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On the political economy of allocation of agricultural disaster relief payments: application to Taiwan

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Abstract

This paper examines the importance of political factors in the allocation of agricultural disaster payments as a result of Typhoon Morakot that ravaged Taiwan in 2009. The instrumental variable model was estimated using a unique data set that combines a national administrative profile of the 607,704 recipients of disaster relief payments and the matched weather and geographic information. Results show that the political factor significantly determined the level of disaster relief payments. The incumbent government paid more to the farms located in towns which voted for the incumbent party to a greater extent than they did for the opposition party.

Keywords: agricultural disaster relief payment, political economy, typhoon, Taiwan

JEL classification: Q18, Q58, D72

1. Introduction

Compared with other industries, agricultural production is weather-dependent. Extreme temperatures and persistent heavy rainfall, droughts and floods result in crop failures, impacting farmers' wellbeing. Farmers are vulnerable to exogenous natural disaster shocks, especially crop farmers (Benson, 2000; Fischer, Shah and Velthuizen, 2002). Agricultural policies are designed to mitigate the losses farmers suffer as a result of natural disasters. In many countries, similar policy tools exist. For instance, the Federal Emergency Management Agency (FEMA) disaster assistance programme in the United States provides supplementary aid to farmers who have suffered from natural disasters. Ideally, these payments should be solely determined by the severity of the weather conditions and subsequent damage if the maximisation of social

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welfare is the policy objective, i.e. the amount of damage should determine the amount of compensation. However, as is this always the case, it is necessary to determine what factors, apart from weather conditions, determine the allocation of relief payments.

Research on political economics has suggested that the targeting of public funds is not always effective, as political considerations may affect their distribution (Persson and Tabellini, 2000; Rausser, Swinnen and Zusman, 2011). The debate on how political parties distribute aid to the citizenry is characterised by two competing approaches. The *core voter model*, like that adopted by Cox and McCubbins (1986), proposes that parties target their stable voter base for support. In contrast, the *swing voter model*, like that of Lindbeck and Weibull (1987), proposes that parties target policy benefits to ideologically neutral voters.[1]

The allocation of public transfers also highly depends on the political systems. In the literature of comparative polities, the importance of electoral rules and the forms of government on public transfers has been highlighted (e.g. Persson and Tabellini, 2000, 2003; Rausser and Roland, 2010; Olper and Raimondi, 2013). The general agreement drawn from the existing studies is that the majoritarian (vs. proportional) electoral rules and presidential (vs. parliamentary) systems would favour targeting specific group provisions over more broad public goods provisions because in majoritarian elections and presidential systems, politicians have more incentives to support the interests of the represented districts (Persson and Tabellini, 2000). Taiwan has a semi-presidential system with plurality elections and there are only two competing parties; therefore, we expect that regions voting for ruling party will gain.

In contrast to the large amount of empirical literature on the political economy of agricultural policy,[2] not much attention has been paid to the allocation of agricultural disaster payments. Exceptions can be found in Garrett and Sobel (2003), Garrett, Marsh and Marshall (2006) and Cole, Healy and Werker (2012). Using the state level data in the United States between 1992 and 1999, Garrett, Marsh and Marshall (2006) examined the extent to which the allocation of direct agricultural disaster payments may have been unequally distributed among the states of different political parties. They found that payments were affected more by rent-seeking opportunities than by the severity of weather conditions. Using similar data, but focusing on the FEMA disaster assistance programme, Garrett and Sobel (2003) found that presidential influences affect the rate of disaster declaration and the allocation of disaster expenditures across states. Moreover, states that are politically important to a president are more likely to be

1 Research interest in political studies has been devoted to empirically testing these two competing hypotheses. Existing evidence is disproportionately directed towards the *core voter* model. These studies find that distributive benefits flow to the strongholds of the governing party (e.g. Levitt and Snyder, 1995; Calvo and Murillo, 2004; Ansolabehere and Snyder, 2006). On the other hand, empirical studies that support the swing voter model can be found in Stein and Bickers (1994), Case (2001), Dahlberg and Johansson (2002) and Stokes (2005).

2 Comprehensive literature review can be found in de Gorter and Swinnen (2002) and Swinnen (2010).

quickly declared disaster areas; one recent study by Cole, Healy and Werker (2012) provided supporting evidence in India. The authors examined how governments respond to adverse weather conditions and how voters may react; their results show that voters may punish the ruling party when the government does not respond vigorously to a crisis.

