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# **Evaluating the Impacts of the 2008-2009 Great Recession on Labor Supply of Family Farm Households**

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# Background Introduction

## – the 2008/2009 Economic Crisis

- On September 14 of 2008, the financial firm, Lehman Brothers, filed for bankruptcy after being denied support by the Federal Reserve Bank. Since then, unemployment rates have been increased dramatically all over the world.
- The financial crisis has resulted in severe impacts on firms, banks, and other economic units.
- Since consumption and income are commonly used as reliable indicators for economic wellbeing, it is expected that the 2008-2009 crisis also impacts the household wellbeing.

# Economic recession and labor supply

- “*How do households respond to financial shocks?*” This question is central to any discussion of how macroeconomic shocks affect the outlook for the economy and the appropriate policy response.
- Such responses on labor supply are also central to discussions of inequality as revealed in consumption and income.
- *What is the link between economic shock and family labor supply?* Benito and Saleheen (2012) stated that family labor can be used as a buffer to cope with exogenous shocks.
- Shedding light on the possible use of labor supply as a response to financial downside has been the aim of many studies in labor economics.

# Literature on the 2008-2009 economic crisis

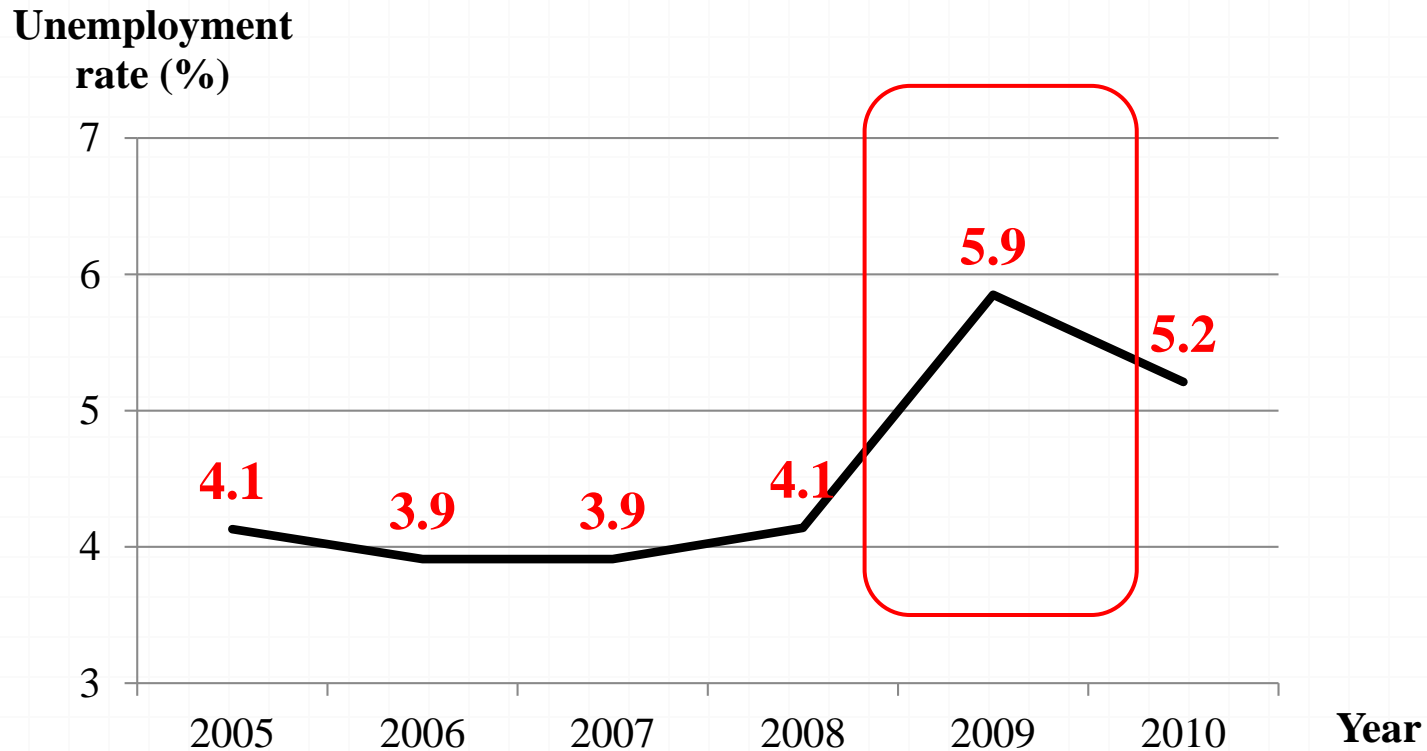
- Enormous paper has focused on the impacts on **macro-economy** of the 2008-2009 financial crisis.
- Literature also investigated the wide-ranging effects of the 2008-2009 economic crisis on household wellbeing (e.g., Duflos and Gaehwiler, 2008; Kirkpatrick, 2002; Littlefield, 2008).
  - Duflos and Gaehwiler (2008) found that economic recession caused households to withdraw savings and cut back on nonfood expenses.
  - Bricker et al. (2012) examined the impact of the 2008 financial crisis on US family's income and consumption: more than 60% of families have a reduce in wealth from 2007 to 2009.
- So far, no study has focused on farm households.

