On the Role of Structural Transformation in Demographic Change: Evidence from Multi-Generation Tracking Survey in the Philippines

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Outline

- Research Questions and Preview
- Identification Strategy
- Data
- Analysis
- Concluding Remarks

What we do

- **Questions:**
  - How has the former agrarian villages been transformed in the past four decades?
  - What was the role of enhanced connectivity and industrialization on demographic transition of the population?
  - Specifically, how does the eldest child's occupation affect the parent's survival rate?
- **Research Framework:**
  - Treatments: Infrastructure investments (SLEx opened in 1977) and industrialization (Laguna Techno Park and other industrial parks)
  - Outcomes: Parent's survival (whether father is alive or not)
  - Data: hybrid of three datasets (1) long-term household panel data, (2) satellite imageries, and (3) administrative data about school opening

What We Found

- Higher exposure to newly constructed highway and industrial estates has led to extended longevity of the male heads with the eldest child whose primary occupation is manufacturing
- Structural transformation affects not only directly to the younger generations through occupational choice but also indirectly to their parents' generations presumably through resource transfer or better cares by the children's generations

Contribution

- Transformation of an economy from agriculture to industrialization and then services has been considered as the key driver of successful long-term economic development (Lewis, 1955; Ranis and Fei, 1961Hayami and Ruttan, 1985; Matsuyama, 1992; Duarte and Restuccia, 2010)
- Demographic transition from a phase of high fertility and high mortality to a low birth and low death phase has been observed among high income economies (Bloom and Canning, 2004; Caldwell, 1981; Richerson, et al., 2009; Miles, 1999)
- Structural transformation changes fertility (Ager et al., 2020)
- No study for the nexus between structural transformation and demographic change using micro data

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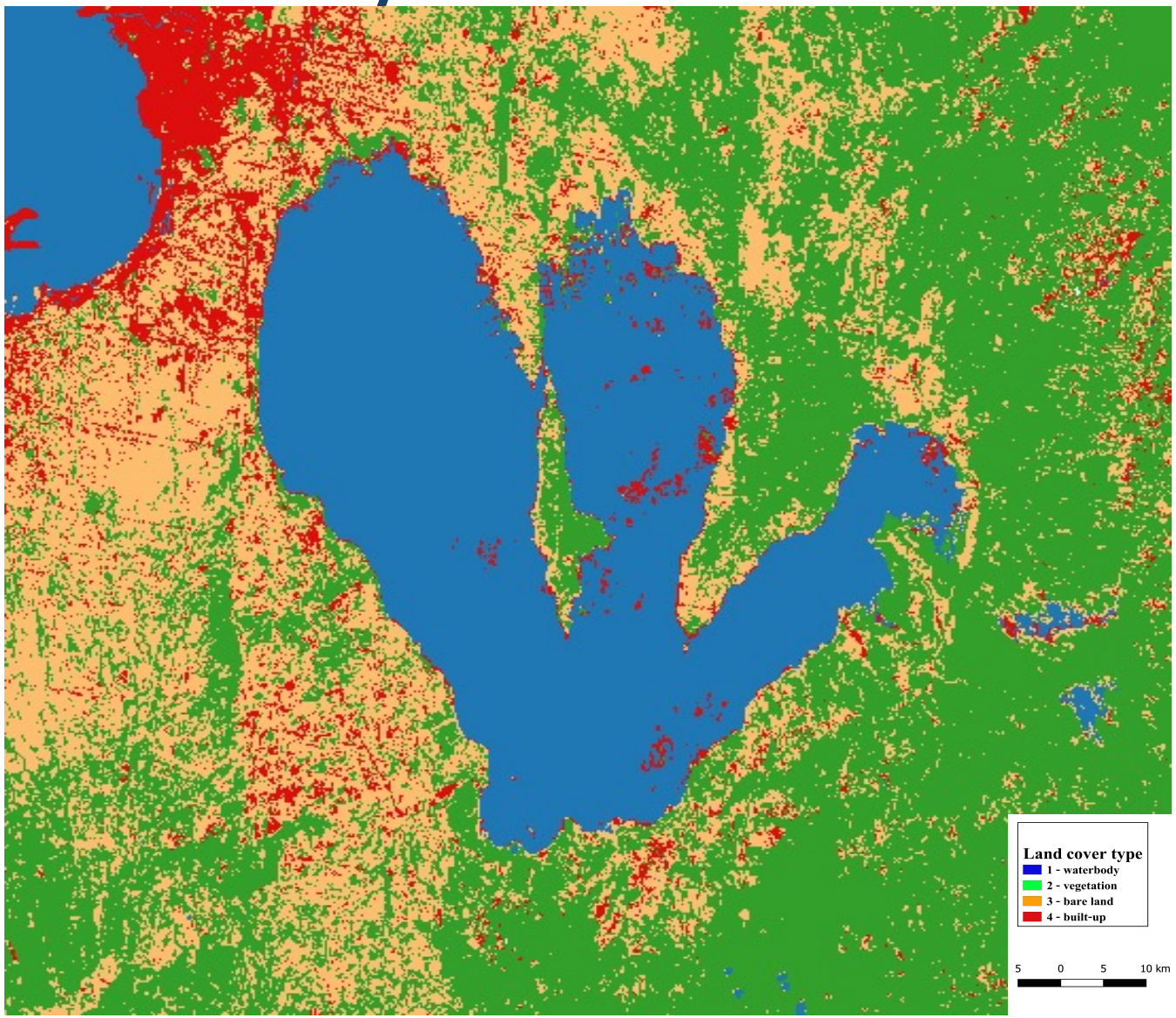
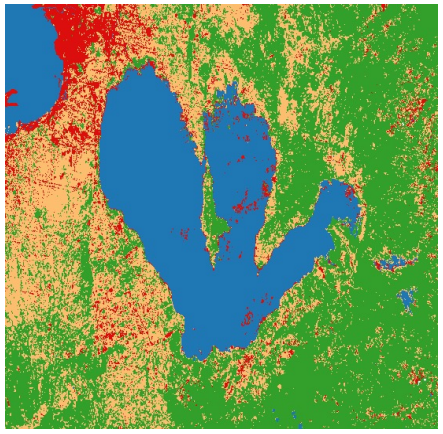
Our Study Area in 1976



- **Laguna Province:**
  - Third-biggest province in the Philippines
  - More than 3 million residents being located to the south of Manila.
- **Lake Laguna:**
  - The largest freshwater lake
  - Allows agriculture and fishery to develop in the villages nearby the lake.
- **A unique setting to study industrialization**
  - In 1976, fairly even-distribution of development between the west and the east (Landsat)
  - After 1978, the west connected better by a highway and gained by industrial parks
  - School openings throughout

Our Study Area in 1976-2016

<1976>



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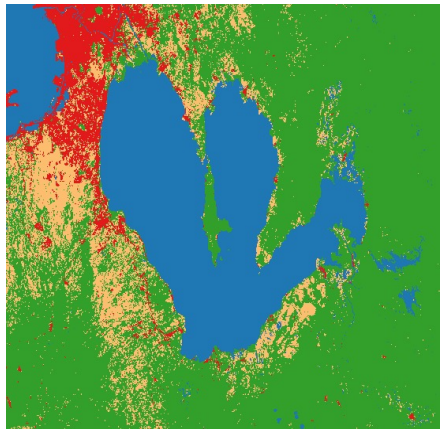

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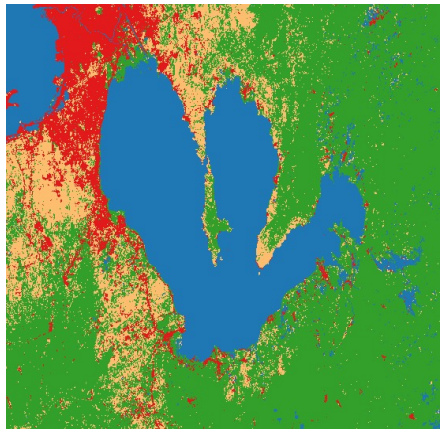