The objective of this study is to contribute to the limited evidence of political economy on agricultural disaster relief payments using a case study of Typhoon Morakot which struck Taiwan in 2009. Some special features set our empirical study apart from previous literature. First, a large-scale farm level data set is used. The use of micro-level data rather than aggregated regional data which were commonly used in previous studies (e.g. Garrett and Sobel, 2003; Garrett, Marsh and Marshall, 2006) enables the extraction of the effect of political factors and other determinants on the allocation of emergency relief payment. Second, our study provides a case study outside the United States. To the best of our knowledge, this study is among the first to provide a case study in East Asian countries on the allocation of agricultural disaster payments.[3] The politics in Taiwan offer some advantages to an examination of the political economy on agricultural disaster payments. Taiwan is a semi-presidential system with plurality electoral rules and there are only two primary political parties, which makes the identification of the political factors a straightforward matter. Therefore, the distribution of the payments makes it a political game of the incumbent government between its political supporters and opponents. Moreover, political economy theory predicts that majoritarian electoral rules and presidential systems are associated with a narrow form of redistribution, like specific group targeted programmes (e.g. Persson and Tabellini, 2000, 2003). Most of the empirical studies address distribution between different sectors (i.e. agriculture vs. non-agriculture), and suggest that political parties in presidential systems will subsidise sectors that support them. For example, farmers who support conservative government may be supported by these parties when in power (Anderson, Rausser and Swinnen, 2013). Our study complements this category of literature by providing an empirical evidence of redistributive bias within the agricultural sector: incumbent government will provide more support to the regions that vote for them.

Using a unique data set that combines an individual farm level administrative profile of 607,704 recipients of agricultural disaster relief payments resulting from Typhoon Morakot and matching weather conditions and geographic characteristics, we find that political factors do influence the allocation of agricultural disaster relief payments. Having controlled for farm characteristics, weather and geographic heterogeneity and the potential endogeneity bias of political factors, we find that farms located in towns where the votes for the incumbent government outnumbered the votes to the opposition political party received

3 Our study is not the first to examine the relationship between agricultural production and exogenous natural shocks in Taiwan. For instance, Chang (2002) evaluated the impact of weather variation on the yields of seven major crops in Taiwan using an aggregated data set. However, her study is silent about the role of political factors.

higher payments. This result may imply that the incumbent government uses agricultural disaster relief payments as a political tool to favour their core supporters among the farmers.

2. The agricultural disaster relief system and Typhoon Morakot

Due to its semi-tropical island geographical location, Taiwan's agriculture is especially vulnerable to natural disaster shocks. Based on historical data, on average, 3.2 typhoons struck Taiwan annually between 1960 and 2010 (CoA, 2011). Heavy rainfall brought by the typhoons cause severe damage to agriculture, especially to crop production. Historical data have shown that the average annual agricultural loss from natural disaster amounts to USD 12.7 billion (CoA, 2011). To ensure farmers' economic wellbeing, the *Agricultural Natural Disaster Relief Act* (ANDRA) was launched in 1991 and agricultural disaster payments were instituted. From 2000 to 2010, the total cash compensation to farms under the ANDRA programme reached USD 935 million (CoA, 2011). Unlike the United States, where different types of agricultural insurance programmes (such as crop insurance programmes) exist, the ANDRA is the only government programme in Taiwan which provides compensation to farmers for crop loss as a result of natural disasters, somewhat similar to the FEMA programme in the United States.

Since the ANDRA is a fully sponsored government programme, the fund is provided by the central government financial budget. The management of the programme and the distribution of the fund are governed by the Council of Agriculture (CoA), where the chairman of the CoA is nominated by the presidential office. The ANDRA programme provides cash payments to the farm producers who have suffered catastrophic losses, and the cash payments are used to reimburse producers for their crop losses. The calculation of the crop losses is based on the following criteria. For crops which can be harvested by transferred cultivation, losses are calculated as 50 per cent of the total production costs; for crops that cannot be transferred for cultivation, losses are calculated as total production costs; and for crops that cannot be harvested, losses are calculated as the cost of setting up the farm.[4]

Agricultural producers have to follow the following procedure to get reimbursed under the ANDRA programme. After the occurrence of a natural disaster, farmers are requested to submit their application to the officials at the local agricultural station;[5] these officials are responsible for collecting information on all of the losses and sending them to the CoA for final inspection and approval. The CoA then determines which administrative districts are to be subsidised

4 Detailed information of the implementation of the programme can be found at http://www.boaf.gov.tw/boafwww/?a=ct&xItem=55161&ctNode=477

5 The officials of the local agricultural station are less politically dependent because each official of the station has to attend and pass the national examinations in Taiwan, and this exam is conducted by the Ministry of Examinations. In other words, no official can be directly nominated without passing the exam. Therefore, the local agricultural station is more politically independent.

based on the financial budget on hand. As a result, the approval of the application is determined by the central government, and local officials and politicians have low influence on the disaster payments. Regardless of the severity of the disaster, available budgets are always limited, so there is no discretionary budget to meet the financial needs of all the farms who have applied for reimbursement; as a result, it is interesting to see how the government distributes its limited financial budget among these applicants.