# Why do we need another paper on this topic in farm households?

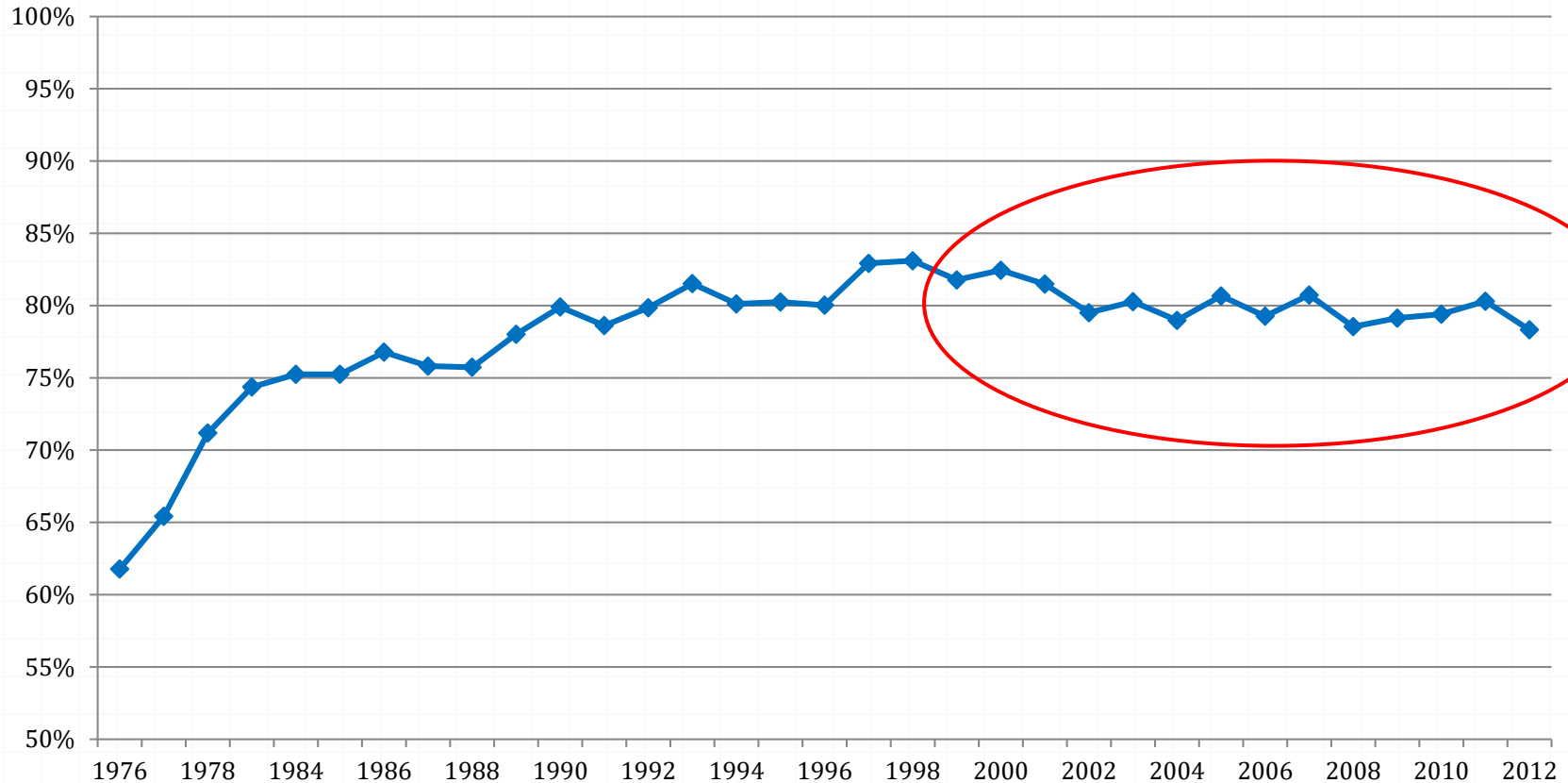
- One of the uniqueness of farm household income is that income from off-farm sources accounts for a certain proportion of total income. It is more pronounced in developed countries.
- In general, farmers have two options to locate their labor supply: on-farm work and the off-farm work.
- Family context is also unique among farm households. Most of the farms are **family farms**. Farm succession is one of the key issues for farm sustainability.



# The macroeconomic impacts of the 2008-2009 economic crisis in Taiwan: A Look at annual unemployment rates



# Total Farm Household Income heavily relies on non-farm sources in Taiwan



Average share of non-farm income to total household income is **78%** (from 1976 to 2012) in Taiwan.



# Research Objectives

- We provide an empirical analysis to examine the 2008-2009 economic recession on labor supply of the farm households using a case study in Taiwan as an illustration.
- A population-based census panel dataset of farm households was used.
- To identify the impacts of the 2008-2009 recession on labor supply of family farm members in Taiwan.
- To distinguish the effects on labor supply on on-farm and off-farm work.
- To distinguish the effect among different age groups of farm household members.
- To distinguish the impacts between short vs. long run.



