

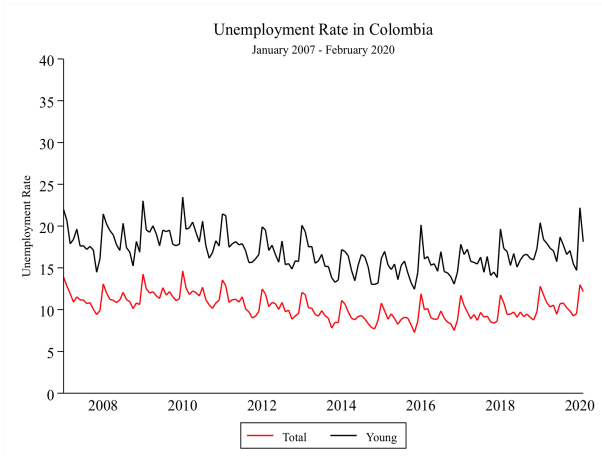
# Labor Market Flows of Young Workers in Colombia

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# Motivation

- Do changes in payroll taxes affect labor market flows of young adults in Colombia?



- Description of labor flows

Kaitz (1970); Blanchard et al. (1990); Mortensen and Pissarides (1994); Pissarides (1990); Burdett and Mortensen (1998);

- Labor Search Models

Burdett and Mortensen (1998); Van den Berg and Ridder (1998); Bontemps, Robin and Van den Berg (2000); Meghir et al. (2015) ; **Narita (2020)**

- Latin-America and Colombia

Prada (2012); Lasso (2013); López y Lasso (2016); Flórez et al (2018); Lasso (2020)

- Payroll Taxes in Colombia

Kugler and Kugler (2009); Antón (2014); **Galiani et al. (2015)**; **Becerra (2017)**

# First Job Act

Law 1429 of 2010 known as “Ley del Primer Empleo”.

- Reduction of the value of payroll taxes of SENA, ICBF, Family Compensation Funds, Health Funds and Pension funds
- **Workers younger than 28 years old.** [► Groups](#)
- First Job Act applied for firms that hire workers between **January 2011 and December 2014.**
- Firms must satisfy some conditions to receive payroll tax reductions [► Conditions](#)

I use the condition for new workers younger than 28 years old to estimate the effect of the First Job act on worker flows.

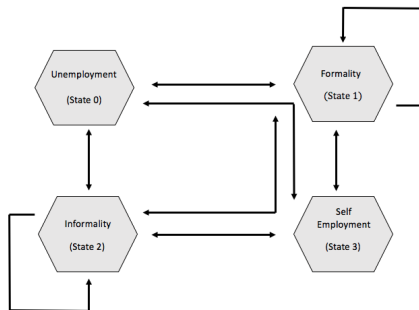
# Structure of The Paper

- 1 Theoretical Framework (Labor Search Model)
- 2 Data (Colombian National Labor Survey)
- 3 Empirical Strategy (Regression Discontinuity Design)
- 4 Results

# Theoretical Framework

Narita (2020)

- Self-employment ability  $\theta$
- Labor experience  $\epsilon$
- Transition probabilities:  $\delta^i$ ,  $\lambda_{\epsilon}^k(\theta)$
- Distribution of wages:  $F^j(w)$
- Non-labor income and home production value:  $b_{\epsilon}(\theta)$ ,  $h_{\epsilon}(\theta)$
- Reservation wages:  $R_{\epsilon+1}^{kj}(\theta)$



