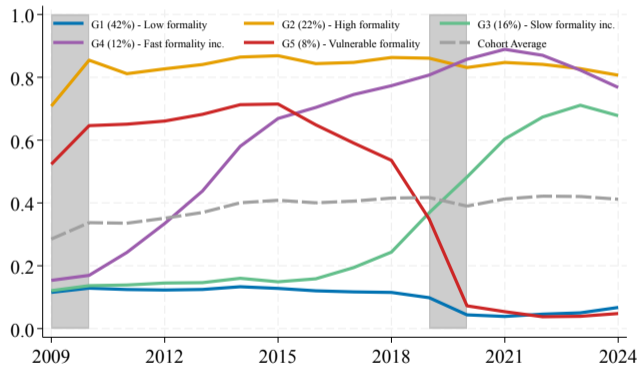
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- **G3** and **G4** (28 percent): increasing attachment.

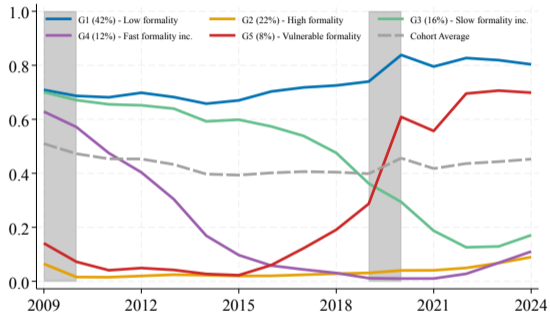
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- **G5** (8 percent): vulnerable attachment.

Extensive Margins of Formal Attachment

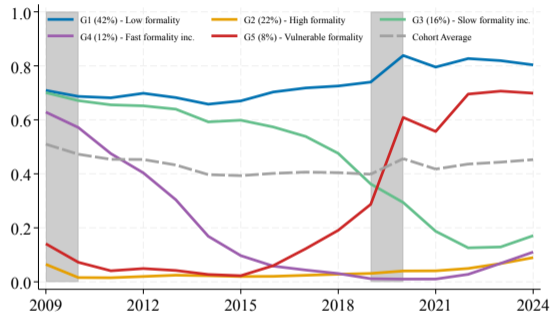
No formal contribution



G1 has no formal contribution in most years.

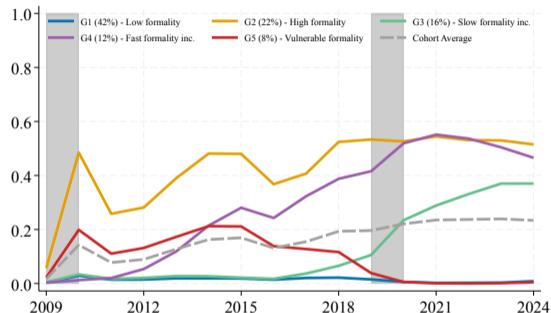
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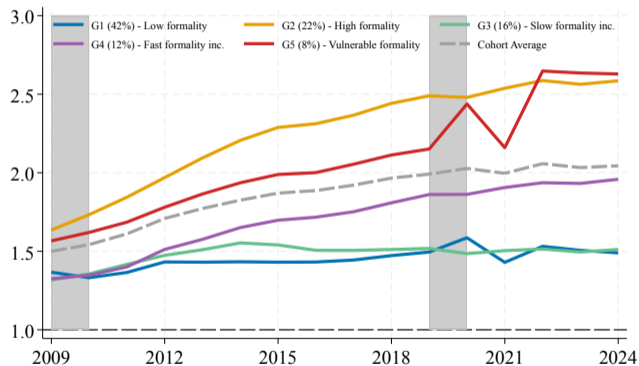
Full-year contribution



Full-year formal employment is rare, even in the high-attachment group, **G2**.

What do histories of formal attachment tell us about earnings?

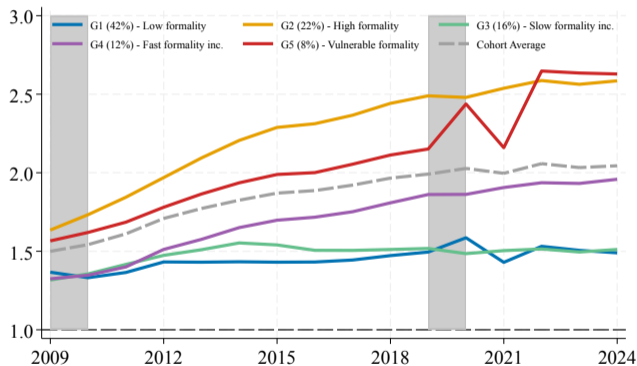
Average Monthly Earnings Relative to the Minimum Wage



- G2 has the highest formal earnings and the strongest earnings growth.