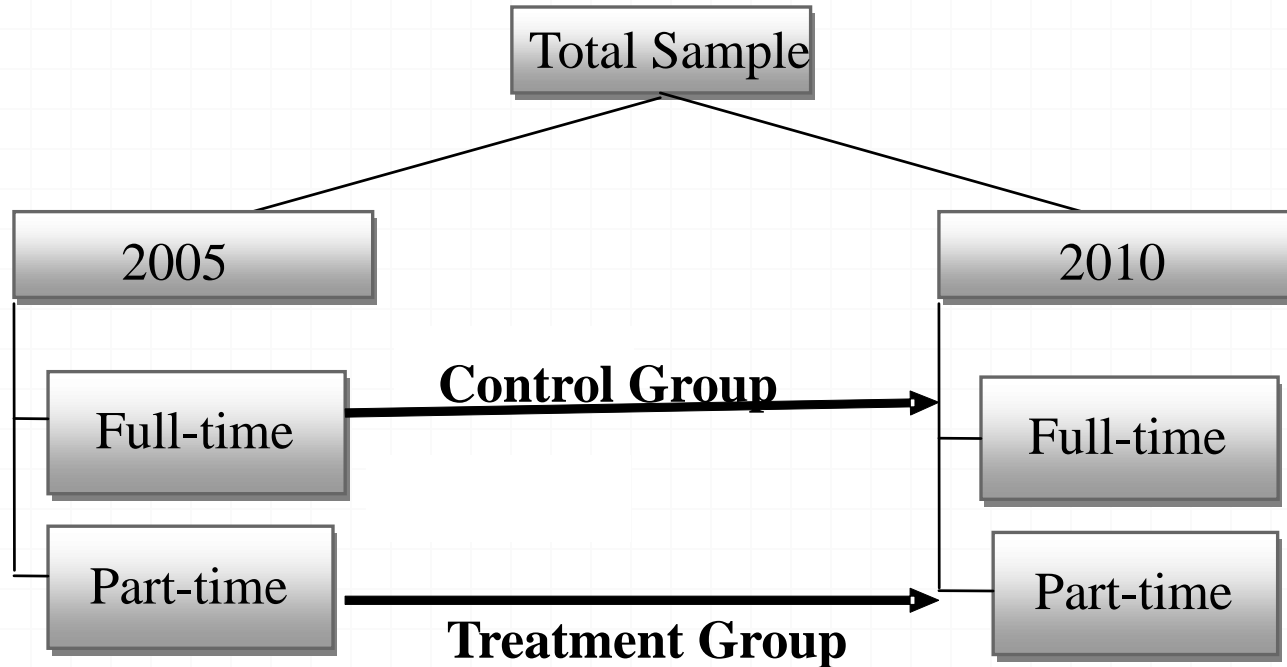
# Our Data: Agriculture Census Survey in Taiwan

- Since 1955, Agriculture Census Survey (ACS) has been conducted in each five year in Taiwan. Every farm household registered in the general household profile was interviewed.
- Two types of information were included: farm production practice and demographic factors of each family farm member.
- The recent two waves of ACS were in 2005 and 2010.
- In total, there are 780,388 and 771,579 farm households included in 2005 and 2010 survey.
- Each farm household was assigned a unique ID when it was first interviewed. We used this ID to construct a balanced panel of 636,040 farm households in each year.

# Data selection

- We excluded commercial farms and single person farms.
- In this dataset, part-time farms are identified if
  - (1). Any of the family member worked off the farm  $\geq 30$  days.
  - or (2). Total non-farm income of the family is  $\geq$ NT\$ 20,000.
- For identification purpose, we use the part-time farms for both year as the **treatment group** because this group of farms were affected by the non-farm labor market. In contrast, full-time farms who don't involve in non-farm labor market for both years are identified as the **control group**.
- Our final balanced panel data include: **565,594** family farms in each year, of which **499,299** (88%) are part-time farms, and **66,295** (12%) are full-time farms.

# Structure of the Panel Data and DiD Design



# Definition of the outcome variables

We have defined several outcome variables related to farm household labor supply.

The short-term impact indicators:

- Total on-farm days in a year;
- Number of family members worked on the farm;
- Number of family members worked off the farm.

For each indicator, we calculate it for three groups:

-- total family members; principle farm operator, different age groups of family members.



## The long-term impact indicator

- If there is any farm successor in the family farm (defined as a dummy variable 0/1).
- Number of farm successors within the family farm.