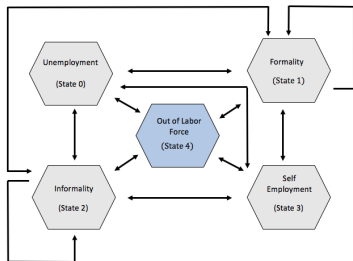
► Bellman Equations

► Measure of Workers

► Firms

# Theoretical Framework

Mancera (2021): Out of labor state



► Measure of Workers

Bellman equation for workers out of labor force

$$\begin{aligned}
 (1+r)H_{\epsilon}(\theta) = & h_{\epsilon}(\theta) + \lambda_{\epsilon}^{41}(\theta) \int_{R_{\epsilon+1}^{41}} \bar{w}^1 W_{\epsilon+1}^1(\chi, \theta) dF^1(\chi) \\
 & + \lambda_{\epsilon}^{42}(\theta) \int_{R_{\epsilon+1}^{42}} \bar{w}^2 W_{\epsilon+1}^2(\chi, \theta) dF^2(\chi) \\
 & + \lambda_{\epsilon}^{43}(\theta) 1\{W_{\epsilon+1}^3(\theta) > H_{\epsilon+1}(\theta)\} W_{\epsilon+1}^3(\theta) \\
 & + \delta_{\epsilon}^4(\theta) 1\{U_{\epsilon+1}(\theta) > H_{\epsilon+1}(\theta)\} U_{\epsilon+1}(\theta) \\
 & + [1 - d_{\epsilon}^4(\theta)] H_{\epsilon+1}(\theta)
 \end{aligned}$$

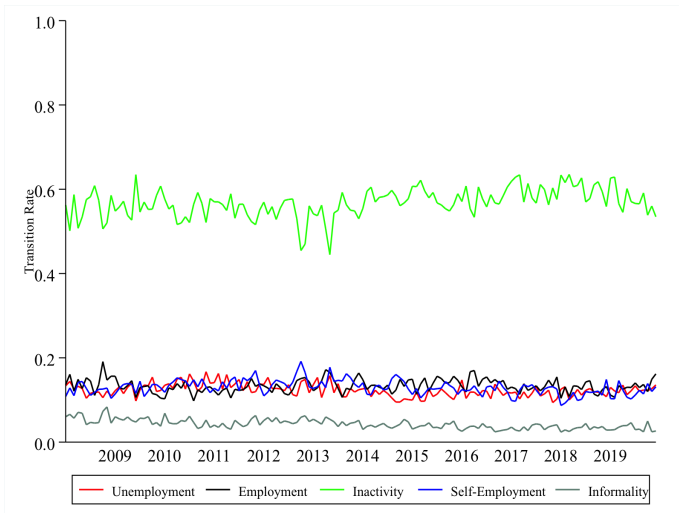
# Colombian National Labor Survey (GEIH)

Individual data from January 2008 to December 2019

	Formal Employment	Informal Employment	Self- Employment	Unemployment	Inactivity
Age (mean)	28,07	27,52	28,52	26,44	25,75
Schooling					
None	0,86	0,67	1,93	0,39	1,24
Primary	3,76	1,53	5,69	1,56	3,37
Secondary	1,54	0,42	1,90	0,68	1,35
High School	16,82	2,13	10,64	5,82	11,75
Vocational education	7,38	0,35	2,73	2,03	1,63
College degree	5,24	0,12	2,42	1,49	0,58
Graduate degree	1,25	0,01	0,53	0,15	0,05
% Females	16,27	3,70	10,76	7,38	15,42
Labor Income					
Mean	\$ 1.695.660	\$ 581.253	\$ 671.182	-	-
Std.dev	\$ 2.602.678	\$ 3.587.242	\$ 915.771	-	-
% Social Security	34,41	4,39	21,48	9,00	17,63