Among all the other agricultural disasters, Typhoon Morakot caused the most severe damage to agricultural production in recent years. On 7 August 2009, it made landfall in Taiwan, and the next day, the storm broke over the waters of the Taiwan Strait. The extreme amount of rain caused severe flooding throughout southern Taiwan and triggered enormous mud- and rock-slides in mountainous areas. It was the deadliest typhoon-related disaster in Taiwan in the past 50 years, leaving 650 people dead and roughly USD 3.2 billion in damages (Yen *et al.*, 2011). Southern Taiwan, the major agricultural production zone, received the heaviest torrential rainfall, ranging from 500 to 1,500 mm (20–60 inches) over most parts of the island, 1,500 to 2,500 mm (60–100 inches) in many cities and counties in central and southern Taiwan (Xu *et al.*, 2011). The total loss in agricultural production was about USD 635 million, with USD 333 million in crop production losses (CoA, 2011).

3. Politics in Taiwan

Chiang Kai-shek's son, Chiang Ching-kuo's, implemented a semi-presidential system with one congress, under the *Kuomintang* (KMT) political party. The one-party dictatorship system was changed into a two-party system with the establishment of the *Democratic Progressive Party* (DPP) in 1986 (Lay, Yap and Chen, 2008).

In 1996, direct presidential elections were introduced and every citizen eligible for political affairs had a civil right to vote for the president. The winning rule of the national presidential election, held once every 4 years, depends on a plurality rule of the entire voting population, rather than that in a majority of the districts. These changes also gave the president the power to appoint and remove many officials without the endorsement of the premier, and the power to issue emergency decrees; as a result, the presidency became a powerful political office (Shen, 2011).

There were only two candidates in the 2008 presidential campaign, representing the KMT and DPP party, respectively. On 22 March 2008, voters elected the candidate of the KMT party as president. He out-polled the candidate of the DPP party by a 2.2 million vote margin of 58–42 per cent.[6] The geographic distribution of the vote ratio (DPP votes/KMT votes) aggregated at the township level is depicted in Figure 1. There are 7,506 towns in Taiwan; in 2,462 towns, the DPP

6 Detailed information on the election outcomes can be found in the Central Election Commission website http://www.cec.gov.tw/bin/home.php