# Sample statistics of the outcome variables

		Treatment		Control		DiD <sup>#</sup>
Year		2005	2010	2005	2010	
Sample		499,299	499,299	66,295	66,295	
Variable	Definition	Mean	Mean	Mean	Mean	
<b>Total family members (including the principle farm operator)</b>						
Farmday_ALL	Annual on-farm days of all family members	153.56	129.43	193.92	155.49	14.31
Onfarm_ALL	Number of household members worked on the farm.	0.79	0.77	1.16	1.04	0.10
Offfarm_ALL	Number of household members worked off the farm.	2.07	1.67	0.01	0.00	-0.40
<b>Principle farm operator</b>						
Farmday_OP	On-farm days of the farm operator (days)	85.91	77.26	115.74	96.80	10.29
Onfarm_OP	If the farm operator worked on the farm (=1).	0.52	0.54	0.75	0.71	0.05
Offfarm_OP	If the farm operator worked off the farm (=1).	0.33	0.30	0.00	0.00	-0.03



Year		Treatment		Control		DiD <sup>#</sup>
		2005	2010	2005	2010	
Sample		499,299	499,299	66,295	66,295	
Variable	Definition	Mean	Mean	Mean	Mean	
<b>Other farm family members (excluding farm operator)</b>						
Farmday_HH	On-farm days of other family members	67.65	52.17	78.18	58.68	4.02
Farmday_1524_HH	On-farm days of other family members aged 15-24	2.33	1.49	1.58	1.72	-0.98
Farmday_2544_HH	On-farm days of other family members aged 25-44	24.10	16.99	26.02	17.30	1.62
Farmday_4564_HH	On-farm days of other family members aged 45-64	31.12	24.38	26.76	20.29	-0.27
Farmday_65_HH	On-farm days of other family members aged >=65	10.10	9.30	23.82	19.38	3.65
Onfarm_HH	Number of household members worked on the farm.	0.27	0.23	0.41	0.33	0.05
Onfarm_1524_HH	Number of household members aged 15-24 worked on the farm.	0.00	0.00	0.01	0.01	0.00
Onfarm_2544_HH	Number of household members aged 25-44 worked on the farm.	0.07	0.06	0.13	0.09	0.03
Onfarm_4564_HH	Number of household members 45-64 worked on the farm.	0.14	0.12	0.14	0.11	0.00
Onfarm_65_HH	Number of household members aged >=65 worked on the farm.	0.06	0.05	0.13	0.12	0.01
Offfarm_HH	Number of household members worked off the farm.	1.74	1.37	0.00	0.00	-0.37
Offfarm_1524_HH	Number of household members aged 15-24 worked off the farm.	0.18	0.12	0.00	0.00	-0.06
Offfarm_2544_HH	Number of household members aged 25-44 worked off the farm.	1.24	0.94	0.00	0.00	-0.30
Offfarm_4564_HH	Number of household members 45-64 worked off the farm.	0.31	0.30	0.00	0.00	-0.01
Offfarm_65_HH	Number of household members aged >=65 worked off the farm.	0.01	0.01	0.00	0.00	0.00

		Treatment		Control		DiD <sup>#</sup>
Year		2005	2010	2005	2010	
Sample		499,299	499,299	66,295	66,295	
Variable	Definition	Mean	Mean	Mean	Mean	
Farm_succ_d	If the farm has at least one farm successor (=1).	0.05	0.05	0.08	0.06	0.01
Farm_succ_person	Number of farm successors	0.06	0.05	0.08	0.07	0.01

# Explanatory Variables

Group		Treatment	Control	Difference
Sample		499,299	66,295	
Variable	Definition	Mean	Mean	
Farmsize	Operating land (hectare)	0.71	0.91	-0.20
Land ownership	Ratio of the land ownership	0.92	0.88	0.04
HHSIZE_male	Male persons aged $\geq 15$ living in the household	2.68	1.20	1.48
HHSIZE_female	Female persons aged $\geq 15$ living in the household	2.41	1.13	1.28
Male_OP	If the farm operator is male (=1).	0.84	0.82	0.02
Age_OP	Age of the farm operator (year)	59.98	67.30	-7.32
Illeterate_OP	If the operator is illiterate (=1).	0.09	0.18	-0.08
Primal_OP	If the operator finished elementary school (=1).	0.53	0.59	-0.07
Junior_OP	If the operator finished junior high school (=1).	0.17	0.11	0.06
Senior_OP	If the operator finished senior high school (=1).	0.21	0.12	0.09
Rice	If rice farm (=1).	0.46	0.41	0.05
Vegetable	If vegetable farm (=1).	0.14	0.15	-0.01
Fruit	If fruit farm (=1).	0.24	0.24	-0.01
Othercrop	If other crop farm (=1).	0.15	0.17	-0.02
Livestock	If livestock farm (=1).	0.02	0.03	-0.01

We also control for 22 administrative districts dummy variables.

# Empirical Analysis (I)

- We start with a standard panel version DiD model.

$$y_{it} = \alpha_1 * t + \alpha_2 (t * d_{it}) + \beta' x_{it} + u_i + \varepsilon_{it}$$

where  $y$  is the outcome variable;  $t$  is time dummy (after=1);  $d$  is the group dummy (part-time farms =1);  $u$  is individual farm fixed effect.

- The parameter  $\alpha_2$  then captures the DiD effect.
- We estimate this model with FE model with clustered standard errors in farm unit.