# Transitions From Out of Labor Force

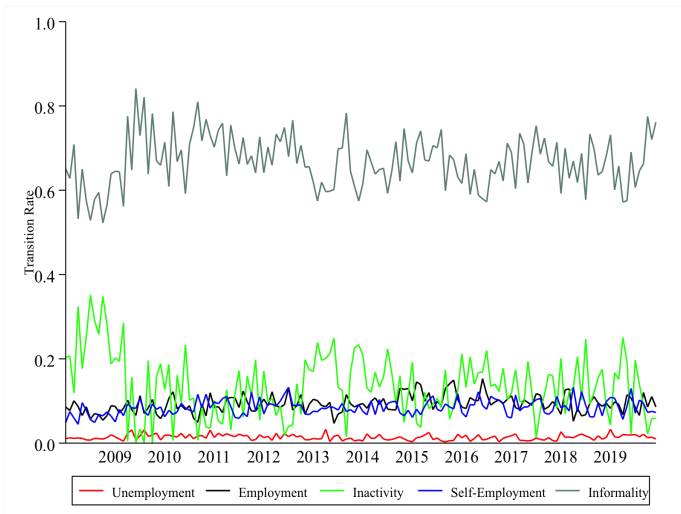


► Retrospective Questions

► Matrix Balancing

► Transition Rates

# Transitions From Informality



# Empirical Strategy

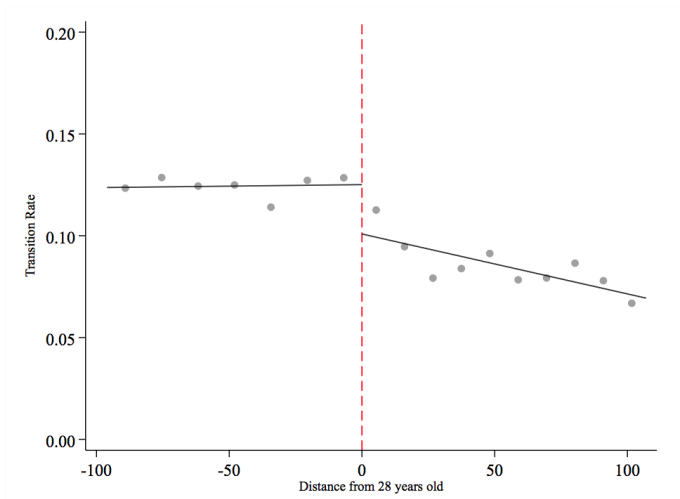
Let  $y_a$  transition rates from one state to another for age groups individuals  $a$

$$y_a = \tau D + f(a) + e_a \quad (1)$$

Where  $D$  is a dummy variable that indicates 1 if the age group is treated and 0 otherwise.  $a$  is normalized age (in months),  $f(a)$  is a polynomial function of age and  $e_a$  is the error term.

# Main Specification

RD estimate of First Job Act effect on transition rates from informality to formality



## RD Estimates of First Job Act

► High School or Less    ► More Than High School

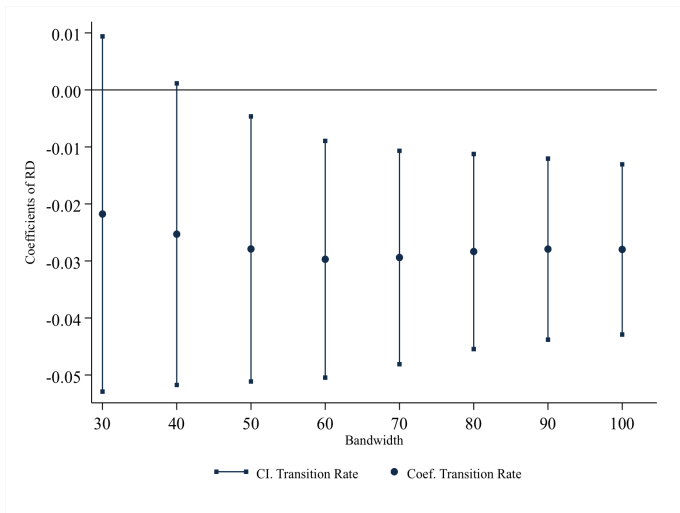
# Robustness Checks

## RD Estimates of First Job Act including time effects

Dependent Variable	All	Men	Women
Informality to Formality	-0.0270** (0.00994)	-0.0679*** (0.0154)	-0.00658 (0.00969)
Unemployment to Formality	-0.00416 (0.0131)	-0.00816 (0.0292)	0.00279 (0.0148)
Inactivity to Formality	0.00141 (0.00507)	-0.00576 (0.0139)	0.00331 (0.00585)
Informality to Self-employment	0.00118 (0.00695)	0.0106 (0.0143)	-0.00329 (0.00871)
Unemployment to Self-employment	0.00607 (0.0166)	0.00336 (0.0200)	-0.00333 (0.0164)
Inactivity to Self-employment	-0.00442 (0.00469)	0.00629 (0.0161)	-0.00854 (0.00532)
<i>N</i>	9454	6448	8797

# Robustness Checks

RD estimates of First Job Act effect with varying bandwidth



► Placebo

# Conclusion

- In this paper, I propose an extension of the on-the-job labor model of Narita (2020) to understand how labor decisions made by firms and workers can affect the flows between states and then I estimate the effect of First Job Act on changes in labor market flows of young adults.
- I found that the reduction in payroll taxes of around 11 percentage points of formal firms in Colombia can raise flows from informality to formality of workers by around 2,8 percentage points. The effect is larger for men whose transition rate increase in 6,2 percentage points.
- This raises the question of which policies encourage flows from other states into formality, even in the context of developing countries such as Colombia.



## To do list

- Run robustness from Cattaneo et al (2014).
- Run McCrary test (2008).
- Estimate the structural model including out of labor force state.