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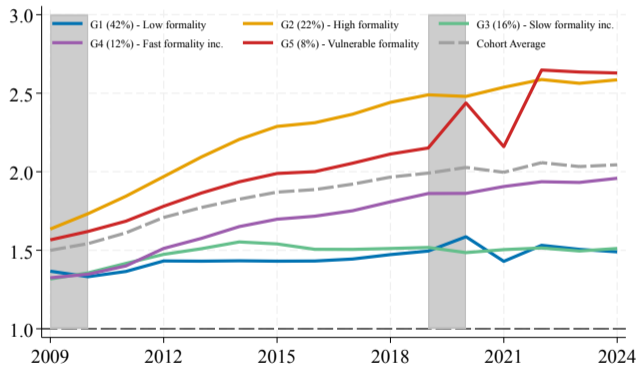
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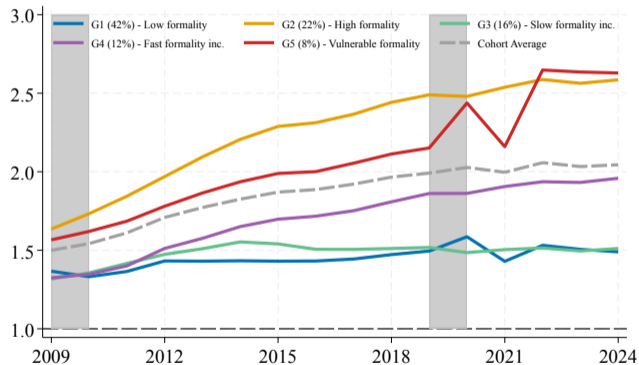
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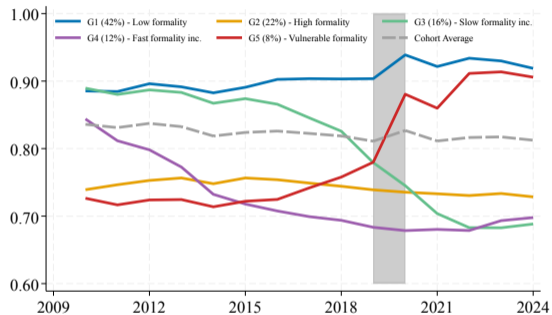
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- **G3** becomes more formal but earnings remain low
- **G4** increases formality and earnings but does not catch up with **G2**.
- **G5** shows selection: high earners remain formal.

Location and Firm Size

Main metropolitan areas

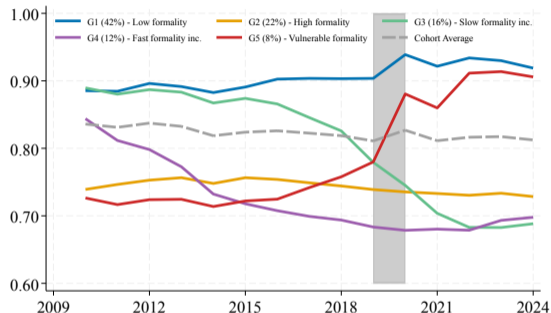


Formal attachment lower in large cities

→ Role of public sector.

Location and Firm Size

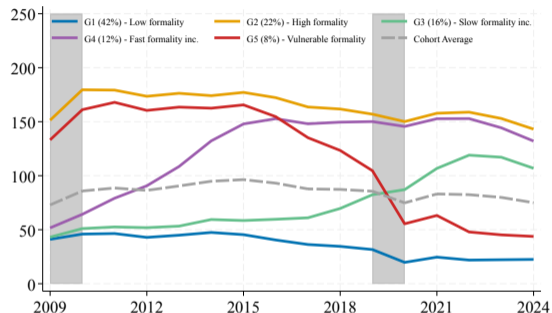
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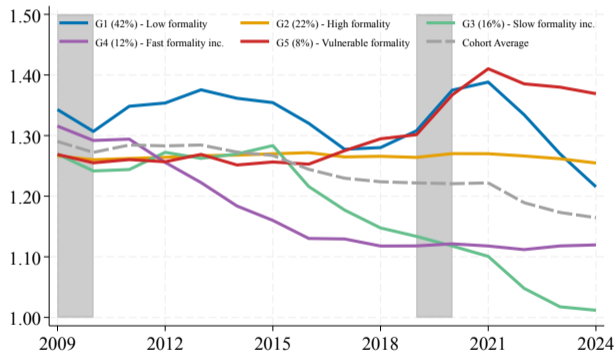