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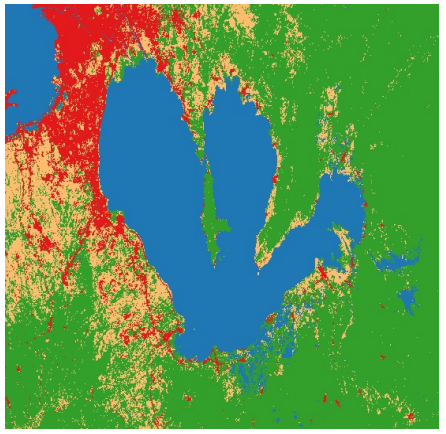

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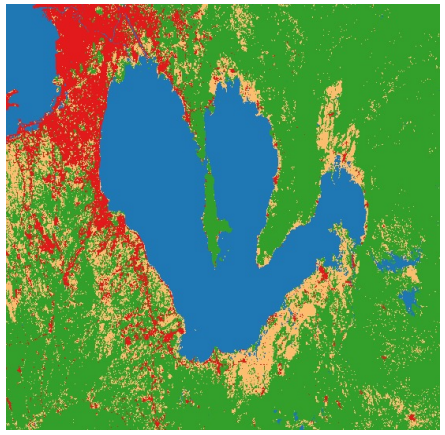

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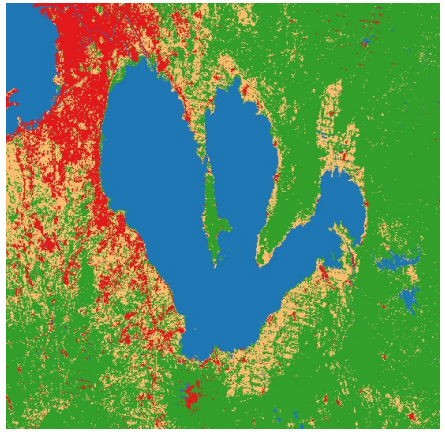

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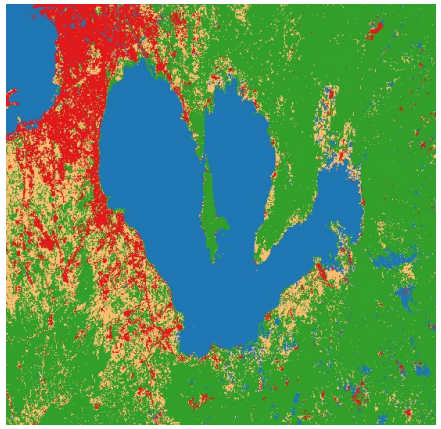

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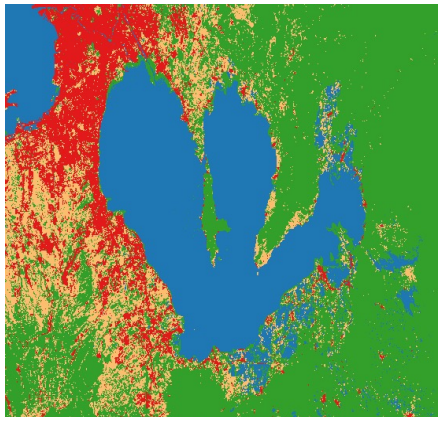
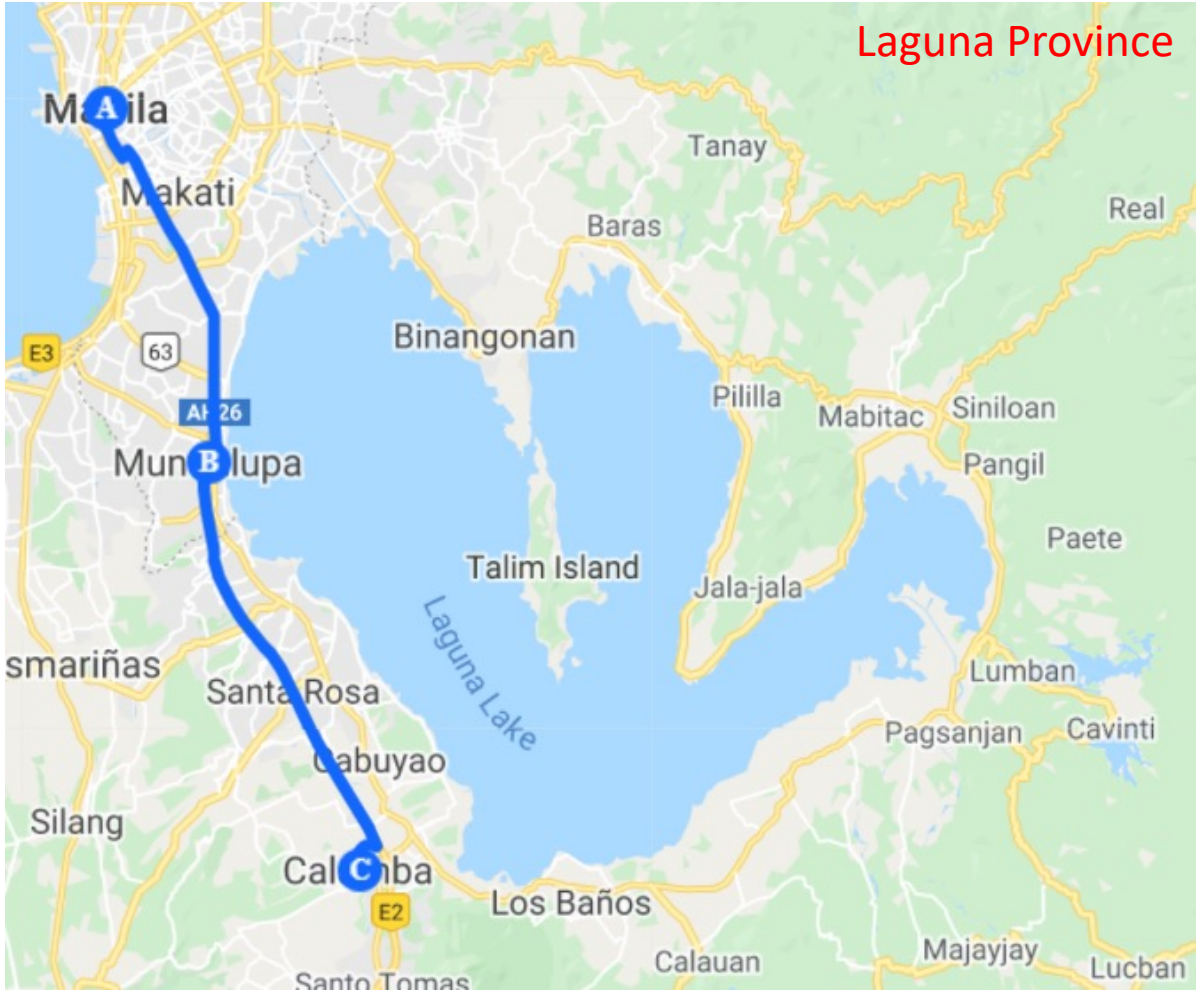


- Data: LANDSAT Satellite Imagery from 1970s to 2010s
- Pixel size: 269m*269m
- Events:
  - Before SLEx: 1976
  - After SLEx/Before Technopark: 1989
  - After Technopark: 1992
  - Survey: 2016
- All the imageries are combined imageries of those in dry season and wet season