# Labor Market Flows of Young Workers in Colombia

Thanks for your attention and comments

# First Job Act Target Groups

- Workers younger than 28 years old
- Workers in forced displacement condition
- Women above 40 years old and without formal employment in the past twelve months
- Heads of household eligible for social assistance programs
- Workers with a 1.5 Colombian minimum wage and without previous experience in the formal sector

► First Job Act

# First Job Act Conditions

- The employer must increase the number of employees in relation to the number of employees that contribute to social security in December to the previous year.
- The employer must increase the total payroll value of the firm in relation to the total payroll value in December to the previous year.
- Payroll taxes that are going to be discounted were fully paid.
- The new worker must not to be hired to replace an old worker. (This means that hiring requires new jobs).
- New jobs do not result from firm's merge.

# Labor Search

## Unemployment

$$\begin{aligned}(1+r) U_{\epsilon}(\theta) = & b_{\epsilon}(\theta) + \lambda_{\epsilon}^{01}(\theta) \int_{R_{\epsilon+1}^{\bar{w}^1}} W_{\epsilon+1}^1(\chi, \theta) dF^1(\chi) \\ & + \lambda_{\epsilon}^{02}(\theta) \int_{R_{\epsilon+1}^{\bar{w}^2}} W_{\epsilon+1}^2(\chi, \theta) dF^2(\chi) \\ & + \lambda_{\epsilon}^{03}(\theta) 1\{W_{\epsilon+1}^3(\theta) > U_{\epsilon+1}(\theta)\} W_{\epsilon+1}^3(\theta) \\ & + \lambda_{\epsilon}^{04}(\theta) 1\{H_{\epsilon+1}(\theta) > U_{\epsilon+1}(\theta)\} H_{\epsilon+1}(\theta) \\ & + [1 - d_{\epsilon}^0(\theta)] U_{\epsilon+1}(\theta)\end{aligned}$$

► Theoretical Framework

# Labor Search

## Out of Labor Force

$$\begin{aligned}(1+r) H_{\epsilon}(\theta) &= h_{\epsilon}(\theta) + \lambda_{\epsilon}^{41}(\theta) \int_{R_{\epsilon+1}^{\bar{w}^1}} W_{\epsilon+1}^1(\chi, \theta) dF^1(\chi) \\ &+ \lambda_{\epsilon}^{42}(\theta) \int_{R_{\epsilon+1}^{\bar{w}^2}} W_{\epsilon+1}^2(\chi, \theta) dF^2(\chi) \\ &+ \lambda_{\epsilon}^{43}(\theta) 1\{W_{\epsilon+1}^3(\theta) > H_{\epsilon+1}(\theta)\} W_{\epsilon+1}^3(\theta) \\ &+ \delta_{\epsilon}^4(\theta) 1\{U_{\epsilon+1}(\theta) > H_{\epsilon+1}(\theta)\} U_{\epsilon+1}(\theta) \\ &+ [1 - d_{\epsilon}^4(\theta)] H_{\epsilon+1}(\theta)\end{aligned}$$

# Labor Search

## Formal Employment

$$\begin{aligned}(1+r) W_{\epsilon}^1(w, \theta) &= w + \delta_{\epsilon}^1 (U_{\epsilon+1}(\theta) + UI + sw) \\ &+ \lambda_{\epsilon}^{11}(\theta) \int_w^{\bar{w}^1} W_{\epsilon+1}^1(\chi, \theta) dF^1(\chi) \\ &+ \lambda_{\epsilon}^{12}(\theta) \int_{R_{\epsilon+1}^{12}(\theta)}^{\bar{w}^2} W_{\epsilon+1}^2(\chi, \theta) dF^2(\chi) \\ &+ \lambda_{\epsilon}^{13}(\theta) 1\{w < R_{\epsilon+1}^{13}(\theta)\} W_{\epsilon+1}^3(\theta) \\ &+ \lambda_{\epsilon+1}^{14}(\theta) 1\{w < H_{\epsilon+1}(\theta)\} H_{\epsilon+1}(\theta) \\ &+ [1 - d^1] W_{\epsilon+1}^1(w, \theta)\end{aligned}$$