# Empirical Analysis (II)

- We extend the basic model by using the matching sample, instead of the raw dataset.
- Why use matching? Because differences in explanatory variables between the treatment and control groups are observed in the baseline year. Therefore, removing these differences can help to clear out the DiD effect.
- The Coarsened Exact Matching (CEM), recently suggested by Iacus *et al.* (2011) and Iacus *et al.* (2009) was used to construct the matched sample.

# Few words on the CEM method

- This procedure has a variety of desirable statistical properties relative to commonly used PSM method including reduced model dependence and ease of use for matching on continuous variables.
- Implementing CEM requires the selected explanatory variables to be recoded into *coarsened categories* so that similar values are grouped together. An *exact matching* algorithm is then applied to the coarsened data (see Iacus *et al.* 2009 for the details of this procedure and comparisons of CEM to other matching techniques).

## References

- Iacus, S., King, G. and Porro, G (2011). Multivariate Matching Methods That are Monotonic Imbalance Bounding. *JASA* 106, 345-361.
- Iacus, S. and Porro, G (2009). Random Recursive Partitioning: A Matching Method for the Estimation of the Average Treatment Effect. *Journal of Applied Econometrics*, 24, 163–185.

# How to justify the matching method?

Two ways to justify the use of the matching method:

- Comparing descriptive statistics of the matching variables in both the treatment and the control group before and after matching
- A more formal method is based on the measure of imbalance suggested by Iacus *et al.* (2009):

$$L(f, g) = \frac{1}{2} \sum_{l_1 \dots l_k} |f_{l_1 \dots l_k} - g_{l_1 \dots l_k}|$$

The lower value of L, the smaller differences of the measured variables between two groups (i.e. better matching quality).



# Evidence of a good matching quality of our study

Group	Unmatched Sample		Matched Sample	
	Treatment	Control	Treatment	Control
Sample	499,299	66,295	362,322	63,388
Variable	Mean	Mean	Mean	Mean
Farmsize	0.71	0.91	0.71	0.86
Land ownership	0.92	0.88	0.90	0.90
HHSIZE_male	2.68	1.20	2.03	1.16
HHSIZE_female	2.41	1.13	1.48	1.10
Male_OP	0.84	0.82	0.82	0.82
Age_OP	59.98	67.30	67.47	67.54
Illeterate_OP	0.09	0.18	0.18	0.18
Primal_OP	0.53	0.59	0.61	0.61
Junior_OP	0.17	0.11	0.11	0.11
Senior_OP	0.21	0.12	0.11	0.11
Rice	0.46	0.41	0.42	0.42
Vegetable	0.14	0.15	0.14	0.14
Fruit	0.24	0.24	0.24	0.24
Othercrop	0.15	0.17	0.17	0.17
Livestock	0.02	0.03	0.03	0.03
<b>L-statistics</b>	0.978		0.386	

# Estimation of our panel-DiD model: Labor Supply

All family farm												
Dependent Variable	Farmday_All				Onfarm_All				Offfarm_All			
	Unmatched		Matched		Unmatched		Matched		Unmatched		Matched	
Variable	Coefficient		Coefficient		Coefficient		Coefficient		Coefficient		Coefficient	
Part-time*Year 2010	22.253	***	14.609	***	0.143	***	0.079	***	-0.154	***	-0.264	***
Year	-35.223	***	-32.510	***	-0.117	***	-0.105	***	0.093	***	0.102	***
Farm Operator												
Dependent Variable	Farmday_OP				Onfarm_OP				Offfarm_OP			
	Unmatched		Matched		Unmatched		Matched		Unmatched		Matched	
Variable	Coefficient		Coefficient		Coefficient		Coefficient		Coefficient		Coefficient	
Part-time*Year 2010	10.198	***	6.268	***	0.062	***	0.020	***	-0.059	***	-0.033	***
Year	-16.536	***	-16.164	***	-0.039	***	-0.036	***	0.052	***	0.053	***
Other Family members (excluding farm operator)												
Dependent Variable	Farmday_HH				Onfarm_HH				Offfarm_HH			
	Unmatched		Matched		Unmatched		Matched		Unmatched		Matched	
Variable	Coefficient		Coefficient		Coefficient		Coefficient		Coefficient		Coefficient	
Part-time*Year 2010	12.055	***	8.341	***	0.081	***	0.059	***	-0.095	***	-0.231	***
Year	-18.686	***	-16.346	***	-0.079	***	-0.068	***	0.041	***	0.049	***
Other controls	Yes		Yes		Yes		Yes		Yes		Yes	
Farm fixed effect	Yes		Yes		Yes		Yes		Yes		Yes	
Sample per year	565,594		425,710		565,594		425,710		565,594		425,710	
Period	2		2		2		2		2		2	