Transport Infrastructure in the late 1970

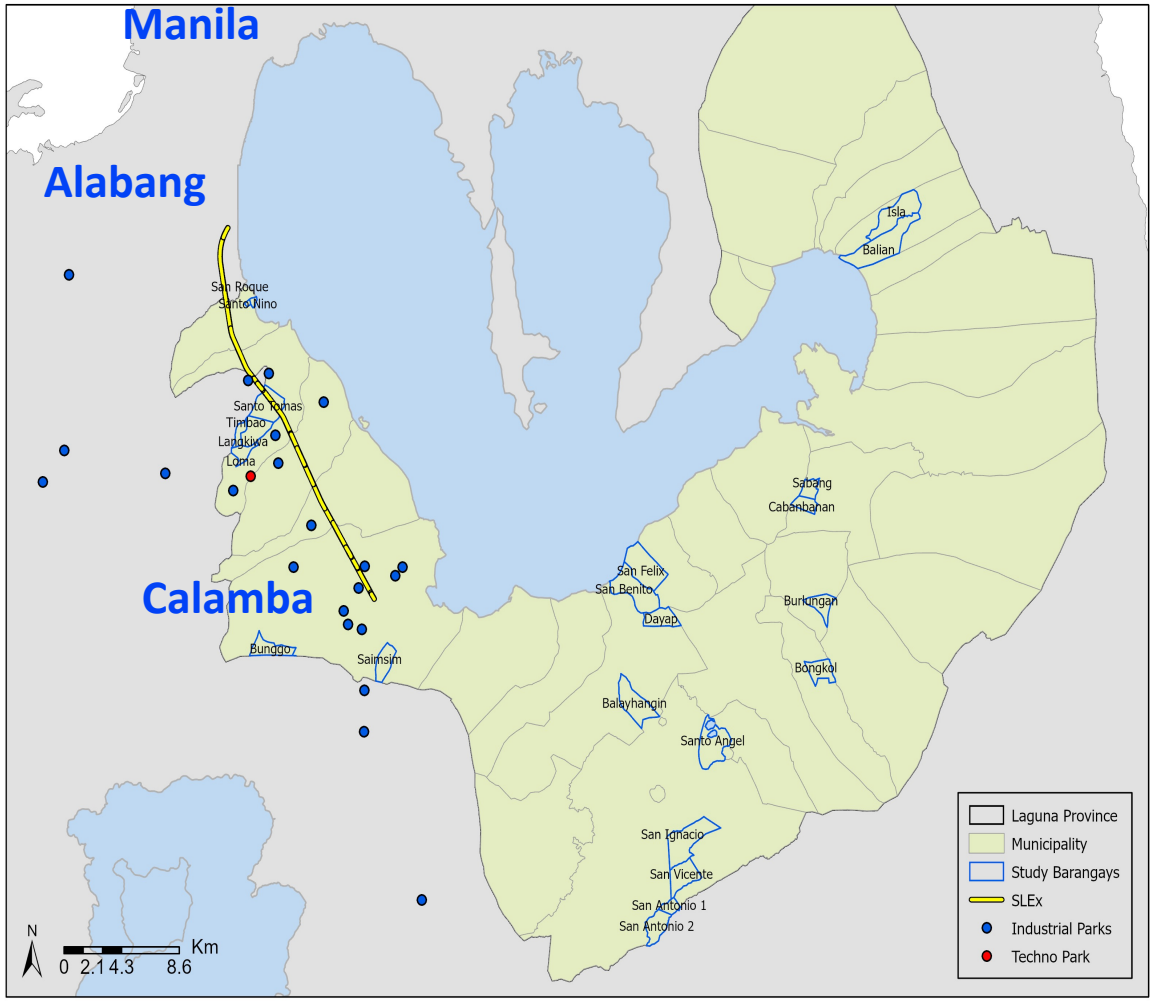
- Southern Luzon Expressway (SLEx)
  - The existing (A-B) route extended to (B-C) in 1978 (Hayami and Kikuchi, 2000)



Emergence of Industrial Parks since the late 1980's

- Since the opening of SLEx, industrial parks have emerged in the area, especially on the western and southern sides of Lake Laguna
- Industrial parks have established since the late 1980's until 2000's
  - Laguna Techno Park since 1989

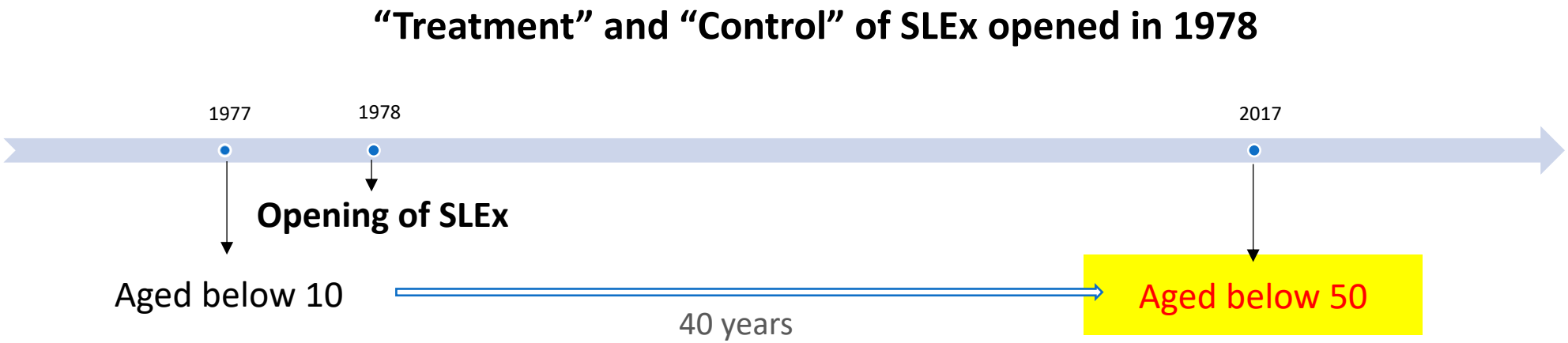
Industrial complex	Establishment year	Land area (in hectares)	Number of companies
Laguna Technopark SEZ	1989	314.9	241
Laguna Technopark Annex	1989	29	N/A
SMPIC Special Economic Zone	1989	3.4	N/A
Carmelray Industrial Park I	1992	80	22
Laguna International Industrial Park	1993	34.9	23
Light Industry & Science Park I	1995	71.7	92
Toyota Sta. Rosa (Laguna) SEZ	1995	81.7	3
Light Industry & Science Park II	1997	68	24
Greenfield Automotive Park	1998	65	2
Calamba Premiere International Park	1999	65.7	18
Carmelray Industrial Park II	1999	143	36
Filinvest Technology Park Calamba	2005	51.1	2



“Treatment Zone”

- Modernization around Laguna Lake
- “Treatment” is defined as year- and zone-specific “exposure to modernization” at village level, capturing:
  - Construction of a highway, SLEx (reduced travel costs and enhanced job availability)
  - Openings of industrial parks
- To pin down “modernization treatment,” we use multiple information:
  - Proximity to SLEx
  - Proximity to industrial parks
  - Satellite imageries
  - Expert’s opinion