# Labor Search

## Informal Employment

$$\begin{aligned}(1+r) W_{\epsilon}^2(w, \theta) = & w + \delta_{\epsilon}^2 U_{\epsilon+1}(\theta) + \lambda_{\epsilon}^{21}(\theta) \int_{R_{\epsilon+1}^{21}(w, \theta)}^{\bar{w}^1} W_{\epsilon+1}^1(\chi, \theta) dF^1(\chi) \\ & + \lambda_{\epsilon}^{22}(\theta) \int_w^{\bar{w}^2} W_{\epsilon+1}^2(\chi, \theta) dF^2(\chi) \\ & + \lambda_{\epsilon}^{23}(\theta) 1\{w < R_{\epsilon+1}^{32}(\theta)\} W_{\epsilon+1}^3(\theta) \\ & + \lambda_{\epsilon}^{24}(\theta) 1\{w < H_{\epsilon+1}(\theta)\} H_{\epsilon+1}(\theta) \\ & + [1 - d_{\epsilon}^2(w, \theta)] W_{\epsilon+1}^2(\theta)\end{aligned}$$



# Labor Search

The measure of workers in formal employment state

$$\begin{aligned} M_{\epsilon+1}^1(w, \theta) &= [1 - d_{\epsilon}^1(w, \theta)] M_{\epsilon}^1(w, \theta) \\ &+ \lambda_{\epsilon}^{01}(\theta) u_{\epsilon}(\theta) \max\{F^1(w) - F^1(R_{\epsilon+1}^{01}(\theta)), 0\} \\ &+ \lambda_{\epsilon}^{21}(\theta) \int_{\underline{w}^2}^{\bar{w}^2} \max\{F^1(w) - F^1(R_{\epsilon+1}^{21}(\chi, \theta)), 0\} dM_{\epsilon}^2(\chi, \theta) \\ &+ \lambda_{\epsilon}^{31}(\theta) m_{\epsilon}^3(\theta) \max\{F^1(w) - F^1(R_{\epsilon+1}^{31}(\theta)), 0\} \\ &+ \lambda_{\epsilon}^{41}(\theta) m_{\epsilon}^4(\theta) \max\{F^1(w) - F^1(R_{\epsilon+1}^{41}(\theta)), 0\} \end{aligned}$$

► Theoretical Framework

# Labor Search

The measure of workers in informal employment state

$$\begin{aligned} M_{\epsilon+1}^2(w, \theta) = & \left[1 - d_{\epsilon}^2(w, \theta)\right] M_{\epsilon}^2(w, \theta) \\ & + \lambda_{\epsilon}^{02}(\theta) u_{\epsilon}(\theta) \max\{F^2(w) - F^2(R_{\epsilon+1}^{02}(\theta)), 0\} \\ & + \lambda_{\epsilon}^{12}(\theta) \int_{\underline{w}^1}^{\bar{w}^1} \max\{F^2(w) - F^2(R_{\epsilon+1}^{12}(\chi, \theta)), 0\} dM_{\epsilon}^1(\chi, \theta) \\ & + \lambda_{\epsilon}^{32}(\theta) m_{\epsilon}^3(\theta) \max\{F^2(w) - F^2(R_{\epsilon+1}^{32}(\theta)), 0\} \\ & + \lambda_{\epsilon}^{42}(\theta) m_{\epsilon}^4(\theta) \max\{F^2(w) - F^2(R_{\epsilon+1}^{42}(\theta)), 0\} \end{aligned}$$

# Labor Search

The measure of workers in self-employment state

$$\begin{aligned} m_{\epsilon+1}^3(\theta) &= [1 - d_{\epsilon}^3(\theta)] m_{\epsilon}^3(\theta) \\ &+ \lambda_{\epsilon}^{03}(\theta) u_{\epsilon}(\theta) 1\{W_{\epsilon+1}^3(\theta) > U_{\epsilon+1}(\theta)\} \\ &+ \lambda_{\epsilon}^{13}(\theta) \int_{\underline{w}^1}^{R_{\epsilon+1}^{31}(\theta)} dM_{\epsilon}^1(\chi, \theta) \\ &+ \lambda_{\epsilon}^{23}(\theta) \int_{\underline{w}^2}^{R_{\epsilon+1}^{32}(\theta)} dM_{\epsilon}^2(\chi, \theta) \\ &+ \lambda_{\epsilon}^{43}(\theta) m_{\epsilon}^4(\theta) 1\{W_{\epsilon+1}^3(\theta) > H_{\epsilon+1}(\theta)\} \end{aligned}$$