High formal attachment closely linked

to larger firms. Industries

Gender and Formal Attachment

Male-to-Female ratio among formal workers

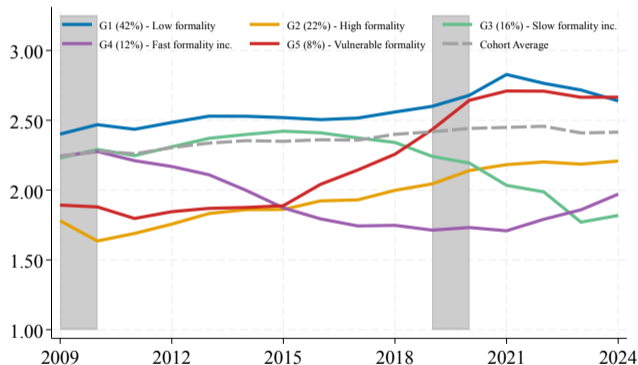


- Formal employment is disproportionately male.
- Increases in formality largely driven by women.
- Pandemic collapse in **G5** disproportionately female.

Formal Attachment and Earnings Dynamics

Earnings Dispersion Across Attachment Groups

Standard Deviation Log-Earnings

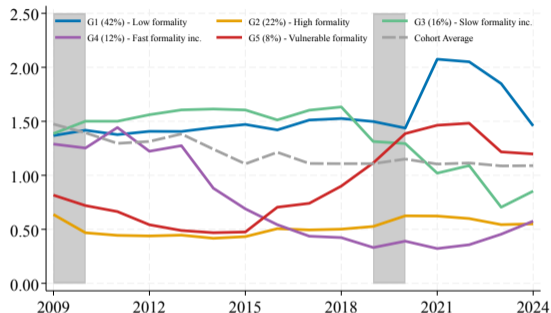


Earnings dispersion driven by workers with low formal attachment.

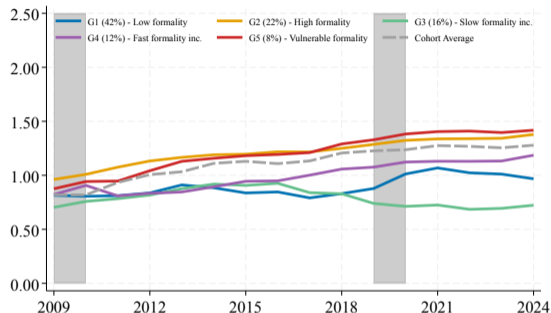
- G1 has highest dispersion; G2 the lowest.
- G3 and G4 compress as their formal attachment rises.
- G5's falling attachment comes with rising earnings dispersion.

Differences in Earnings Dispersion from Bottom of Distribution

P50-P10



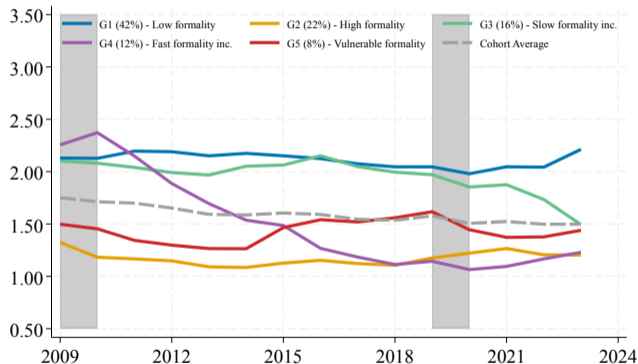
P90-P50



- Earnings dispersion driven by the bottom half of distribution.
- Upper-half dispersion similar across groups; Lower-half dispersion reflects formality.