Time-Specific Exposure to “Treatment” for DID



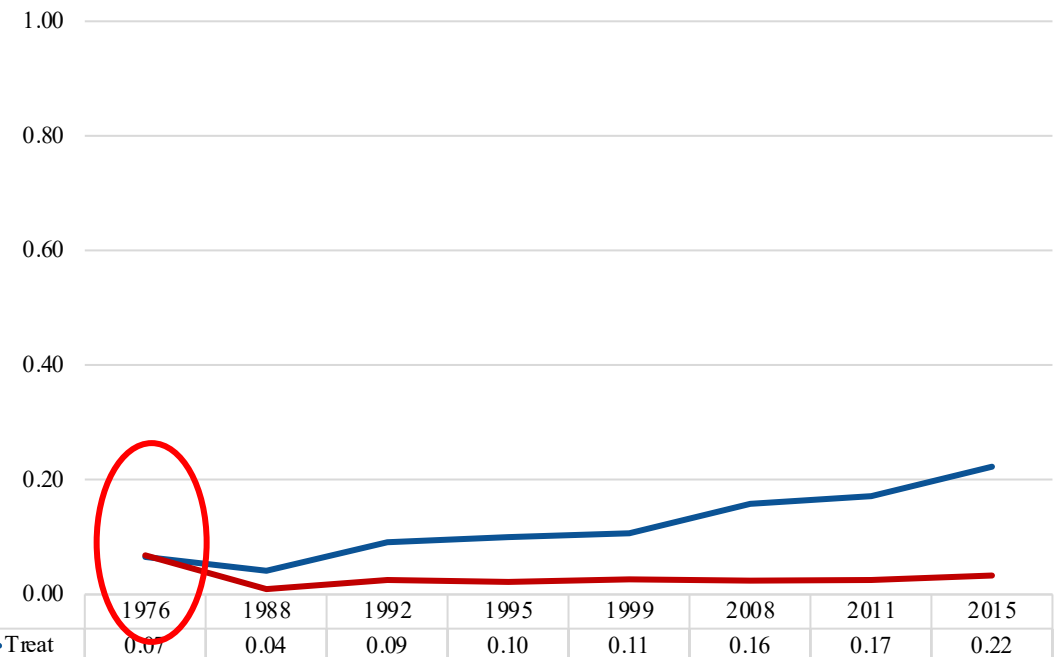
- **“Treatment”**: those who were below age 10 (and deciding on schooling and occupational choice) in 1977; and **“Control”**: those who were above age 19 in 1977

- We adopt DID framework

Checking Baseline Balance and Parallel Trend

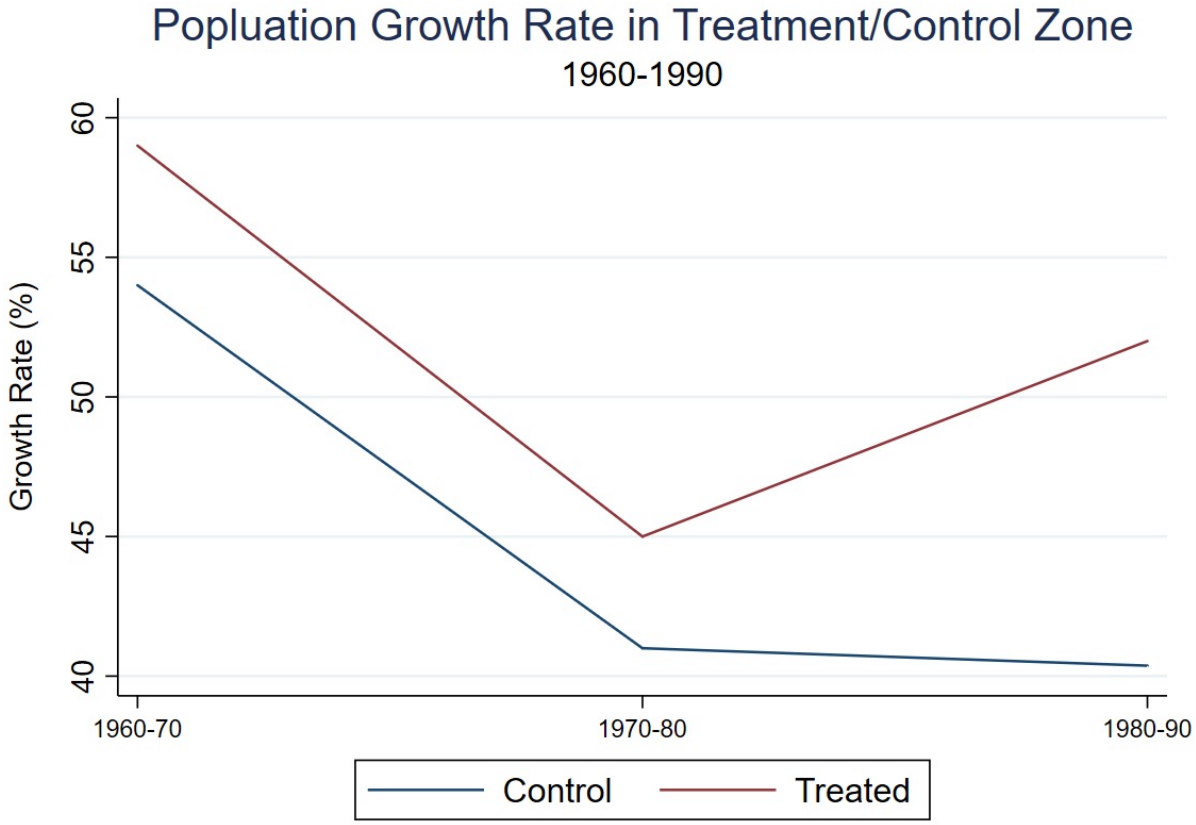
- Baseline balance in the built-up proportion in 1976 (using satellite imageries)

Proportion of Built-up



	1976	1988	1992	1995	1999	2008	2011	2015
Treat	0.07	0.04	0.09	0.10	0.11	0.16	0.17	0.22
Control	0.07	0.01	0.02	0.02	0.03	0.02	0.02	0.03

- Parallel trends in population growth before 1980



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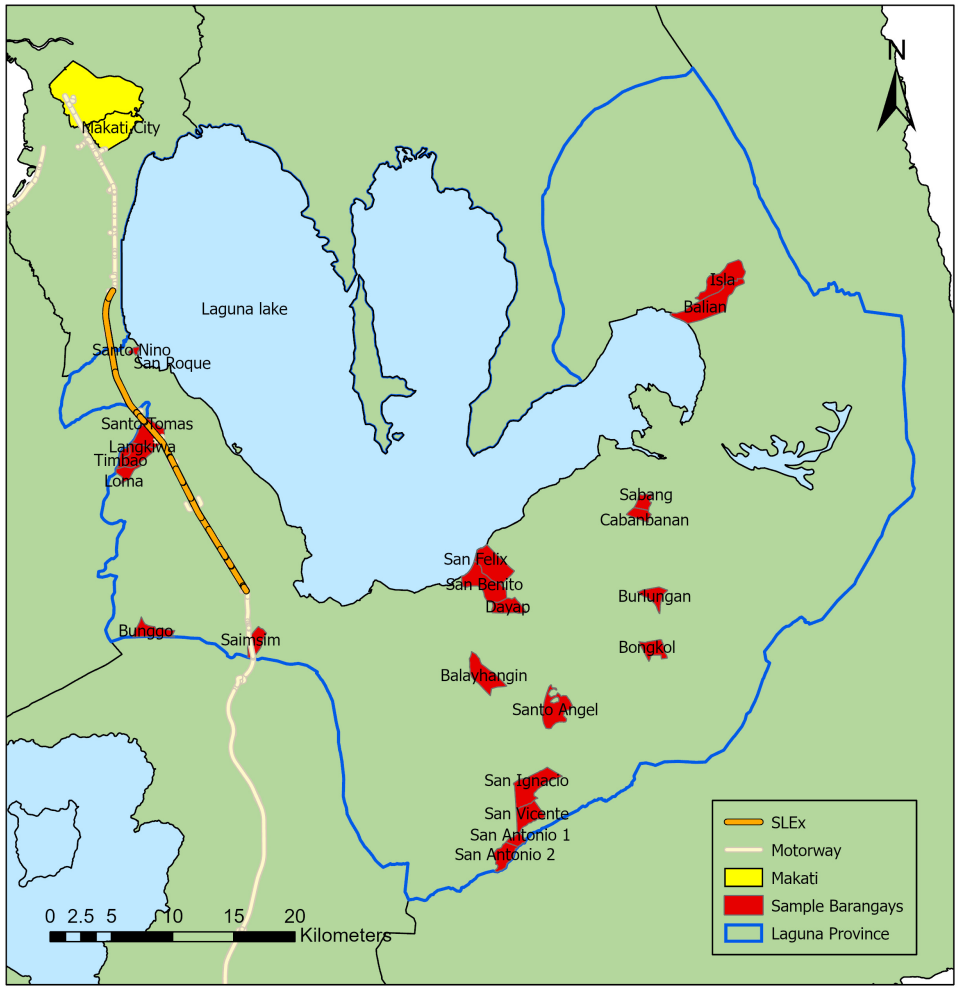
Laguna Multipurpose Household Surveys

