

Non-Contributory Health Insurance and Household Labor Supply: Evidence from Mexico

Gabriella Conti¹ Rita Ginja²
Renata Narita³

¹UCL, IFS

²Uppsala University, UCLS

³University of São Paulo

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Introduction & Motivation

- ▶ Many developed and developing countries are expanding access to near-universal health coverage (US, Peru, Colombia, India, China).
 - ▶ → Cut the link between health insurance provision and employment
 - ▶ → Implicit transfer(tax) to the informal workers/non-employed (formal)
- ▶ What are the consequences for the labor market?
- ▶ Innovation: Focus on the intra-household allocation of labor, instead of individual level decisions
 - ▶ Health Insurance (**HI**) coverage typically is granted to one individual and extended to the other members of the household.

Research Questions

- ▶ We use the case of Mexico to understand the mechanisms behind labor market movements associated to implementation of universal HI
 - ▶ Non-contributory health insurance introduced in 2002 (**Seguro Popular**)
 - ▶ → How much of the increase in informality in Mexico is due to the introduction of non-contributory HI?
 - Household level perspective: joint decision of head + spouse
 - ▶ → Do families value job amenities as access to health care services when taking labor market decisions?
 - ▶ → What are the welfare impacts of changing the benefits of non-contributory health insurance?
 - Previously not studied in the context of health insurance reforms in developing countries

Preview

We analyze the effects of non-contributory HI on the labor market choices of heads of household and their spouse

- ▶ Reduced Form:
 - ▶ increases informality among low educated families with children by 3%
 - ▶ decrease in salaries among low educated males
- ▶ We estimate a **household** labor market model with search frictions where head & spouse can be:
 - ▶ *non-employed*
 - ▶ working on *formal* sector
 - ▶ working on *informal* sector
- ▶ We recover the *willingness to pay for HI outside the formal sector*
 - ▶ **Before 2002:** non-employed and informal sector workers pay for health care.
 - ▶ **After 2002:** non-employed and informal sector workers are entitled to **public HI**.
- ▶ Counterfactual simulations: increasing generosity of SP would have been needed to be associated with larger impacts on informality

Outline

- ▶ Background
- ▶ Basic Facts: Reduced Form Estimates
- ▶ Structural Model
- ▶ Results and simulations
- ▶ (Preliminary) Conclusions

Some Literature

► Structural/Theory

- Dey and Flinn (2008), Fang and Shephard (2015): household search model with health insurance (EP, EP+ACA)
 - Aizawa and Fang (2013): labor market search model + health shocks
- Albrecht, Navarro and Vroman, (2009), Meghir, Narita and Robin (2015): formal and informal sectors
- Finkelstein, Hendren and Luttmer (2015): welfare benefit to recipients per dollar of government spending in Medicaid

► Effects of the Mexican Health Reform on labor market Literature

- **Increase/no** impacts on informality and wages

Background: The Mexican Health Reform

- ▶ Mexico before Seguro Popular (2002)
 - ▶ 50% of population: employed in formal sector received coverage through the Social Security Institutions
 - ▶ 50% of population: informal or nonemployed used public health services run by the Ministry Health of or private clinics/hospitals.
 - fee required for most services
 - in 2000 50% of health expenditures were "out-of-pocket"
- ▶ In 2002 Seguro Popular launched as pilot in 5 states and officially implemented in 2004
 - ▶ 2012: Full-coverage
 - ▶ Eligibility: Anyone **not covered** by Social Security (IMSS, ISSSTE, PEMEX...)
 - ▶ Household coverage

Data

Data: ENE 2000-2004 (Encuesta Nacional de Empleo) and ENOE 2005-2012 (Encuesta Nacional de Ocupacion y Empleo)

- ▶ Rotating panel: individual (and its family) surveyed for 5 consecutive quarters → We focus on the first 2 surveys for each individual.
- ▶ Sample of around 600 municipalities surveyed since 2000.
- ▶ Couples where the head is 20-59 years old (78% of individuals are married).
- ▶ 2 groups of education: Low (head has at most 6 years of education) vs. High.