Earnings Growth Across Attachment Groups

Standard Deviation Log-Earnings Growth

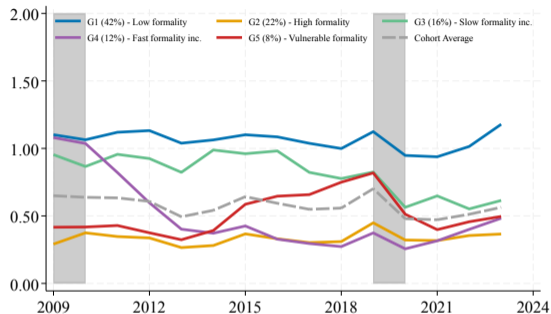


Earnings growth volatility driven by workers with low formal attachment.

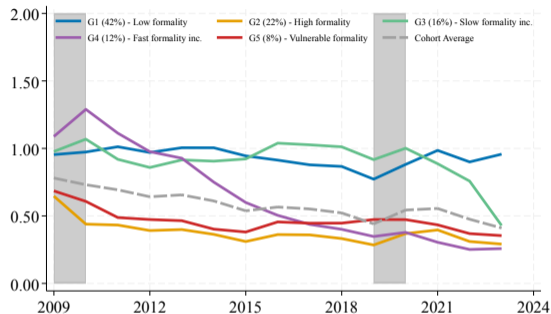
- **G1** remains the highest-volatility group throughout the sample.
- **G4** shows the sharpest decline in volatility as its attachment to formal work rises.

Upside and Downside Growth Risk Across Attachment Groups

P50-P10



P90-P50



- Similar earnings growth dispersion above and below median (unlike earnings levels).
- Formal attachment negatively correlated with upside and downside growth dispersion.
- Exception is **G5**: its level dispersion rises as attachment falls, but growth dispersion does not rise as sharply (consistent with selection).

Conclusions

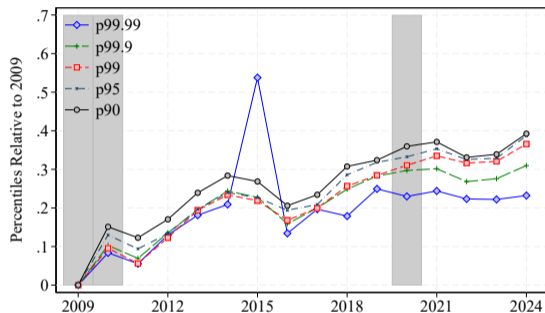
- Colombia's formal workers experienced broad earnings growth and modest declines in concentration from 2009 to 2024.
- Stable aggregate inequality masks sharp differences in formal labor market histories.
- Formal attachment is a persistent and economically meaningful dimension of labor market segmentation.
- Workers with weak attachment drive earnings dispersion and earnings growth volatility.
- For policy, the object is not only the formality rate at a point in time, but the durability of formal jobs over workers' careers.

Thank you

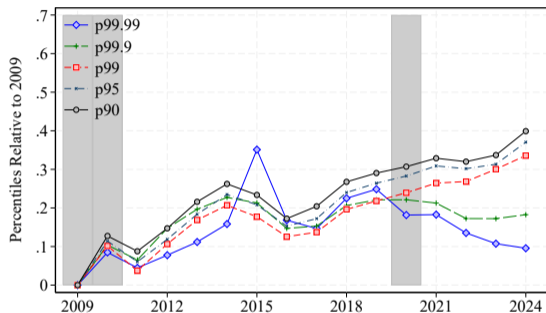
Appendix: Growth of Top Earnings Percentiles

Back

Women



Men

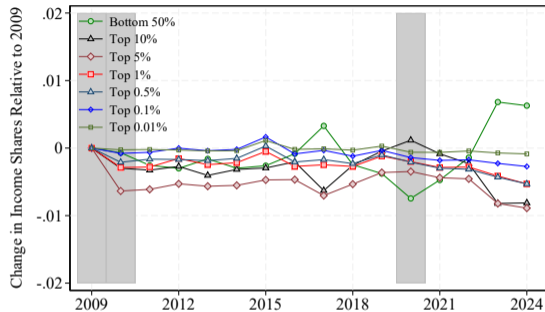


- Growth is stronger around P90 and P95 than at the very top of the distribution.
- The 99.9th and 99.99th percentiles flatten after 2018 for women and decline for men.