# Labor Search

The measure of workers in out of labor force state

$$\begin{aligned} m_{\epsilon+1}^4(\theta) &= [1 - d_{\epsilon}^4(\theta)] m_{\epsilon}^4(\theta) \\ &+ \lambda_{\epsilon}^{04}(\theta) u_{\epsilon}(\theta) 1\{H_{\epsilon+1}(\theta) > U_{\epsilon+1}(\theta)\} \\ &+ \lambda_{\epsilon}^{14}(\theta) \int_{\underline{w}^1}^{R_{\epsilon+1}^{41}(\theta)} dM_{\epsilon}^1(\chi, \theta) \\ &+ \lambda_{\epsilon}^{24}(\theta) \int_{\underline{w}^2}^{R_{\epsilon+1}^{32}(\theta)} dM_{\epsilon}^2(\chi, \theta) \\ &+ \lambda_{\epsilon}^{34}(\theta) m_{\epsilon}^3(\theta) 1\{H_{\epsilon+1}(\theta) > W_{\epsilon+1}^3(\theta)\} \end{aligned}$$

► Theoretical Framework

# Labor Search

## Firms

- Formal firms steady state profit

$$\pi_1(p, w) = (1 - \sigma) \sum_{\epsilon} \sum_{\theta} [p - (1 + \tau + \delta_{\epsilon}^1 s) w] \ell_{\epsilon}^1(w, \theta) \gamma_{\epsilon} q_{\theta}$$

- Informal firms steady state profit

$$\pi_2(p, w) = [p - C - w] \sum_{\epsilon} \sum_{\theta} \ell_{\epsilon}^2(w, \theta) \gamma_{\epsilon} q_{\theta}$$

- With normalized labor size of formal and informal firms equal to:

$$\ell_{\epsilon}^1(w, \theta) = \frac{1}{n_1} \frac{dM_{\epsilon}^1(w, \theta)}{dF^1(w)} \quad \text{and} \quad \ell_{\epsilon}^2(w, \theta) = \frac{1}{n_2} \frac{dM_{\epsilon}^2(w, \theta)}{dF^2(w)}$$

# Retrospective Questions

## Formal Employment

State	Question	Question Code
Formal Employment	¿Have you ever worked for at least two consecutive weeks?	P7430
	¿How long have you been working for the last time? At least for two weeks	P7440
	¿How long have you last looked for a job?	P7456
	¿Have you looked for work for the first time or have you worked before for at least two consecutive weeks?	P7310
	¿How many weeks ago have you stopped working for the last time?	P7320
	¿How many weeks have you been or were you looking for work?	P7250
	¿How long have you been working in this company, business, industry, office, firm or farm continuously?	P6426
	Before the current job, ¿did you have another job?	P7020
	¿How many months were you without a job between your current job and your previous one?	P760

► Transition

# Retrospective Questions

## Unemployment

State	Question	Question Code
Unemployment	¿Have you ever worked for at least two consecutive weeks?	P7430
	¿How long has it been since you last worked?	P7440
	¿How many weeks ago have you stopped working for the last time?	P7320
	In this last job you were:	P7350
	¿How long have you been working in this company, business, industry, office, firm or farm continuously?	P6426
	In your previous job you were:	P7028
	¿How many months were you without a job or job between your current job and your previous one?	P760
	¿How long have you been working in this company, business, industry, office, firm or farm continuously?	P6426
	In this job you are:	P6430

# Retrospective Questions

## Informal Employment

State	Question	Question Code
Informal Employment	¿How many weeks ago have you stopped working for the last time?	P7320
	In this last work it was:	P7350
	¿How long have you been working in this company, business, industry, office, firm or farm?	P6426
	In your previous job you were:	P7028
	¿How many months were you without a job or job between your current job and your previous one?	P760
	In this job you are:	P6430



# Retrospective Questions

## Self-Employment

State	Question	Question Code
Self-Employment	¿How many weeks ago have you stopped working for the last time?	P7320
	In this last work it was:	P7350
	¿How long have you been working in this company, business, industry, office, firm or farm?	P6426
	In your previous job you were:	P7028
	¿How many months were you without a job or job between your current job and your previous one?	P760
	In this job you are:	P6430