# Estimation of our panel-DiD model: Labor supply

		For Age 15-24					
Dependent Variable	Farmday_1524_HH		Onfarm_1524_HH		Offfarm_1524_HH		
	Unmatched	Matched	Unmatched	Matched	Unmatched	Matched	
Variable	Coefficient		Coefficient		Coefficient		
Part-time*Year 2010	-0.791 ***	-0.349 **	-0.001 **	-0.001	-0.041 ***	-0.013 ***	
		For Age 25-44					
Dependent Variable	Farmday_2544_HH		Onfarm_2544_HH		Offfarm_2544_HH		
	Unmatched	Matched	Unmatched	Matched	Unmatched	Matched	
Variable	Coefficient		Coefficient		Coefficient		
Part-time*Year 2010	5.939 ***	3.545 ***	0.048 ***	0.037 ***	-0.102 ***	-0.235 ***	
		For Age 45-64					
Dependent Variable	Farmday_4564_HH		Onfarm_4564_HH		Offfarm_4564_HH		
	Unmatched	Matched	Unmatched	Matched	Unmatched	Matched	
Variable	Coefficient		Coefficient		Coefficient		
Part-time*Year 2010	2.931 ***	2.873 ***	0.019 ***	0.016 ***	0.047 ***	0.022 ***	
		For Age >=65					
Dependent Variable	Farmday_65_HH		Onfarm_65_HH		Offfarm_65_HH		
	Unmatched	Matched	Unmatched	Matched	Unmatched	Matched	
Variable	Coefficient		Coefficient		Coefficient		
Part-time*Year 2010	3.976 ***	2.271 ***	0.016 ***	0.006 **	0.001 ***	-0.005 ***	

# Estimation of our panel-DiD model: Farm succession

Dependent Variable	Farm_succ_d				Farm_succ_person			
	Unmatched		Matched		Unmatched		Matched	
Variable	Coefficient		Coefficient		Coefficient		Coefficient	
Part-time*Year 2010	0.029	***	0.029	***	0.026	***	0.032	***
Year	-0.024	***	-0.016	***	-0.021	***	-0.018	***
Other controls	Yes		Yes		Yes		Yes	
Farm fixed effect	Yes		Yes		Yes		Yes	
Sample per year	565,594		425,710		565,594		425,710	

# Short summary of the findings

- The 2008-2009 economic recession resulted in a decrease in off-farm labor supply, an increase in on-farm labor supply. Results are robust for farm operator and other family members.
- Among the family members, the impacts are more pronounced for persons aged 25-44.
- In the long run, the shock increases the changes of farm succession.

# Empirical Analysis (III)

- Although using the standard DiD model can identify the effect, it fails to capture the “intensity” of the exogenous shock.
- Farms located in different area may suffer different level of shocks. To identify this possibility, we estimate a variation of the panel-DiD model.

$$y_{it} = \alpha_1 * t + \alpha_2 (t * d_{it} * \Delta wage_i) + \beta' x_{it} + u_i + \varepsilon_{it}$$

Where  $\Delta wage$  is the change in average annual salary of the general works in each region (i.e. wage 2010 - wage2005).

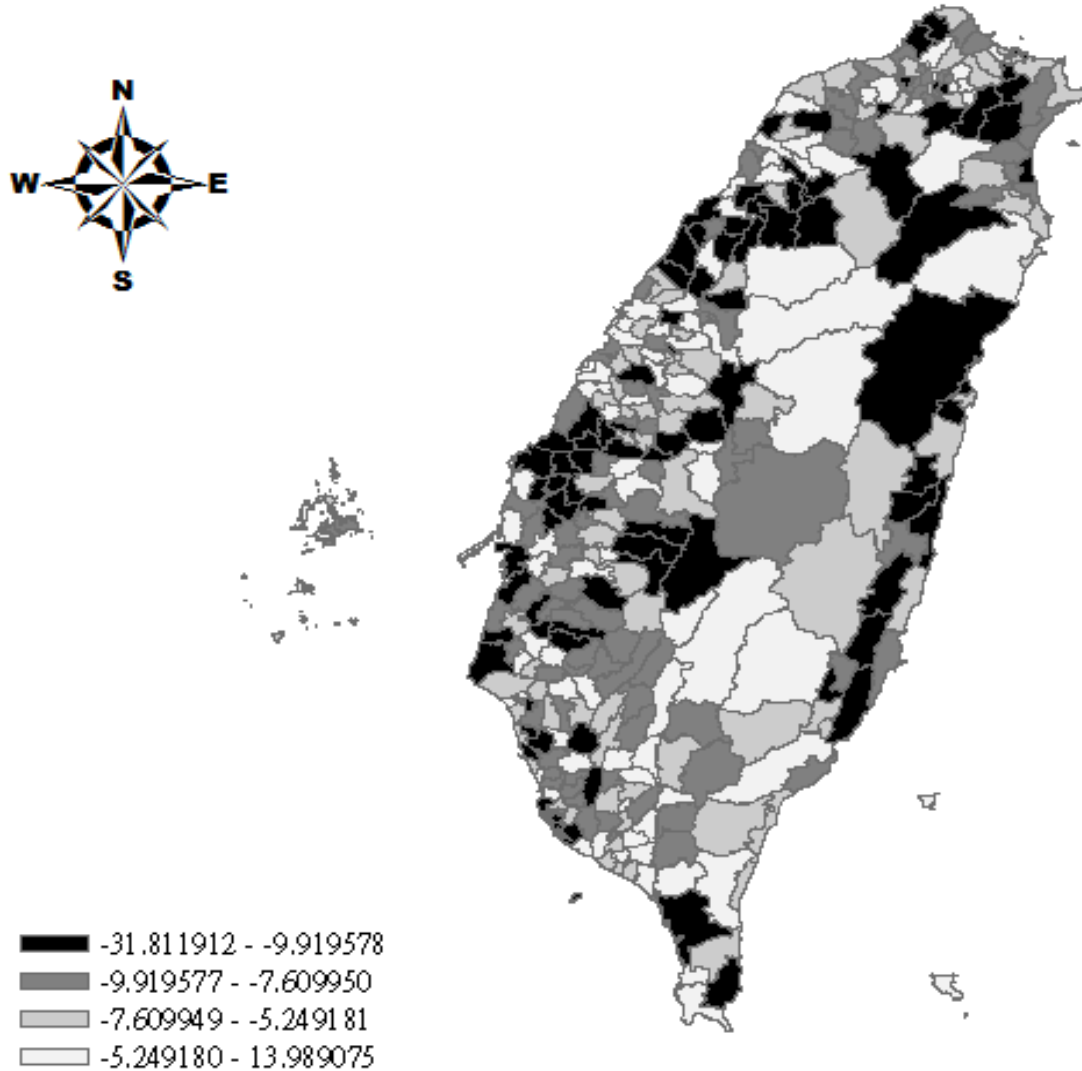
The DiD effect is then captured by :  $\hat{\alpha}_2 * \Delta wage$