Basic Descriptives of the Data

	High Education		Low Education	
	2001	2007	2001	2007
Informal Households	0.360	0.356	0.625	0.656
Head Formal-Spouse Formal (FF)	0.157	0.162	0.043	0.036
Head Formal-Spouse Informal (FI)	0.077	0.105	0.053	0.067
Head Formal-Spouse Not Working (FN)	0.334	0.298	0.238	0.198
Head Informal-Spouse Formal (IF)	0.063	0.067	0.036	0.036
Head Not Working-Spouse Formal (NF)	0.008	0.011	0.006	0.007
Head Informal-Spouse Informal (II)	0.106	0.124	0.160	0.199
Head Informal-Spouse Not Working (IN)	0.223	0.198	0.402	0.394
Head Not Working-Spouse Informal (NI)	0.006	0.009	0.016	0.017
Head Not Working-Spouse Not Working (NN)	0.025	0.025	0.047	0.046
<i>Mean Log wages: Formal Sector</i>				
Head	9.079	8.544	8.962	8.786
Spouse	8.484	8.130	8.328	8.169
<i>Mean Log wages: Informal Sector</i>				
Head	8.859	7.935	8.554	7.826
Spouse	6.916	6.605	6.326	6.376

Basic Facts: Reduced Form

- ▶ What is the impact on informality of **implementing SP** in the municipality of residence?
 - ▶ Use information about the *exact* date of affiliation from the official registry of SP beneficiaries (*Padrón*).
 - A municipality has access to SP when (at least) 10 families are affiliated to the program.
 - ▶ Difference-in-differences strategy: we exploit the spatial and temporal variation of the rollout of SP
 - ▶ Differential impact of SP by the presence of children
 - **SS** coverage is extended to children in household
 - **SP** coverage is very generous for medical conditions associated to poor children

Figure 1: Temporal variation

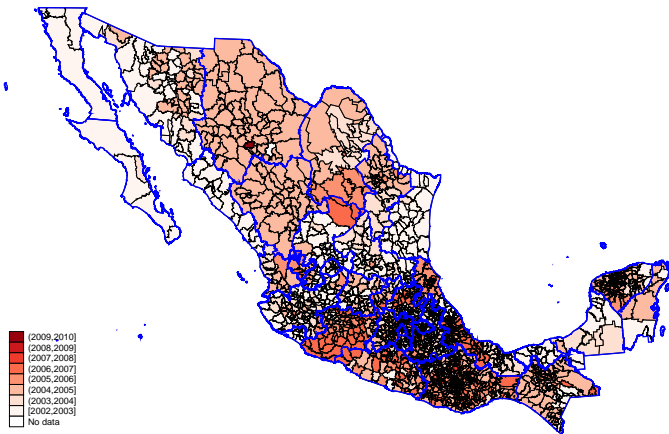


Table 1: Reduced Form Estimates: the dependent variable is the share of informal households by municipality-quarter (without Social Security).

	(1)	(2)	(3)	(4)
	Low Education		High Education	
	No Children	Children	No Children	Children
SP	-0.007 (0.018)	0.022** (0.010)	0.001 (0.027)	0.008 (0.011)

Note: Estimates obtained using the ENE/ENEO data. Controls excluded from table include: the share of households in each municipality-quarter by education group, age of the head, locality size, municipality fixed effects, state-year trend, quarter fixed effects, and a linear trend in characteristics of the municipality of residence taken in 2000 (quadratic in the index of deprivation, log of total population, share of uninsured individuals, share of occupied individuals in the primary, secondary and tertiary sectors; the number of hospitals and health centers in 2001, total number of doctors and nurses in hospitals per 1,000 uninsured individuals in 2001).

Standard errors clustered by municipality. *** Significant at 1%, ** Significant at 5%, * Significant at 10%.

Table 2: Reduced Form Estimates: the dependent variable is the log salary.

	(1) Head Informal	(2) Formal	(3) Spouse Informal	(4) Formal
Panel A: Low Education				
SP	-0.228*** (0.054)	-0.057 (0.075)	-0.105 (0.096)	-0.047 (0.110)
Mean 2001	3920	6835	380	5790
Panel B: High Education				
SP	-0.133* (0.069)	-0.003 (0.073)	-0.271** (0.106)	0.062 (0.104)
Mean 2001	5641	7715	549	5664

Note: Estimates obtained using the ENE/ENEO data. Controls excluded from table include: the share of households in each municipality-quarter by education group, age of the head, locality size, municipality fixed effects, state-year trend, quarter fixed effects, and a linear trend in characteristics of the municipality of residence taken in 2000 (quadratic in the index of deprivation, log of total population, share of uninsured individuals, share of occupied individuals in the primary, secondary and tertiary sectors; the number of hospitals and health centers in 2001, total number of doctors and nurses in hospitals per 1,000 uninsured individuals in 2001).