- Initiated in 1975 by Profs. Robert Evenson and Barry Popkin in Laguna province, the Philippines
- Originally, 34 villages representing socio-economic condition of entire Laguna province
- Stratified (random) sampling of villages based on 4 group categories in 1975:
    1. Lowland rice farming villages
    2. Upland village with other crops
    3. Fishing village
    4. Semi-urban village with non-farm employment opportunities
- Resurveys in 1977, 1982, 1985, 1990, 1992, and 1998



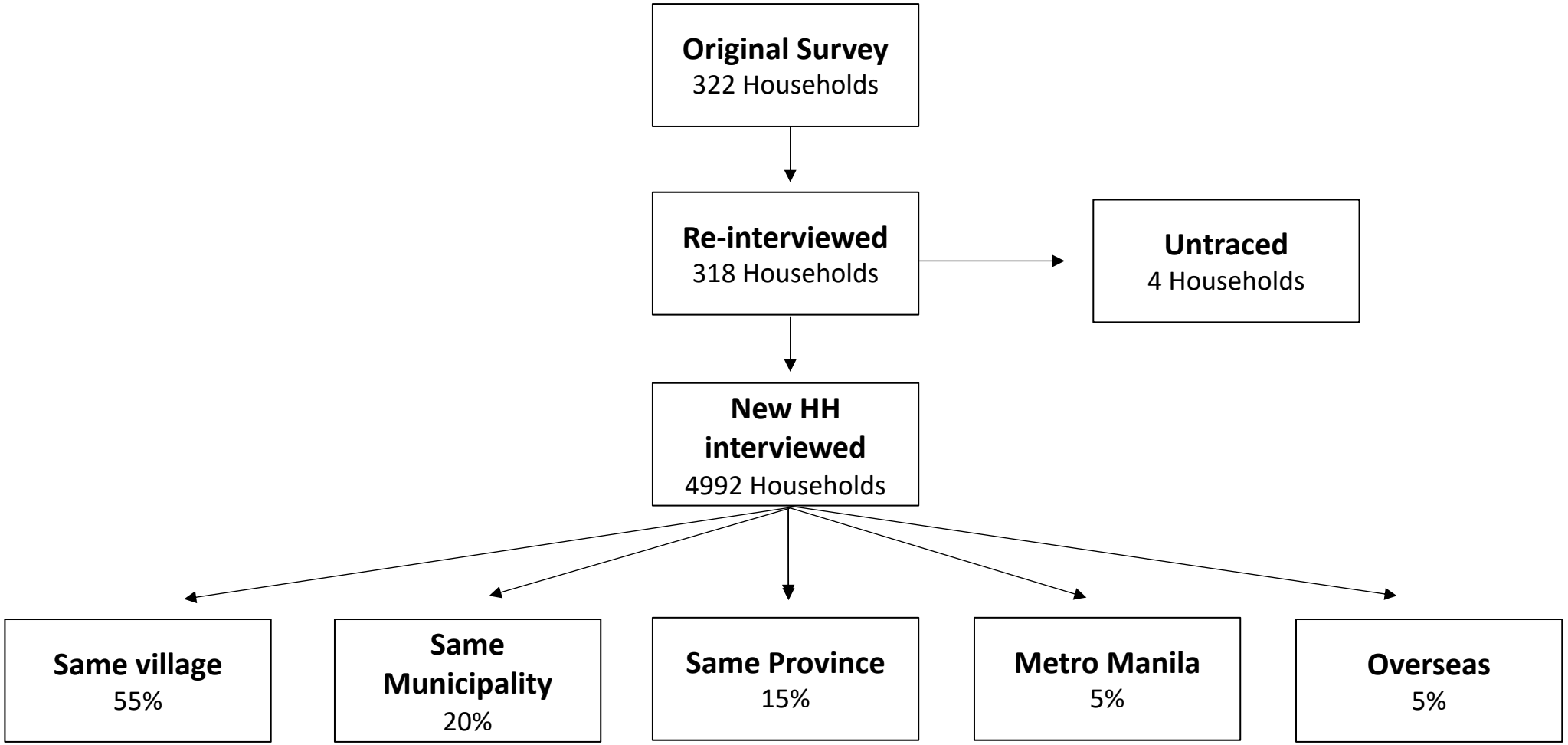
Our Tracking Survey

- The tracking project started in 2010 to track subset of original 576 households from 1975, resurveyed in 1977
  - 322 households from 23 villages (resurveyed in 1977)
- In 2017-2019, we tracked all the descendants of the available 318 households from the 322 households and original 23 villages, tracing changes over 40 years (21,017 individuals in 4,992 households with 318 dynasties)
  - Individual tracking survey: birth year, educational attainment, current and lifetime major occupation, agricultural land holdings and utilization, and possessions of assets
  - village tracking survey: recall information on changes in access to infrastructure and large city

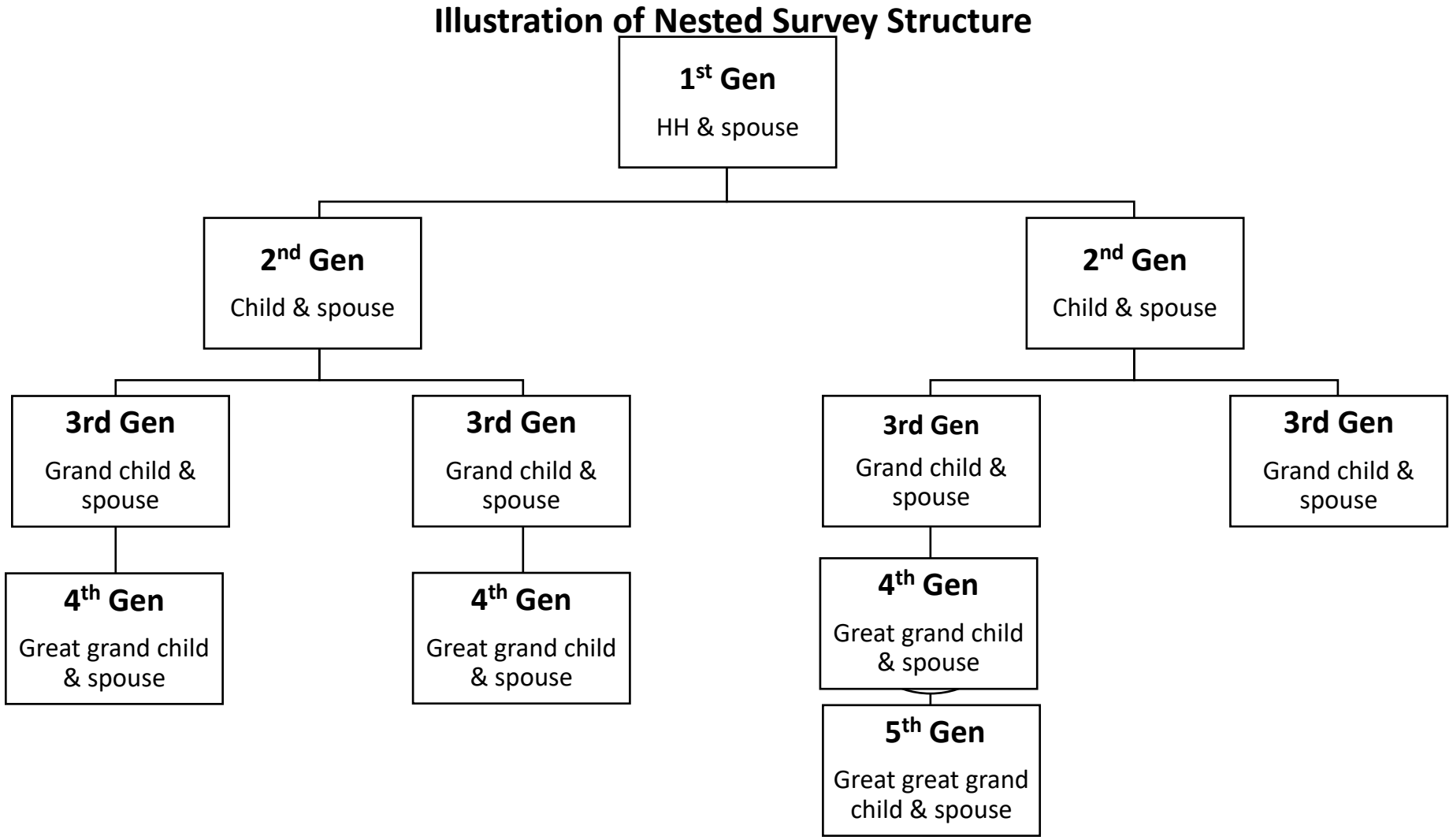
- Working sample:
  - Age restriction: above 19 years old in 2017 to exclude those who are in post-secondary education and below 80 years old (top 5 percentile) in 2017 to rules out significant time trend before 1970s
  - Relationship restriction: sample excludes all the spouses of original household heads and their families' descendants who were likely to spend their childhood in different village and entered the household after finishing schooling
  - 8,476 individuals in 4,256 households with 318 dynasties