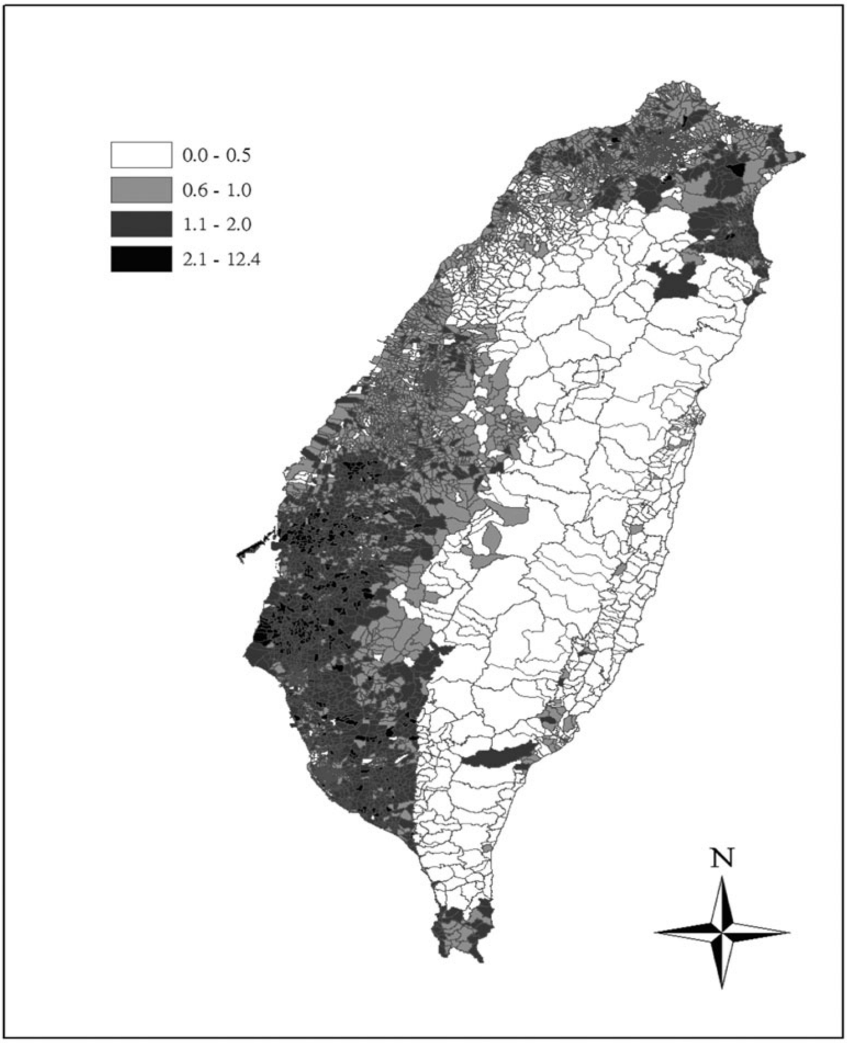

Fig. 1. Distribution of the political parties in Taiwan (at the township level). *Note*: The measured variable is the vote ratio (DPP votes/KMT votes). In total, there are 7,506 towns in Taiwan, and the average vote ratio of DPP votes over the KMT votes is 0.89. These data were provided by the Central Election Commission in Taiwan.

votes were more numerous (we use the term 'DPP towns' hereafter), while in 5,044, the KMT votes were greater (we use the term 'KMT towns' hereafter). Given that the average vote ratio in the township level is 0.89 and the number of KMT towns is much larger than the DPP towns, it can be seen that the total votes in KMT towns are less than the ones in DPP towns.

Since our analysis is based on the disaster payments for farmers, it is important to know the number of farmers in the KMT and DPP towns. To do this, we plotted the share of farm population over the entire population (measured by the number of farm households over the total number of households) at the township level in Figure 2.[7] In total, the average share is 19 per cent of the 7,506 towns. Among the 5,044 KMT towns, the average share is 15 per cent, while it is 27 per cent among the 2,462 DPP towns, with a higher share of farm households in the southwest part of the island. More solid evidence of farmers' political identify is provided by looking at the relationship between the vote ratio and the share of the farm population (Figure 3). It appears that these two variables are positively correlated, which means that farmers are more likely to support the DPP party.[8]

4. Data

Data used in this study are unique; in what follows, we describe each of the data sources in detail.

4.1. National administrative applicant profile

The primary data set is a national administrative profile of all of the crop farms which submitted an application for agricultural loss due to Typhoon Morakot, under the ANDRA programme. This profile was collected from the Agriculture and Food Agency of the Council of Agriculture in Taiwan, and contains information on the farms which received disaster relief payments.[9] The information details farm types, farm size, total received payments and the geographic location of each recipient. Consistent with the information contained in this data set, we specified a continuous variable as the total disaster payment that each farm received due to Typhoon Morakot. In addition, a continuous variable of the total planned farmland area in the beginning of 2009 is included. Several dummy variables are also specified for rice (the reference group), special crops, vegetables, fruit and other crop farms. As with other large-scale administrative data, not much information on the socio-demographic characteristics of the recipients, such as age, education, farm household structure, etc., is documented. After deleting those with missing values on the selected variables, the final sample used for the empirical analysis consists of 607,704 crop farms.

4.2. Weather and geographical data

Although it would be ideal to merge the weather information with the exact geographic location of each farm, it is not possible to do so due to the

7 It would be ideal to use the share of agricultural voters in the total electorate. However, this information is not available in that individual vote outcome is always difficult to collect. We can only collect the national data on the total number of farm households and total households in each town.

8 In Figure 3, we plotted the observed data, and depicted the fitted pattern from the linear and nonparametric kernel regression model.

9 In total, approximately 675,000 farms submitted applications; of which, about 92 per cent of the farms that applied for relief payments were approved by the government.