Standard errors clustered by municipality. *** Significant at 1%, ** Significant at 5%, * Significant at 10%.

The model

- ▶ Frictional labor market and workers receive job offers when both employed and non-employed.
- ▶ Job offers can be **formal or informal** and are characterized by a wage rate. If formal the individual (and the couple) will have social security coverage.
- ▶ The acceptance of an offer depends upon the state of the spouse.
- ▶ Model is estimated for 8 groups
 - ▶ poverty of area of residence (north vs. south)
 - ▶ presence of children <15
 - ▶ education of head: low vs. high
 - ▶ before vs. after SP: to recover value of SP
- ▶ Time unit: quarter.

The Model: Definitions

- ▶ The instant utility by type of household is given by:
 - ▶ $u = w_1(j) + w_2(j) + a * 1(\text{any } j = \text{formal}) + \gamma * 1(\text{all } j \neq \text{formal})$, if both spouse 1 and 2 work
 - ▶ $u = w_1(j) + b_2 + a * 1(j = \text{formal}) + \gamma * 1(j \neq \text{formal})$, if only the spouse 1 works
 - ▶ $u = b_1 + w_2(j) + a * 1(j = \text{formal}) + \gamma * 1(j \neq \text{formal})$, if only the spouse 2 works
 - ▶ $u = b_1 + b_2 + \gamma$, if neither works
 - w in the formal sector is after tax wage (but before social security contributions)
 - w in the informal sector is the gross wage.
 - b non-labor income
- ▶ Head (1) and spouse (2) face mutually exclusive shocks, $\delta_k^{sj}(\cdot)$, $k = f, i, j = 1, 2$.
- ▶ $\lambda_{kk'}(\cdot)$ is the probability of transition from sector k to k' and $k, k' = f, i$
- ▶ If the employed spouse loses job, an offer may be created in the informal sector for the nonemployed spouse
- ▶ a captures all amenities in the formal sector relative to the informal sector, except for HI by SP
- ▶ γ value of HI by SP

Workers' Value Functions

F_k $k = f, i$ is the (empirical) distribution of wages accepted by the non-employed.

► Formal

- W_{fn}
- W_{nf}
- W_{ff}
- W_{fi}
- W_{if}

► Informal

- W_{in}
- W_{ii}
- W_{ni}
- W_{nn}

ValueFunctions

Workers' Value Functions

► One is working: in the formal sector

$$\begin{aligned}
 rW_{fn}(w_1) = & w_1 + b_2 + a + \delta_f^{s_1}(1 - p^{s_2})(W_{nn} - W_{fn}(w_1)) + \\
 & \delta_f^{s_1} p^{s_2} \int \max \{W_{ni}(x) - W_{fn}(w_1), 0\} dF_i^{s_2}(x) + \\
 & \lambda_{ff}^{s_1} \int \max \{W_{fn}(x) - W_{fn}(w_1), 0\} dF_f^{s_1}(x) + \\
 & \lambda_{fi}^{s_1} \int \max \{W_{in}(x) - W_{fn}(w_1), 0\} dF_i^{s_1}(x) + \\
 & \lambda_{nf}^{s_2} \int \max \{W_{ff}(w_1, x) - W_{fn}(w_1), W_{nf}(x) - W_{fn}(w_1), 0\} dF_f^{s_2}(x) + \\
 & \lambda_{ni}^{s_2} \int \max \{W_{fi}(w_1, x) - W_{fn}(w_1), 0\} dF_i^{s_2}(x)
 \end{aligned}$$

where $p^{s_2} = \Pr[\text{spouse 2 } N \rightarrow I \mid \text{spouse 1 } F \rightarrow N]$.