# Retrospective Questions

## Out of Labor Force

State	Question	Question Code
Out of Labor Force	¿Have you looked for work for the first time or had you worked before for at least two consecutive weeks?	P7310
	¿How many weeks ago have you stopped working for the last time?	P7320
	¿How many weeks have you been or were you looking for work?	P7250
	¿How long have you been working in this company, business, industry, office, firm or farm continuously?	P6426
	Before the current job, ¿did you have another job?	P7020
	¿How many months were you without a job or job between your current job and your previous one?	P760
	¿How long did have your last work?	P7440

# Bi-proportional Matrix Scaling

- 'Initial' matrix  $Z$  of dimension  $n$  by  $m$  where  $a_{ij} \in \mathbb{R}^+$  and an unknown 'target' matrix  $Z^*$  with the same dimensions and other mathematical properties
- Third matrix  $\tilde{Z}$  not only with the same dimension and mathematical properties as  $Z^*$  but also with the same known margin
- $\sum_{i=1}^n \bar{z}_{ij}^* = \sum_{i=1}^n \tilde{z}_{ij}$  and  $\sum_{j=1}^m \bar{z}_{ij}^* = \sum_{j=1}^m \tilde{z}_{ij}$
- The problem is to obtain a  $\tilde{Z}$  that is as close as possible to  $Z^*$

► Transition

# Transition Rates

- Stock of states: Unemployment ( $U_t$ ), Formal Employment ( $E_t$ ), Informal Employment ( $IE_t$ ), Self-employment ( $S_t$ ), Out of labor force ( $H_t$ )
- Transitions between states or flows
- Matrix Balance
- Transition rates, e.g., Transition Rate from Unemployment to Employment ( $\lambda_t^{UE}$ )

$$\lambda_t^{UE} = \frac{U_{t-1}E_t}{U_{t-1}}$$

# Additional Estimates

RD Estimates of First Job Act for individuals with high school degree or less

Dependent Variable	All	Men	Women
Informality to Formality	-0.0299*** (0.00765)	-0.0642*** (0.0137)	-0.0115 (0.00904)
Unemployment to Formality	-0.00595 (0.0135)	-0.0450 (0.0352)	0.00465 (0.0142)
Inactivity to Formality	0.00999 (0.00537)	0.00353 (0.0167)	0.0130* (0.00629)
Informality to Self-employment	0.00446 (0.00644)	0.0118 (0.0137)	-0.000284 (0.00873)
Unemployment to Self-employment	-0.00191 (0.0162)	0.0282 (0.0260)	-0.00984 (0.0179)
Inactivity to Self-employment	-0.00591 (0.00571)	-0.0151 (0.0148)	-0.00468 (0.00607)
<i>N</i>	204	204	204

# Additional Estimates

RD Estimates of First Job Act for individuals with more than high school degree

Dependent Variable	All	Men	Women
Informality to Formality	-0.00877 (0.0330)	0.0441 (0.0932)	0.00756 (0.0337)
Unemployment to Formality	0.0319** (0.0197)	0.0785* (0.0390)	0.0172* (0.0257)
Inactivity to Formality	-0.00441 (0.0136)	-0.00177 (0.0280)	-0.00632 (0.0148)
Informality to Self-employment	-0.0142 (0.0251)	-0.00176 (0.0444)	-0.0133 (0.0272)
Unemployment to Self-employment	-0.0168** (0.0144)	-0.0170 (0.0274)	-0.0151* (0.0189)
Inactivity to Self-employment	-0.00549 (0.0105)	0.0434 (0.0290)	-0.0167 (0.0125)
<i>N</i>	204	204	204

# Placebo Estimates

## RD estimates of placebo sample

Dependent Variable	All	Men	Women
Informality to Formality	0.00140 (0.00532)	0.00321 (0.0104)	-0.000367 (0.00543)
Unemployment to Formality	-0.0172* (0.00730)	-0.0259 (0.0159)	-0.0152 (0.00851)
Inactivity to Formality	-0.00643 (0.00348)	0.00209 (0.0107)	-0.00500 (0.00373)
Informality to Self-employment	-0.00911 (0.00701)	-0.00897 (0.0128)	-0.00902 (0.00699)
Unemployment to Self-employment	0.00278 (0.0162)	-0.0136 (0.0119)	0.00845 0.00845
Inactivity to Self-employment	-0.00553 (0.00332)	0.00852 (0.00907)	-0.00746 (0.00372)
<i>N</i>	204	204	204