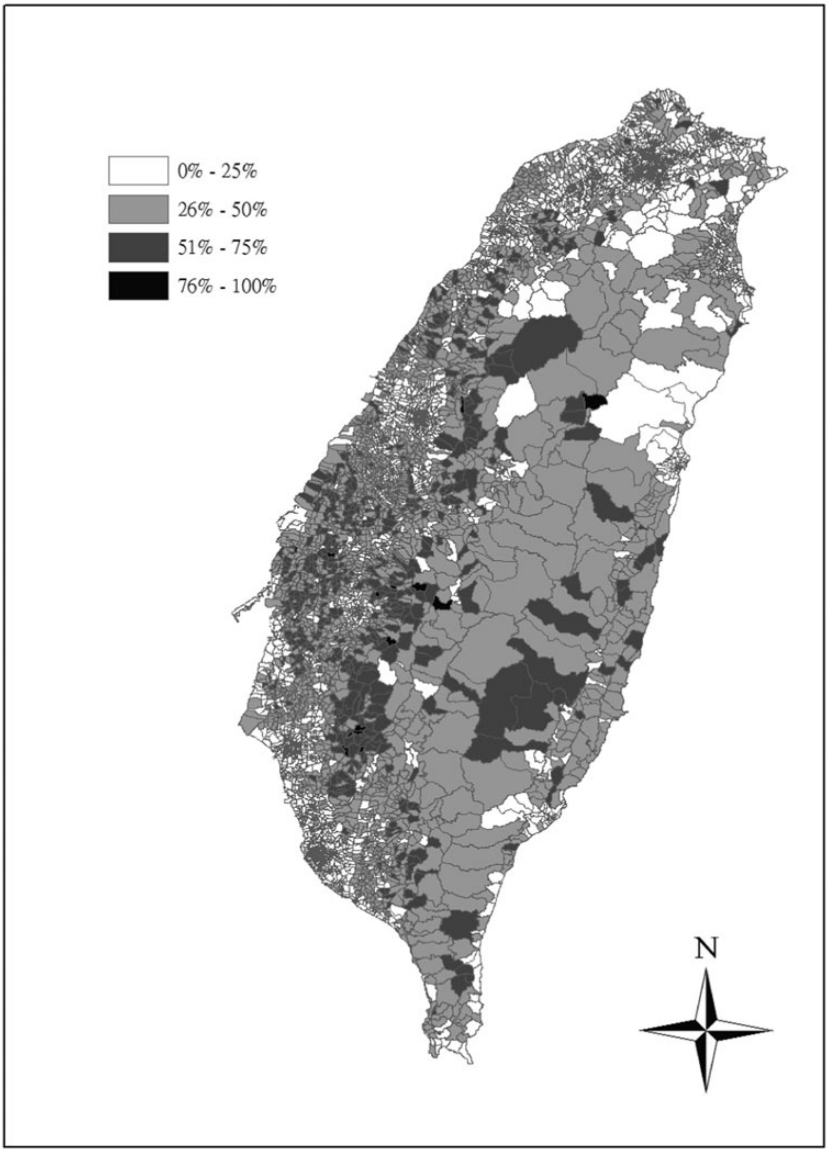

Fig. 2. Distribution of the ratio of the number of farm households over the total number of households in Taiwan (at the township level). *Note:* The measured variable is the ratio of the number of farm households over the total number of households. Therefore, a large value of this measure indicates a large share of farm households. In total, there are 7,506 towns in Taiwan and the average share of the farm household is 19 per cent. The data of the number of farm households were provided by the Council of Agriculture, and the data of the total number of households were provided by the Ministry of Interior in Taiwan.

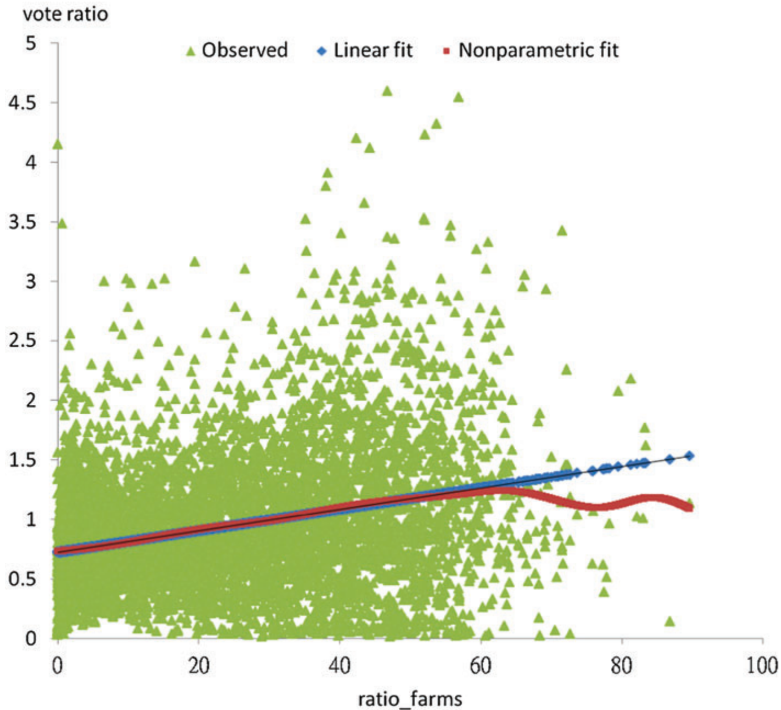

Fig. 3. Correlation between vote ratio and the share of farms (at the township level). *Note*: *Y*-axis is the vote ratio (DPP votes/KMT votes) in each town, and the *X*-axis is the share of farm households over the total number of households in each town. In total, there are 7,506 towns in Taiwan. The fitting function is specified as: vote ratio $= f$ (ratio_farms) $+ \varepsilon$. The parametric linear model and a non-parametric kernel regression model are used for model estimation.