Workers' Value Functions

► One is working: in the formal sector

$$rW_{fn}(w_1) = w_1 + b_2 + a + \delta_f^{s_1}(1 - p^{s_2}) \underbrace{(W_{nn} - W_{fn}(w_1))}_{\text{No offer to spouse}} +$$

$$\underbrace{\delta_f^{s_1} p^{s_2} \int \max \{W_{ni}(x) - W_{fn}(w_1), 0\} dF_i^{s_2}(x)}_{\text{Spouse may decide to be informal}} +$$

$$\lambda_{ff}^{s_1} \int \max \{W_{fn}(x) - W_{fn}(w_1), 0\} dF_f^{s_1}(x) +$$

$$\lambda_{fi}^{s_1} \int \max \{W_{in}(x) - W_{fn}(w_1), 0\} dF_i^{s_1}(x) +$$

$$\lambda_{nf}^{s_2} \int \max \{W_{ff}(w_1, x) - W_{fn}(w_1), W_{nf}(x) - W_{fn}(w_1), 0\} dF_f^{s_2}(x) +$$

$$\lambda_{ni}^{s_2} \int \max \{W_{fi}(w_1, x) - W_{fn}(w_1), 0\} dF_i^{s_2}(x)$$

where $p^{s_2} = \Pr[\text{spouse 2 receive offer to } N \rightarrow I \mid \text{spouse 1 } F \rightarrow N]$.

Workers' Value Functions

► One is working: in the formal sector

$$\begin{aligned}
 rW_{fn}(w_1) = & w_1 + b_2 + a + \delta_f^{s_1}(1 - p^{s_2})(W_{nn} - W_{fn}(w_1)) + \\
 & \delta_f^{s_1} p^{s_2} \int \max \{W_{ni}(x) - W_{fn}(w_1), 0\} dF_i^{s_2}(x) + \\
 & \lambda_{ff}^{s_1} \int \underbrace{\max \{W_{fn}(x) - W_{fn}(w_1), 0\}}_0 dF_f^{s_1}(x) + \\
 & \lambda_{fi}^{s_1} \int \underbrace{\max \{W_{in}(x) - W_{fn}(w_1), 0\}}_{\text{Head may become informal}} dF_i^{s_1}(x) + \\
 & \lambda_{nf}^{s_2} \int \underbrace{\max \{W_{ff}(w_1, x) - W_{fn}(w_1), W_{nf}(x) - W_{fn}(w_1), 0\}}_{\text{Spouse maybe become formal}} dF_f^{s_2}(x) + \\
 & \lambda_{ni}^{s_2} \int \underbrace{\max \{W_{fi}(w_1, x) - W_{fn}(w_1), 0\}}_{\text{Spouse gets informal offer}} dF_i^{s_2}(x)
 \end{aligned}$$

where $p^{s_2} = \Pr[\text{spouse 2 } N \rightarrow I \mid \text{spouse 1 } F \rightarrow N]$.

Workers' Value Functions

► One is working: in the informal sector

$$\begin{aligned}
 rW_{in}(w_1) = & w_1 + b_2 + \gamma + \delta_i^{s_1}(1 - q^{s_2})(W_{nn} - W_{in}(w_1)) + \\
 & \delta_i^{s_1} q^{s_2} \int \max \{W_{ni}(x) - W_{in}(w_1), 0\} dF_i^{s_2}(x) + \\
 & \lambda_{ij}^{s_1} \int \max \{W_{in}(x) - W_{in}(w_1), 0\} dF_i^{s_1}(x) + \\
 & \lambda_{if}^{s_1} \int \max \{W_{fn}(x) - W_{in}(w_1), 0\} dF_f^{s_1}(x) + \\
 & \lambda_{nf}^{s_2} \int \max \{W_{if}(w_1, x) - W_{in}(w_1), W_{nf}(x) - W_{in}(w_1), 0\} dF_f^{s_2}(x) + \\
 & \lambda_{ni}^{s_2} \int \max \{W_{ii}(w_1, x) - W_{in}(w_1), 0\} dF_i^{s_2}(x)
 \end{aligned}$$

where $q^{s_2} = \Pr[\text{spouse 2 } N \rightarrow I \mid \text{spouse 1 } I \rightarrow N]$.

- Value functions $W_{nf}(w_2)$ and $W_{ni}(w_2)$ are similar and, they only exchange status between spouses 1 (head) and 2 (spouse).