# Wage data and the changes in wage in Taiwan

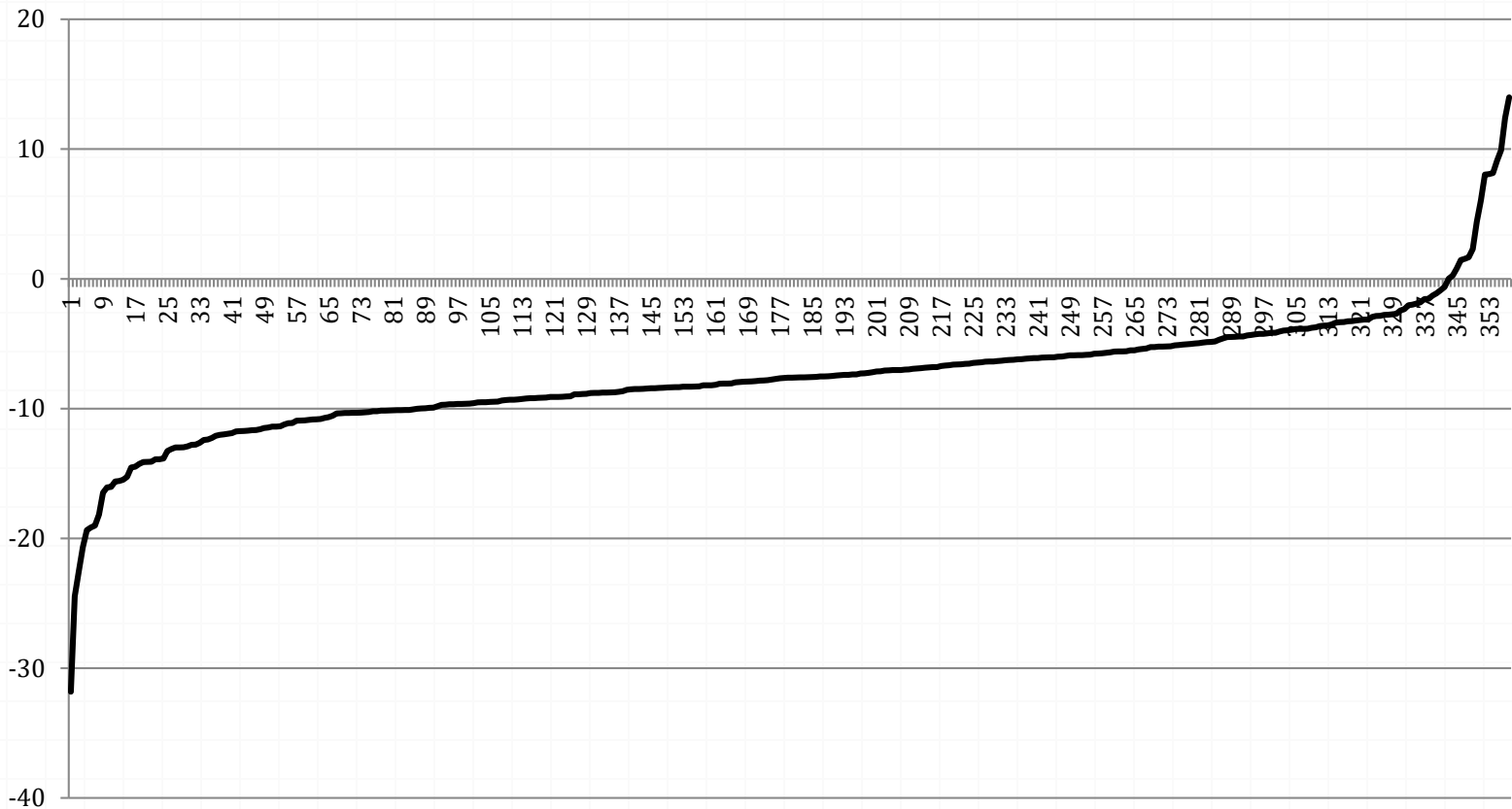
- We collected the average wage data per worker drawn from the Labor Census Survey in 2005 and 2010 in the county level.
- In total, there are 358 counties in Taiwan.
- We then merged the county level wage dataset into our farm household data based on the county each farm is located.
- If it is evaluated in the county level, the annual average salary per worker is NT\$ 479,500 in 2005, and it reduced to NT\$ 446,500 thousand in 2010.