Tracking Survey (by Location)

Tracking the households after 40 years



Tracking Survey (by Generation)



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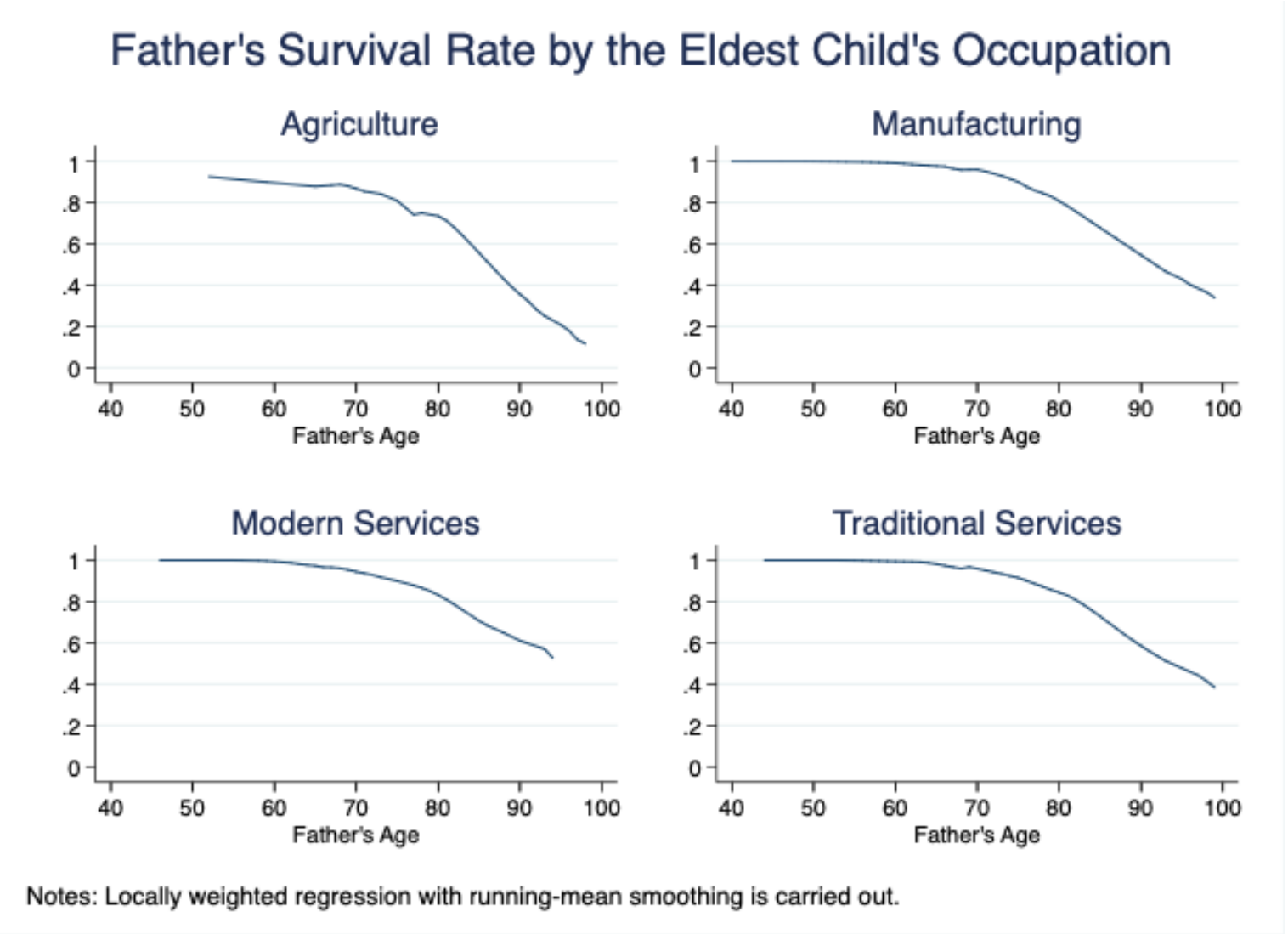
Father’s Survival Rate