Identification: Value of Leisure, of Formal and Informal Sectors

- ▶ Value functions are increasing functions of $w \rightarrow$ one reservation wage for each choice
- ▶ Workers' Flow Conditions: equate **flows out** of each sector to **flows into** the sector.
- ▶ Then, **value of leisure**: strong monopsony power for the low wage earners
 - ▶ $b_1 \Rightarrow \min(W_{in}) = W_{nn}$
 - ▶ $b_2 \Rightarrow \min(W_{ni}) = W_{nn}$.
- ▶ Value of Formal and Informal Sectors ("Diff-in-Diff")
 - ▶ Using data pre-Seguro Popular (under $\gamma = 0$), we identify a

$$W_{ni}(\underline{w}^{t=0}) = W_{nf}(\underline{w}^{t=0}),$$

- ▶ Given a and using data after the implementation of SP, we identify γ

$$W_{ni}(\underline{w}^{t=1}) = W_{nf}(\underline{w}^{t=1}).$$

Estimation

We use a fixed-point solution to estimate

$$\Theta = (F_f^{s1}, F_i^{s1}, \lambda_{if}^{s1}, \lambda_{fi}^{s1}, \lambda_{ni}^{s1}, \lambda_{nf}^{s1}, \delta_i^{s1}, \delta_f^{s1}, q^{s1}, p^{s1}, b_1, \\ F_f^{s2}, F_i^{s2}, \lambda_{if}^{s2}, \lambda_{fi}^{s2}, \lambda_{ni}^{s2}, \lambda_{nf}^{s2}, \delta_i^{s2}, \delta_f^{s2}, q^{s2}, p^{s2}, b_2, a, \gamma).$$

- ▶ 2-Steps Estimation
- ▶ The F_f and F_i are obtained nonparametrically from the data on the wages accepted by the non-employed.
- ▶ Then, given F-distribution and an initial guess for all the unknowns we solve the model for
 - ▶ value of leisure ($b, 2$), marginal willingness to pay (a, γ)
 - ▶ measure of couples in any joint state
 - ▶ for the transitions parameters ($\lambda, 20$)

Details

Table 3: Model Fit: Stocks.

Region Education Children 0-14	(1)	(2)			(3)	(4)
	South				North	
	Low Yes				High No	
	Data	Model			Data	Model
Stocks						
m_{ff}	0.017	0.010			0.160	0.086
m_{fi}	0.041	0.019			0.071	0.050
m_{fn}	0.157	0.126			0.294	0.325
m_{if}	0.021	0.075			0.066	0.095
m_{nf}	0.003	0.020			0.016	0.049
m_{ij}	0.207	0.184			0.104	0.060
m_{in}	0.507	0.474			0.201	0.173
m_{ni}	0.015	0.042			0.012	0.041
m_{nn}	0.031	0.049			0.077	0.121

Table 4: Model Fit: Wages.

Region Education Children 0-14	(1)	(2)	(3)	(4)
	South Low Yes		North High No	
	Data	Model	Data	Model
Formal wage: head				
P10	8.778	9.652	9.284	9.590
P25	9.069	10.040	9.590	9.998
P75	9.652	10.720	10.509	10.917
P90	9.943	11.109	11.019	11.529
Informal wage: head				
P10	7.498	8.474	9.148	9.148
P25	8.474	9.032	9.457	9.664
P75	9.450	9.729	10.593	10.696
P90	9.868	10.426	11.212	11.315
Formal wage: spouse				
P10	8.762	8.822	9.111	9.281
P25	8.943	9.063	9.451	9.535
P75	9.546	9.666	10.214	10.299
P90	9.968	9.968	10.638	10.723
Informal wage: spouse				
P10	6.949	7.083	8.240	8.240
P25	7.755	7.889	8.748	8.875
P75	8.830	9.234	9.891	10.145
P90	9.234	9.771	10.526	10.653

Table 5: Model Estimates: marginal willingness to pay to be in formal and informal sectors and value of leisure.