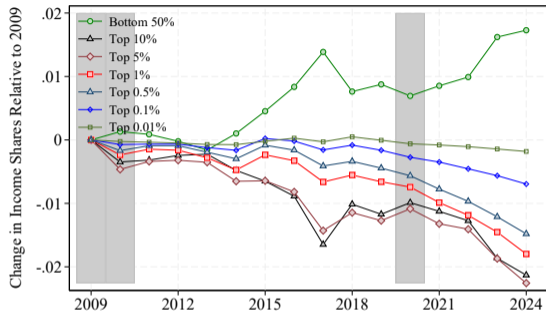
Appendix: Earnings Shares

Back

Women

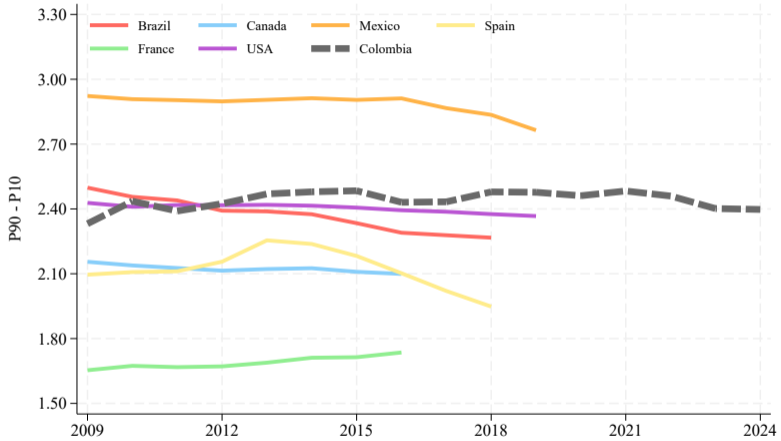


Men



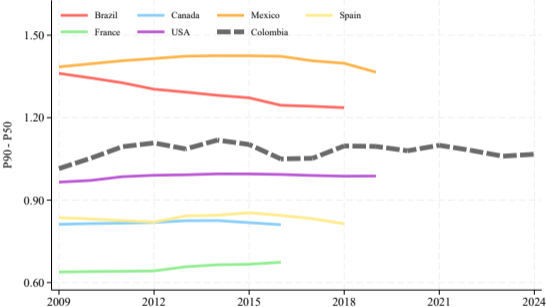
- Earnings concentration declines modestly, especially through gains in the bottom half of the men's distribution.
- Top earnings shares fall more visibly for men; women's earnings shares are comparatively stable over the period.