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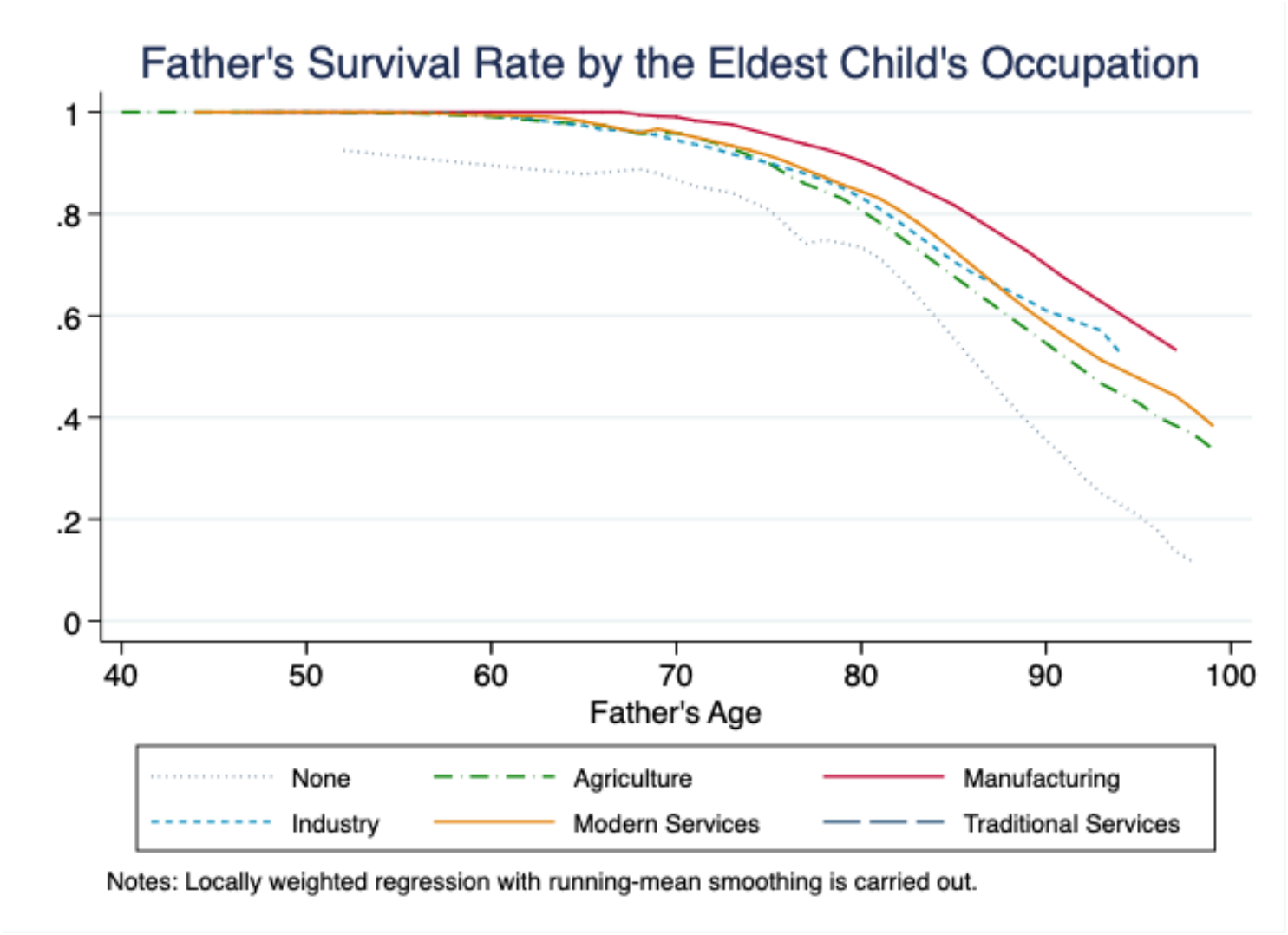

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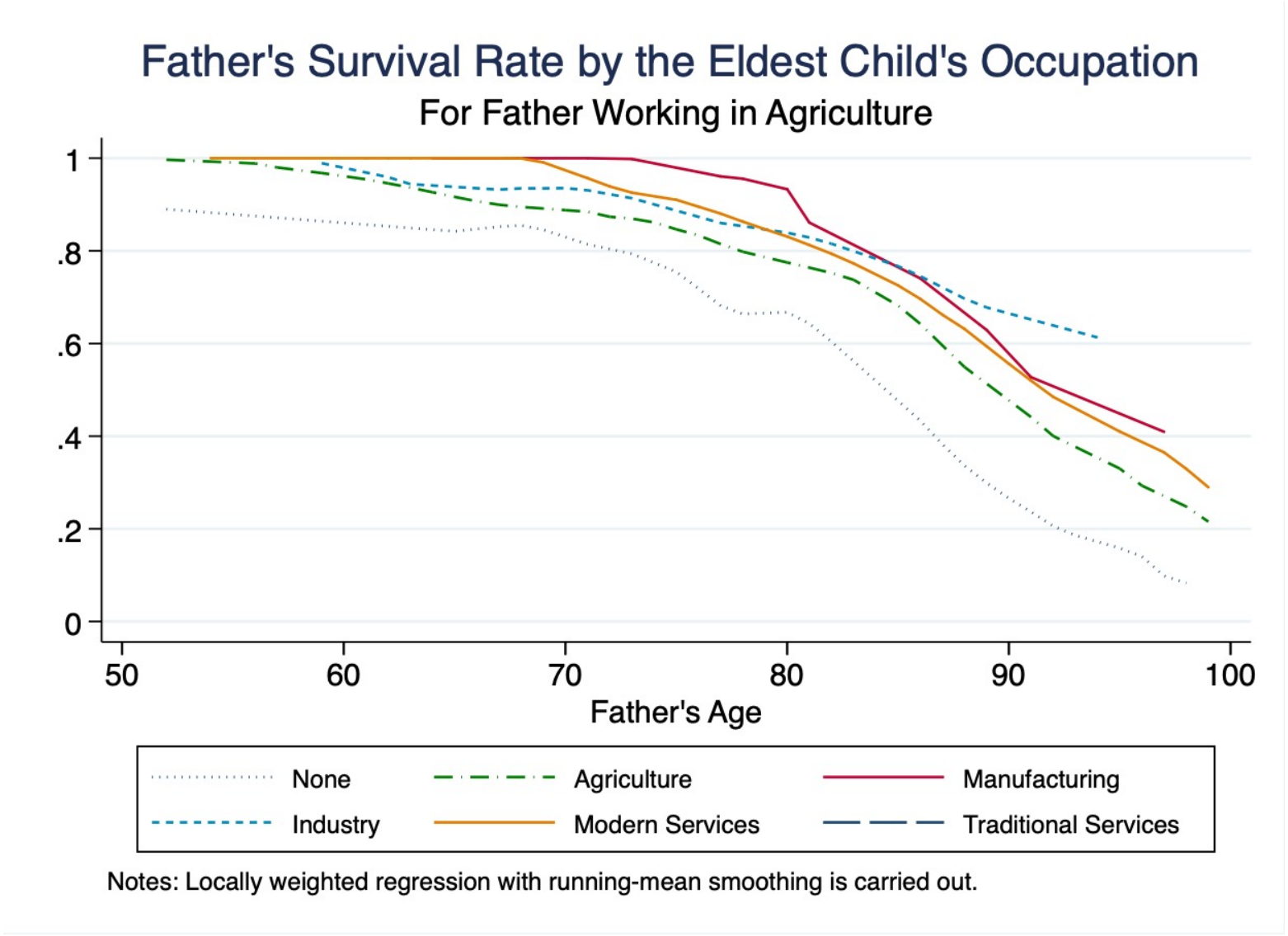


Survival Function of "Fathers":

- **Linear Probability Model (LPM):**

$$S^{M}_{ihjt} = {}_{\gamma}{}^{M}A_t + \eta^{M}_{j} + \theta^{M}(A_t d_j) + Z^{M}_{ihjt}\gamma^{M} + e^{M}_{ihjt}, \quad (1)$$

where

S^{M}_{ihjt} = discrete variable representing survival status of "father" of individual *i* in family tree *h* of village *j* and born in cohort *t*

A_t = individual is in the after (younger) cohort aged 30-49 in 2017 (equivalently, below age 10 in 1977)