	(1)	(2)	(3)	(4)
Education	Low		High	
Children 0-14	Yes	No	Yes	No
Panel A: South				
$\frac{b_1}{w_i^{head}}$	0.025	0.036	0.087	0.089
$\frac{b_2}{w_i^{spouse}}$	0.036	0.046	0.059	0.067
$\frac{a}{w_i^{spouse}}$	-0.544	-0.497	-0.253	-0.195
$\frac{\gamma}{w_i^{spouse}}$	0.013	0.035	0.029	0.027
Panel B: North				
$\frac{b_1}{w_i^{head}}$	0.066	0.058	0.171	0.126
$\frac{b_2}{w_i^{spouse}}$	0.067	0.069	0.069	0.073
$\frac{a}{w_i^{spouse}}$	-0.395	-0.421	-0.202	-0.162
$\frac{\gamma}{w_i^{spouse}}$	0.030	0.042	0.029	0.021

Table 6: Estimated transition rates.

	(1)	(2)	(3)	(4)
Education high Children 0-14 Region	Low Yes South		High No North	
	Head	Spouse	Head	Spouse
δ_f	0.024	0.134	0.027	0.113
δ_i	0.037	0.450	0.075	0.359
λ_{nf}	0.146	0.031	0.139	0.062
λ_{ni}	1.033	1.067	0.289	0.234
λ_{fi}	4.878	0.644	0.788	0.348
λ_{if}	0.066	0.059	0.209	0.161
p	1.000	1.000	0.360	1.000
q	0.123	1.000	0.077	0.535

Table 7: Counterfactual Experiment: Changing willingness to pay to have HI outside the formal sector (γ).

	South, Low Educ, Children			North, High Educ, No Children		
	$\hat{\gamma}$	$5 \times \hat{\gamma}$	$10 \times \hat{\gamma}$	$\hat{\gamma}$	$5 \times \hat{\gamma}$	$10 \times \hat{\gamma}$
Stocks						
FF	-0.01	-0.08	-0.15	-0.10	-0.54	-1.12
FI	0.00	-0.07	-0.31	-0.05	-0.20	-0.44
FN	0.00	-0.60	-0.85	0.10	0.08	-0.19
IF	-0.09	-0.41	-0.83	-0.13	-0.53	-1.10
NF	-0.01	-0.03	-0.03	-0.04	-0.15	-0.18
II	0.06	0.46	-0.79	0.10	0.43	0.92
IN	0.05	0.66	3.53	0.14	0.96	2.21
NI	0.00	0.03	-0.18	0.00	0.06	0.14
NN	0.00	0.03	-0.39	-0.03	-0.11	-0.24
Mean Wage of Head: Formal Sector	0.05	2.89	4.46	0.00	0.02	0.05
Mean Wage of Head: Informal Sector	-0.07	-2.93	-3.97	0.00	-0.03	-0.06
Mean Wage of Spouse: Formal Sector	0.35	1.66	3.09	0.01	0.03	0.06
Mean Wage of Spouse: Informal Sector	-0.01	0.00	0.93	0.00	-0.01	-0.02
Total Welfare (%)	0.38	0.22	2.08	0.27	1.55	3.32
Welfare per sector: head %						
formal sector	0.06	3.29	5.13	0.22	2.26	5.63
informal sector	0.50	0.02	1.91	0.67	2.44	4.61
nonemployment	0.54	0.21	5.92	0.25	0.94	1.47
Welfare per sector: spouse %						
formal sector	0.47	1.69	3.77	0.28	1.51	2.97
informal sector	0.58	2.25	4.51	0.39	1.66	3.23
nonemployment	0.31	-0.25	-0.20	0.10	0.87	2.09

Table 8: Counterfactual Experiment: Changing willingness to pay to have HI outside the formal sector (γ).