confidentiality rule of the data collection. To overcome this drawback, we followed a common approach used in previous studies, merging the weather station data and the farm location at the township level (e.g. Garrett, Marsh and Marshall, 2006). There are 322 weather stations in Taiwan, and daily weather information was collected in each weather station. These data were used to monitor and predict weather conditions throughout Taiwan's 7,506 towns; the average town area is approximately 765 hectare. By employing Geographic Information Systems (GIS) mapping techniques, we first identified the nearest weather station of each town and used this station as the representative weather station of the town. Weather data of the representative station of each town were then merged with individual farm data based on the township level. In regard to weather characteristics, the cumulative precipitation and maximum wind speed variables were specified to reflect weather conditions in the local area where each farm is located. We used a 3-day-average record of precipitation and wind speed collected in the weather stations managed by the Central Weather Bureau.[10]

We also specified several variables to capture geographic heterogeneity in the township level by matching the natural environment maps provided by the Construction and Planning Agency, and geographic location of the towns using the GIS technique. Several dummy variables are specified to indicate if the town is covered by hilly land area, located in a manufacturing developed area, or water protection zone, or in a natural protection zone. In addition, two variables are included for the average slope and altitude of each town, based on the central point of each town, as provided by the National Land Survey Center.

4.3. Presidential election profile

The election outcome or political preference of the individuals is always difficult to collect for empirical analysis; self-reported values may likely differ from the realised election outcome. To find a more objective measure of political preference, we used the township level election outcome data merged with each farm at the town level drawn from the 2008 presidential election in Taiwan, the year before Typhoon Morakot struck. The data set was supplied by the Central Election Commission. The 2008 presidential election data set was used because the presidential election is a nationwide election in Taiwan, so the ballots are nationally representative. Second, the 2008 data are the closest to this event. Because there were two candidates for the 2008 presidential election (KMT vs. DPP), the votes were specified. Accordingly, we created a dummy variable which indicated whether or not the votes to the DPP (opposition party) were more numerous than the KMT's (incumbent party). We constructed a continuous variable of the vote ratio in each town, defined by the ratio of the total votes of the DPP party to the total votes of the KMT party.

We also drew data from the presidential election outcomes in 2004 and 2000 with dummy variables to indicate if a town had more DPP or KMT votes, as well as a continuous measure for the vote ratio of the DPP party over the KMT party at the township level of each year data set. These lagged variables of the political variables in 2004 and 2000 were then used as the instruments for the 2008 election variable to avoid the potential endogeneity bias between the political factors and disaster payments; it is a popular method used in political science studies to deal with this issue (e.g. Gerber, 1998; Lau and Pomper, 2002).[11] In the empirical analysis, we performed some statistical tests to justify the validation of the selected instruments.

10 Typhoon Morakot hit Taiwan between 7–10 August 2009, and the most serious damage occurred in 7–9 August (Liu *et al.*, 2010); therefore, we used these 3 days' average rainfall and maximum wind speed data.

11 Sovey and Green (2011) provided a comprehensive review of the studies in political science that used the instrumental method to address the endogeneity issue. They concluded that using the lagged variable is popular in research in this area.

4.4. Other explanatory variables

Since farmers may have learned from previous disaster shocks and thus adapted their strategy to apply for the ANDRA payments, we specified a continuous variable to indicate the average ANDRA payment at the town ship level between 2006 and 2008 (aggregated data were provided by Council of Agriculture).

Since farm population is not equally distributed between DPP and KMT towns (Figures 1–3), it was important to control for the differences in the share of farm population, so we specified an explanatory variable for the share of the number of farm households to the total number of households in the township level in 2009 (these data were provided by the Council of Agriculture and the Ministry of Interior).

In addition to the average value of climate condition, we also include the square terms of the weather variables to capture the potential non-linear effects of climate condition on farm production (e.g. Mendelsohn, Nordhaus and Shaw, 1994; Wang *et al*., 2009). Moreover, several interaction terms between crop types and weather variables are included because some crops are more rain/wind resistant than others.

4.5. Sample statistics of the selected variables

In our sample, 1,032 towns were included and matched with the individual farm data. The geographic allocation of these hardest hit towns in southwest Taiwan is depicted in Figure 4. By mapping Figure 4 with Figures 1 and 2, it appears that the study area has the highest concentration of farms, with 487 KMT towns and 545 DPP towns.