Appendix: Earnings Dispersion in GRID

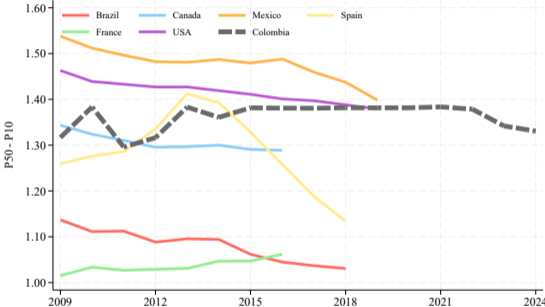


Appendix: Dispersion Above and Below Median in GRID

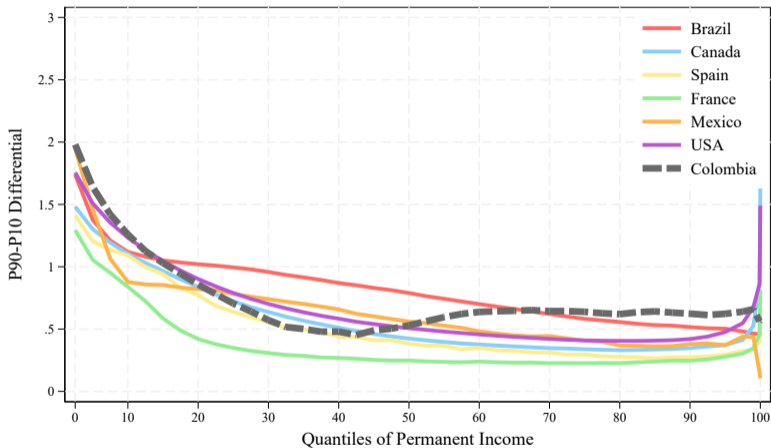
P90-P50



P50-P10



Appendix: Earnings Growth Volatility in GRID



Trajectory	$t = 1$	$t = 2$	$t = 3$	Description
F_1	0.00	0.10	0.20	Low attachment, slight increase
F_2	0.75	0.80	0.85	High attachment
F_3	0.20	0.50	0.85	Increasing attachment
F_4	0.05	0.10	0.20	Low attachment, close to F_1
F_5	0.85	0.80	0.70	High attachment, slight decrease
F_6	0.85	0.45	0.10	Decreasing attachment

- F_1 and F_4 are close: $\|F_1 - F_4\|_2 = 0.050$.
- F_1 and F_2 are far apart: $\|F_1 - F_2\|_2 = 1.214$.

	F_1	F_2	F_3	F_4	F_5	F_6
F_1	–					
F_2	1.214	–				
F_3	0.789	0.626	–			
F_4	0.050	1.184	0.778	–		
F_5	1.209	0.180	0.731	1.175	–	
F_6	0.925	0.834	0.994	0.879	0.695	–

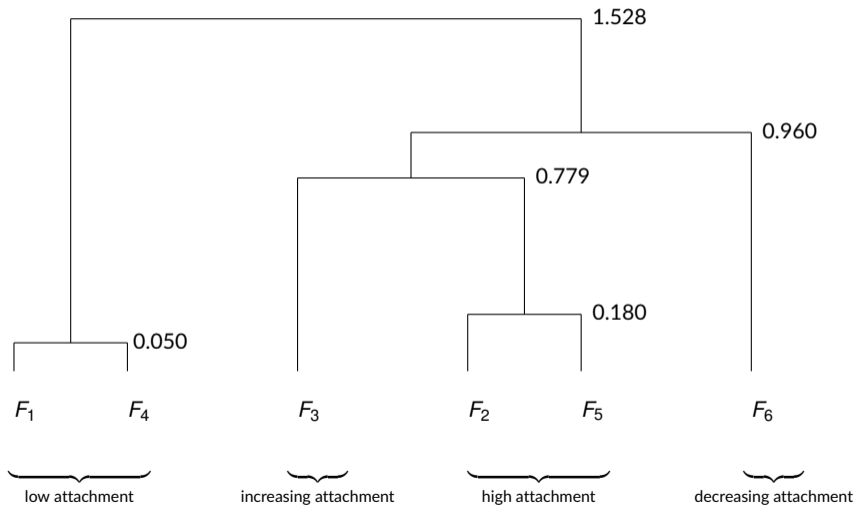
- Closest pair: F_1 and F_4 .

- Merge them into their centroid:

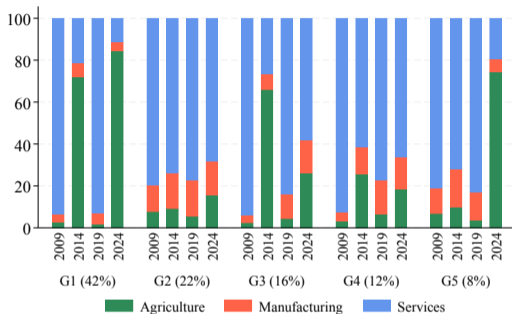
$$\begin{aligned} F_{14} &= (F_1 + F_4)/2 \\ &= (0.025, 0.100, 0.200). \end{aligned}$$

- Next closest pair after updating distances: F_2 and F_5 .

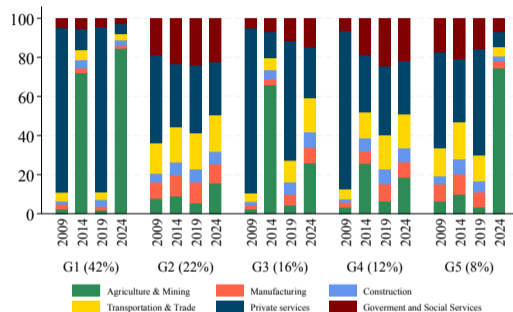
Appendix: Dendrogram



Sectors



Industries



- Services dominate formal employment, but sectoral composition varies across attachment groups.
- Government and social services become more prevalent in groups with rising formal attachment.