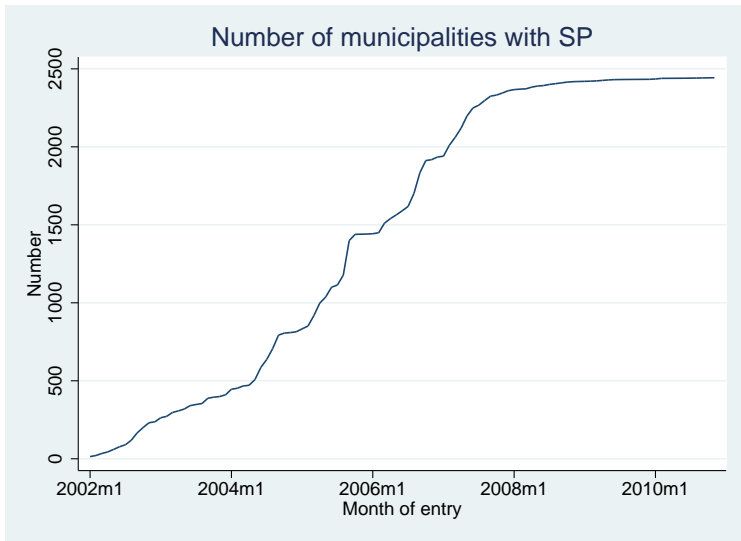
	South, Low Educ, Children $10 \times \hat{\gamma}$	North, High Educ, No Children $10 \times \hat{\gamma}$
Transitions: Head		
Nonemployment-Formal	-0.08	-0.04
Nonemployment-Informal	-0.04	0.28
Formal-Nonemployment	-0.02	-0.02
Formal-Informal	0.37	0.79
Informal-Nonemployment	0.00	0.00
Informal-Formal	0.03	0.02
Nonemployment-Informal, if spouse loses formal job	-0.68	0.37
Nonemployment-Informal, if spouse loses informal job	0.05	0.13
Transitions: Spouse		
Nonemployment-Formal	-0.11	-0.25
Nonemployment-Informal	-1.70	-0.28
Formal-Nonemployment	-0.09	-0.04
Formal-Informal	1.50	0.81
Informal-Nonemployment	0.06	0.13
Informal-Formal	-0.29	-0.79
Nonemployment-Informal, if head loses formal job	-11.49	-2.29
Nonemployment-Informal, if head loses informal job	-9.74	0.01

Conclusions (for now)

- ▶ First joint-labor supply model for households accounting for informality → 50% of the households in developing/middle-income countries.
- ▶ Application: Mexico.
- ▶ The data shows that SP has impacts on the labor market choices of household members:
 - ▶ increase of informality
 - ▶ low educated males switch from formal to informal sector
- ▶ **Structural model:** estimates show that low educated families with young children value more being outside the formal sector before SP.
 - ▶ The *marginal willingness for SP* is small relative to earnings
- ▶ On-going
 - ▶ Account for local provision of preschool for formal and informal sector moms.

Appendix

Figure 2: Enrollment overtime



► Evidence is mixed

- **Informality:** No impact (Gallardo-Garca, 2006; Barros, 2011; Campos and Knox, 2010, Aguilera, 2011, ...) to small increases in the share of informality for low education, married with children or older adults (Azuara and Marinescu, 2010, Aterido et al 2010, Bosch and Cobacho, 2011, Bosch and Campos, 2014)
- **Unemployment/OLF:** Reduction on flow out of unemployment/OLF (Aterido et al, 2010), and women in families with disable/dependent people reduce unemployment/inactivity to become informal workers (del Valle, 2014)
- **Wages:** No effect (Barros, 2009, Azuara and Marinescu, 2010) or negative impact on informal wages (Aterido et al, 2010, Pérez-Estrada, 2011)

back

Workers' Value Functions: Both work

► In the formal sector

$$\begin{aligned}
 rW_{ff}(w_1, w_2) = & w_1 + w_2 + a + \delta_f^{s_1} (W_{nf}(w_2) - W_{ff}(w_1, w_2)) + \delta_f^{s_2} (W_{fn}(w_1) - W_{ff}(w_1, w_2)) + \\
 & \lambda_{ff}^{s_1} \int \max \{ W_{ff}(x, w_2) - W_{ff}(w_1, w_2), 0 \} dF_f^{s_1}(x) + \lambda_{fi}^{s_1} \int \max \{ W_{if}(x, w_2) - W_{ff}(w_1, w_2), 0 \} dF_i^{s_1}(x) + \\
 & \lambda_{ff}^{s_2} \int \max \{ W_{ff}(w_1, x) - W_{ff}(w_1, w_2), 0 \} dF_f^{s_2}(x) + \lambda_{fi}^{s_2} \int \max \{ W_{fi}(w_1, x) - W_{ff}(w_1, w_2), 0 \} dF_i^{s_2}(x)
 \end{aligned}$$