Sample statistics of the variables are presented in Table 1. The total sample included 607,704 recipients of the disaster relief payments, with 70 per cent in a DPP town and 30 per cent in a KMT town. Without controlling for other non-political determinants of the disaster payments, farms in a KMT town received more payments compared with those in a DPP town (NTD 7,850 vs. NTD 6,200), on average. To underscore the extent to which disaster payments may correspond to the intensity of the political identity, we present a sample distribution of the payments by various categories of the vote ratio (DPP votes/KMT votes) in Table 2. It appears that farms located in a town with a smaller value of vote ratio received high payments. Interestingly, only 30 per cent of the recipients were located in KMT towns (i.e. vote ratio <1), but they had 38 per cent of the total payments.

Weather and geographic characteristics also differ for farms located in these two different types of towns (Table 1). For instance, the 3-day average amount of precipitation and wind speed for farms located in opposition party territory was larger than in the case of farms in the incumbent party territory. This is interesting because farms which suffered more severe damage should have received higher payment in maximising social welfare. However, the simple sample statistics show that while farms located in DPP towns suffered more severe weather

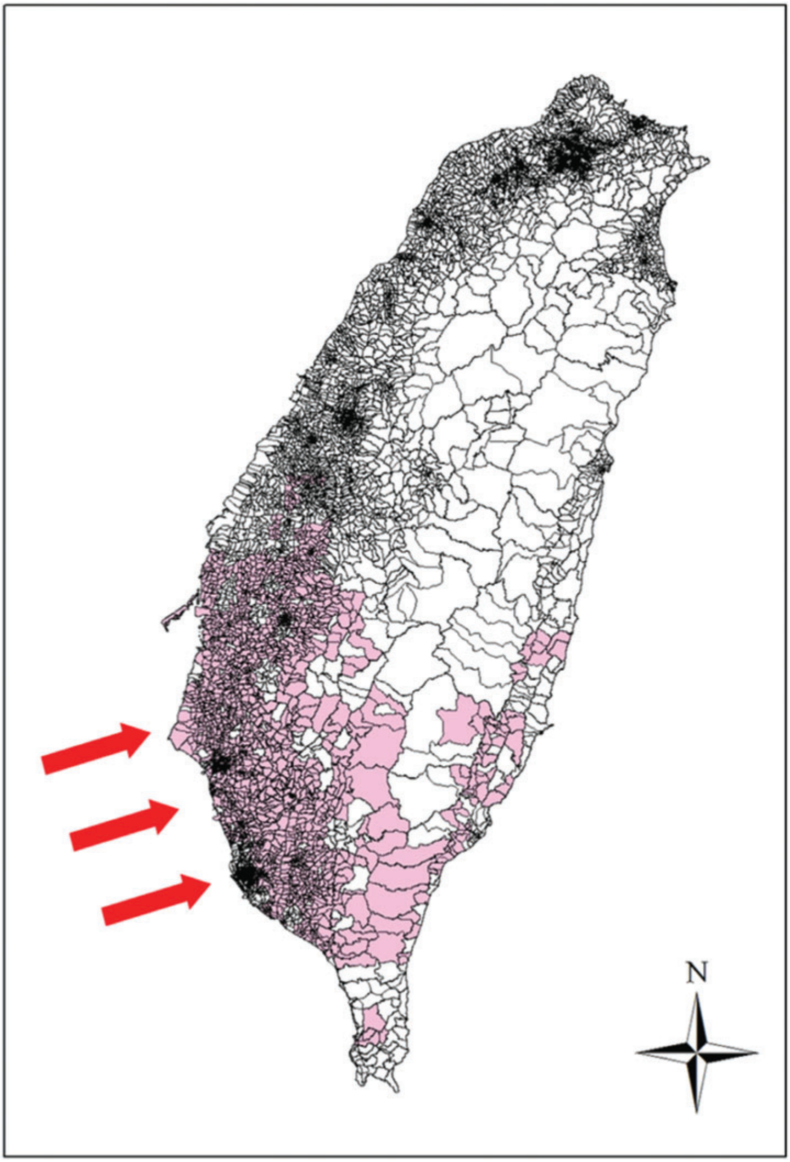

Fig. 4. Study area in the selected sample (at the township level). *Note*: In total, 1,032 towns are included in our sample. Of which 545 (53 per cent) are towns where the votes to the DPP party are larger than those of the KMT party, while 487 (47 per cent) are towns where the DPP votes are smaller than those of the KMT votes.

conditions, they received lower payments compared with their counterparts of farms in KMT towns. This finding attests to the importance of political factors in the allocation of the disaster payments.