# Changes in the average wage rates in the county level (wage in 2010 minus wage in 2005)



# Sample distribution of the change in wage in the county level



# Estimation results: Labor supply

	<b>All family farm</b>											
	Farmday_All				Onfarm_All				Offfarm_All			
	Unmatched		Matched		Unmatched		Matched		Unmatched		Matched	
	Coefficient		Coefficient		Coefficient		Coefficient		Coefficient		Coefficient	
DiD Effect	1.816	***	2.573	***	0.015	***	0.010	***	-0.024	***	-0.047	***
	<b>Farm Operator</b>											
	Farmday_OP				Onfarm_OP				Offfarm_OP			
	Unmatched		Matched		Unmatched		Matched		Unmatched		Matched	
	Coefficient		Coefficient		Coefficient		Coefficient		Coefficient		Coefficient	
DiD Effect	0.878	***	-11.993	***	0.005	***	0.001		-0.005	***	-0.003	***
	<b>Other Family members (excluding farm operator)</b>											
	Farmday_HH				Onfarm_HH				Offfarm_HH			
	Unmatched		Matched		Unmatched		Matched		Unmatched		Matched	
	Coefficient		Coefficient		Coefficient		Coefficient		Coefficient		Coefficient	
DiD Effect	0.938	***	1.363	***	0.010	***	0.009	***	-0.020	***	-0.043	***

# Estimation results: Labor supply

		<b>For Age 15-24</b>										
Dependent Variable	Farmday_1524_HH				Onfarm_1524_HH				Offfarm_1524_HH			
	Unmatched		Matched		Unmatched		Matched		Unmatched		Matched	
Variable	Coefficient		Coefficient		Coefficient		Coefficient		Coefficient		Coefficient	
DiD Effect	-0.165	***	-0.075	**	0.010	***	0.000		-0.007	***	-0.004	***
		<b>For Age 25-44</b>										
Dependent Variable	Farmday_2544_HH				Onfarm_2544_HH				Offfarm_2544_HH			
	Unmatched		Matched		Unmatched		Matched		Unmatched		Matched	
Variable	Coefficient		Coefficient		Coefficient		Coefficient		Coefficient		Coefficient	
DiD Effect	0.567	***	0.905	***	0.006	***	0.007	***	-0.018	***	-0.039	***
		<b>For Age 45-64</b>										
Dependent Variable	Farmday_4564_HH				Onfarm_4564_HH				Offfarm_4564_HH			
	Unmatched		Matched		Unmatched		Matched		Unmatched		Matched	
Variable	Coefficient		Coefficient		Coefficient		Coefficient		Coefficient		Coefficient	
DiD Effect	0.031	***	0.330	**	0.001	***	0.001		0.006	***	0.000	
		<b>For Age &gt;=65</b>										
Dependent Variable	Farmday_65_HH				Onfarm_65_HH				Offfarm_65_HH			
	Unmatched		Matched		Unmatched		Matched		Unmatched		Matched	
Variable	Coefficient		Coefficient		Coefficient		Coefficient		Coefficient		Coefficient	
DiD Effect	0.504	***	0.204		0.003	***	0.000		0.000		-0.001	*

# Estimation results: farm succession

Dependent Variable	Farm_succ_d		Farm_succ_person	
	Unmatched	Matched	Unmatched	Matched
Variable	Coefficient	Coefficient	Coefficient	Coefficient
DiD Effect	0.003 ***	0.004 ***	0.003 ***	0.005 ***

# Summary of the findings

- When the changes in annual wage in the county level is considered, we can explore the effects on the intensity margin of the shocks.
- Results are robust as the cases when the dummy indicators are used.

# Conclusion

- It is evident that the 2008-2009 financial crisis impacts the labor supply of the farm households.
- The crisis reduced the off-farm labor supply and increased on-farm labor supply. This result confirms the belief that “agriculture is a buffer to accommodate unemployment of the nonfarm labor market.”
- Among others, the effects of the family members aged 25-44 are more pronounced. If the farm policy is designed for promoting farm succession, this group of farm family members should be the target.





# The End

This is a very preliminary draft and welcome for  
any comment.

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