► formal and informal sector (W_{fi} and W_{if})

$$\begin{aligned}
 rW_{fi}(w_1, w_2) = & w_1 + w_2 + a + \delta_f^{s_1} (W_{ni}(w_2) - W_{fi}(w_1, w_2)) + \delta_i^{s_2} (W_{fn}(w_1) - W_{fi}(w_1, w_2)) + \\
 & \lambda_{ff}^{s_1} \int \max \{ W_{fi}(x, w_2) - W_{fi}(w_1, w_2), 0 \} dF_f^{s_1}(x) + \lambda_{fi}^{s_1} \int \max \{ W_{ii}(x, w_2) - W_{fi}(w_1, w_2), 0 \} dF_i^{s_1}(x) + \\
 & \lambda_{ii}^{s_2} \int \max \{ W_{fi}(w_1, x) - W_{fi}(w_1, w_2), 0 \} dF_i^{s_2}(x) + \\
 & \lambda_{if}^{s_2} \int \max \{ W_{ff}(w_1, x) - W_{fi}(w_1, w_2), W_{nf}(x) - W_{fi}(w_1, w_2), 0 \} dF_f^{s_2}(x)
 \end{aligned}$$

► Both work: in the informal sector

$$\begin{aligned}
 rW_{ii}(w_1, w_2) = & w_1 + w_2 + \gamma + \delta_i^{s1} (W_{ni}(w_2) - W_{ii}(w_1, w_2)) + \\
 & \delta_i^{s2} (W_{in}(w_1) - W_{ii}(w_1, w_2)) + \\
 & \lambda_{ii}^{s1} \int \max \{ W_{ii}(x, w_2) - W_{ii}(w_1, w_2), 0 \} dF_i^{s1}(x) + \\
 & \lambda_{if}^{s1} \int \max \{ W_{fi}(x, w_2) - W_{ii}(w_1, w_2), W_{fn}(x) - W_{ii}(w_1, w_2), 0 \} dF_f^{s1}(x) + \\
 & \lambda_{ii}^{s2} \int \max \{ W_{ii}(w_1, x) - W_{ii}(w_1, w_2), 0 \} dF_i^{s2}(x) + \\
 & \lambda_{if}^{s2} \int \max \{ W_{if}(w_1, x) - W_{ii}(w_1, w_2), W_{nf}(x) - W_{ii}(w_1, w_2), 0 \} dF_f^{s2}(x)
 \end{aligned}$$

► Neither works

$$\begin{aligned}
 rW_{nn} = & b_1 + b_2 + \gamma + \\
 & \lambda_{nf}^{s_1} \int \max \{W_{fn}(x) - W_{nn}, 0\} dF_f^{s_1}(x) + \\
 & \lambda_{ni}^{s_1} \int \max \{W_{in}(x) - W_{nn}, 0\} dF_i^{s_1}(x) + \\
 & \lambda_{nf}^{s_2} \int \max \{W_{fn}(x) - W_{nn}, 0\} dF_f^{s_2}(x) + \\
 & \lambda_{ni}^{s_2} \int \max \{W_{in}(x) - W_{nn}, 0\} dF_i^{s_2}(x)
 \end{aligned}$$

back

- ▶ Solve the model for distributions of offered wages, transition parameters, b and γ , using a fixed point solution.
 - ▶ F_f and F_i distributions are obtained from the data on the wages accepted by the nonemployed.
 - ▶ Given the F distributions and an initial guess for the transition parameters, the value of leisure, the marginal willingness to pay parameters, for $\frac{m_f}{m_n} G_f$ and $\frac{m_i}{m_n} G_i$, and for the minimum and maximum support for each value function:
 - ① We interpolate the minimum and maximum support of the value functions.
 - ② We calculate the reservation wages using the value functions.
 - ③ Given F_f and F_i distributions, transition rates, value of leisure, a , and γ , we solve $\frac{m_f}{m_n} G_f(w)$ and $\frac{m_i}{m_n} G_i(w)$ using the flow equations.
 - ④ Update the b , a and γ using the identifying restrictions.
 - ⑤ Update the value functions.
 - ⑥ Update the transition parameters using the transition moments we construct and match to the data.
 - ⑦ Update $\frac{m_f}{m_n} G_f$ and $\frac{m_i}{m_n} G_i$.