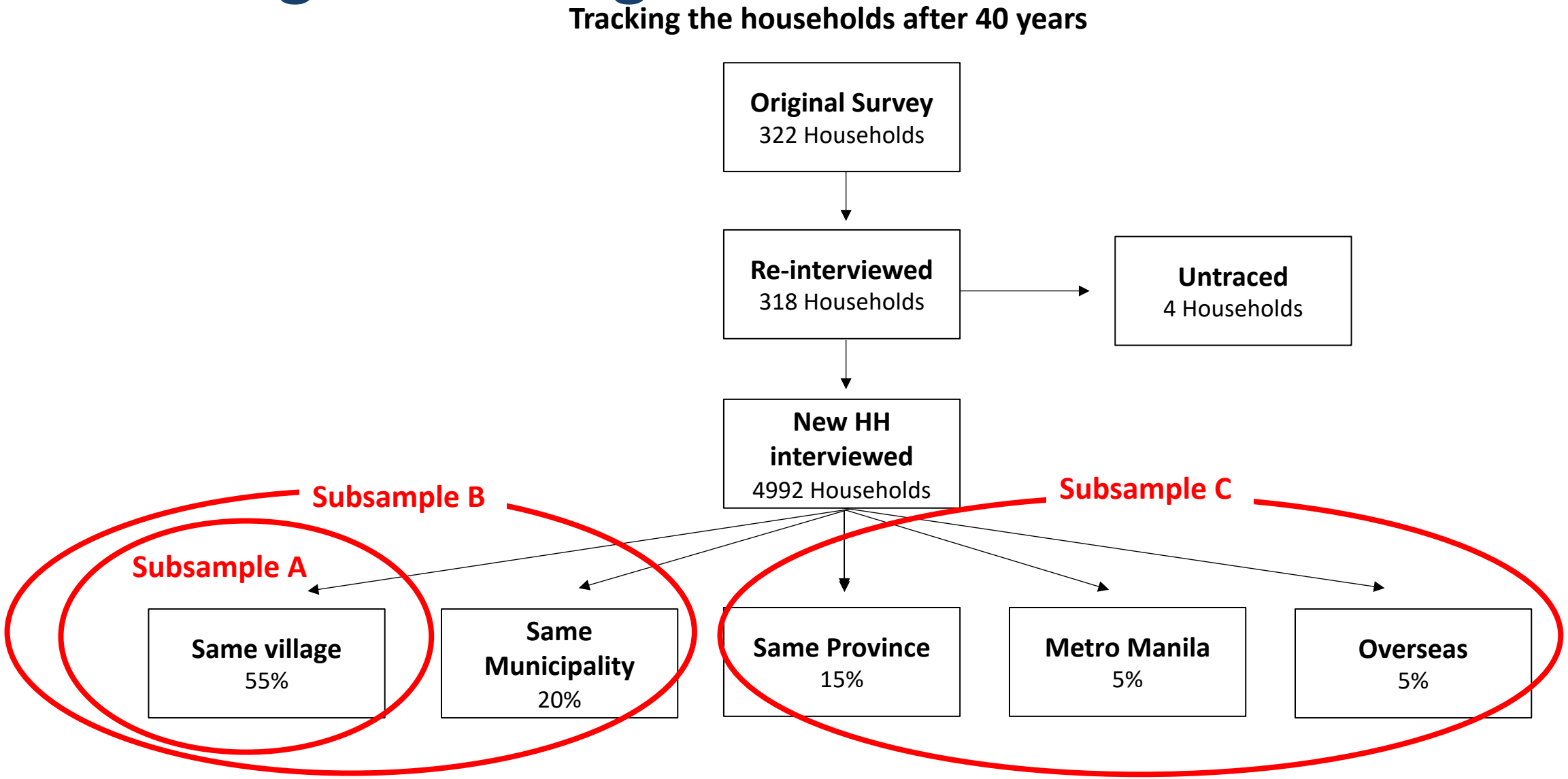
d_j = modernization treatment indicator which takes one for treatment zone

Z^{M}_{ihjt} = vector of control variables

e^{M}_{ihjt} = unobserved individual-level component

- We confine our analysis to the industry-specific subsamples in which "father" engaged in agriculture and "the eldest children" worked in sector *M*

Estimation by Sub-Sample, considering endogenous migration



	Original Barangay				Original Municipality				Outside Original Municipality			
	Entire	Agriculture	Manufacturing	Traditional Services	Entire	Agriculture	Manufacturing	Traditional Services	Entire	Agriculture	Manufacturing	Traditional Services
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable: Father is alive												
Access to school	0.076	0.099	-0.035	0.047	0.059	0.067	-0.103	0.067	0.036	0.196	0.136	0.017
	(0.053)	(0.147)	(0.105)	(0.090)	(0.042)	(0.125)	(0.093)	(0.068)	(0.056)	(0.182)	(0.119)	(0.128)
Father's education	0.008	0.005	-0.019	0.025**	0.006	0.008	-0.012	0.024**	0.006	-0.022	0.014	0.002
	(0.006)	(0.016)	(0.013)	(0.011)	(0.005)	(0.014)	(0.011)	(0.010)	(0.006)	(0.022)	(0.014)	(0.018)
Mother's education	0.002	0.010	0.008	-0.005	-0.006	0.009	-0.005	-0.010	-0.003	0.007	0.002	-0.002
	(0.006)	(0.022)	(0.013)	(0.011)	(0.005)	(0.018)	(0.010)	(0.009)	(0.006)	(0.017)	(0.012)	(0.017)
Grandfather's education	0.009	-0.007	0.007	0.045***	0.007	-0.009	0.010	0.041***	0.017**	0.040	0.010	0.009
	(0.009)	(0.029)	(0.019)	(0.017)	(0.007)	(0.022)	(0.013)	(0.013)	(0.008)	(0.034)	(0.018)	(0.022)
Grandmother's education	-0.057***	-0.061*	-0.024	-0.104***	-0.046***	-0.056**	-0.015	-0.092***	-0.041***	-0.091**	-0.042**	-0.024
	(0.010)	(0.032)	(0.020)	(0.018)	(0.007)	(0.025)	(0.015)	(0.015)	(0.009)	(0.035)	(0.018)	(0.024)
Age	0.022**	0.005	0.037*	0.024	0.027***	0.022	0.032**	0.023	0.028**	0.010	0.032	0.061
	(0.010)	(0.033)	(0.020)	(0.021)	(0.008)	(0.026)	(0.016)	(0.017)	(0.011)	(0.037)	(0.031)	(0.043)
Age^2	-0.000***	-0.000	-0.001**	-0.000*	-0.000***	-0.000	-0.001***	-0.000**	-0.000***	-0.000	-0.001*	-0.001*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.008	0.039	-0.006	-0.020	-0.002	0.044	0.042	-0.037	-0.028	-0.020	0.025	-0.104
	(0.028)	(0.098)	(0.062)	(0.052)	(0.023)	(0.080)	(0.048)	(0.045)	(0.027)	(0.108)	(0.055)	(0.068)
Father's Age	-0.010***	-0.019***	-0.007**	-0.012***	-0.010***	-0.018***	-0.010***	-0.012***	-0.004*	-0.013*	0.006	-0.001
	(0.002)	(0.005)	(0.004)	(0.004)	(0.002)	(0.004)	(0.003)	(0.003)	(0.002)	(0.007)	(0.004)	(0.005)
Treat	-0.048	-0.115	-0.338**	0.128	-0.056	-0.093	-0.324***	0.076	-0.079	-0.212	0.174	-0.135
	(0.052)	(0.127)	(0.149)	(0.085)	(0.040)	(0.102)	(0.121)	(0.072)	(0.066)	(0.256)	(0.139)	(0.154)
Young	0.041	0.102	-0.079	0.043	-0.039	0.040	-0.356**	-0.063	0.050	-0.082	0.243	-0.139
	(0.057)	(0.165)	(0.185)	(0.100)	(0.047)	(0.139)	(0.148)	(0.085)	(0.057)	(0.194)	(0.166)	(0.137)
Treat*Young	-0.027	0.040	0.273*	-0.178	0.044	0.115	0.329**	-0.044	0.082	0.358	-0.133	0.134
	(0.063)	(0.183)	(0.163)	(0.109)	(0.049)	(0.142)	(0.133)	(0.089)	(0.073)	(0.307)	(0.150)	(0.175)
N	491	77	89	153	676	100	132	202	318	38	58	75
r2	0.418	0.534	0.469	0.491	0.423	0.532	0.455	0.469	0.368	0.527	0.705	0.326

Remarks

- We find:
  - Significant and economically large impacts of their children's exposure to modernization and resulting engagement to the manufacturing jobs on their fathers' longevity
  - The effect is not through the change of their own occupation but expanded resource transfer to their parents or improved elderly care by their children
  - Structural transformation influences the demographics of various generations
  - This directly affects the exposed generation through occupation choice or income effect and indirectly through fertility decisions of the exposed generation on their older generation.

Thank you very much!