Table 1. Sample statistics of the selected variables

Group		Full Sample		DPP party (opposition party)		KMT party (incumbent party)		
Sample size		607,704		425,503 (70%)		182,201 (30%)		
Variable	Definition	Mean	SD	Mean	SD	Mean	SD	Difference (DPP − KMT)
Individual application data								
Payment	Received disaster payments (NTD 1,000)	6.69	11.64	6.20	10.23	7.85	14.34	−1.65***
Farm size	Farmland area (hectare)	0.70	0.83	0.66	0.72	0.78	1.01	−0.12***
Rice	If rice farm (=1)	0.27	0.44	0.28	0.45	0.24	0.43	0.04***
Special crop	If special crop farm (=1)	0.12	0.33	0.13	0.33	0.11	0.31	0.02***
Vegetable	If vegetable farm (=1)	0.23	0.42	0.22	0.42	0.23	0.42	−0.01***
Fruit	If fruit farm (=1)	0.35	0.48	0.34	0.47	0.38	0.48	−0.04***
Other crops	If other crops farm (=1)	0.03	0.18	0.03	0.17	0.04	0.20	−0.01***
Aggregated township data								
Vote ratio	Vote ratio (DPP votes/KMT votes) in 2008 election	1.32	0.62	1.59	0.55	0.71	0.21	0.87***
Vote ratio_lag1	Vote ratio (DPP votes/KMT votes) in 2004 election	1.89	0.86	2.25	0.78	1.08	0.33	1.17***
Vote ratio_lag2	Vote ratio (DPP votes/KMT votes) in 2000 election	1.07	0.46	1.26	0.41	0.63	0.20	0.63***
Ratio_farms	Number of farm households over total households	0.40	0.20	0.43	0.14	0.33	0.14	−0.10***
Disasters	Average disaster payments between 2006 and 2008 (NTD 1,000/farm)	4.88	4.96	4.76	4.75	5.16	5.40	−0.40***
Rainfall	3-day average precipitation (mm, divided by 100)	5.71	3.21	6.19	3.29	4.60	2.70	1.59***
Wind	3-day average wind speed (m/s, divided by 10)	2.51	0.50	2.62	0.37	2.27	0.65	0.35***
Hilly land	If located in hilly land area (=1)	0.06	0.23	0.05	0.21	0.09	0.28	−0.04***

(*continued*)

Table 1. (*continued*)

Group		Full Sample		DPP party (opposition party)		KMT party (incumbent party)		
Sample size		607,704		425,503 (70%)		182,201 (30%)		
Variable	Definition	Mean	SD	Mean	SD	Mean	SD	Difference (DPP − KMT)
Manufacture	If located in manufacturing developed area (=1)	0.02	0.13	0.01	0.11	0.03	0.16	−0.01***
Water preservation	If located in water preservation area (=1)	0.15	0.36	0.15	0.35	0.16	0.36	−0.01***
Protection zone	If located in natural resource protection zone (=1)	0.01	0.11	0.01	0.11	0.01	0.12	0.00***
Slope	Slope (°)	2.95	6.73	2.33	5.19	4.41	9.21	−2.09***
Altitude	Altitude (m)	73.64	109.88	42.73	76.55	145.83	154.68	−103.10***

Note: The exchange rate as of June 2013 was 1 USD = NTD 30 approximately.
*** indicates the significance at 1 per cent level.

Table 2. Sample statistics of payments by vote ratio

	Number of farms		Payments	
Vote ratio	Total number of farms	Share of number of farms (%)	Average payments (NTD 1,000/farm)	Share of total payments (%)
<0.25	8,207	1	18.19	4
[0.25, 0.5)	21,545	4	13.83	8
[0.5, 0.75)	59,665	10	6.25	10
[0.75, 1.0)	92,681	15	6.58	16
[1.0, 1.25)	152,473	25	6.78	28
[1.25, 1.5)	92,640	15	6.61	17
[1.5, 1.75)	63,337	10	5.93	1
[1.75, 2.0)	26,676	4	4.78	4
≥2	90,480	15	5.40	13

Note: 1 USD is approximately equal to NTD 34. Vote ratio = votes of the DPP (opposition) party/votes of the KMT (incumbent) party. The exchange rate as of June 2013 was 1 USD = NTD 30 approximately.

5. Econometric strategy

To examine the effect of the political factors on disaster payments and to control for potential endogeneity, our empirical analysis is built on a two-equation system where the first equation specifies the political identity and the second specifies the disaster payment. Let the continuous variables y_i indicate the received payments for ith farm, and let DPP_i be the dummy indicator whose value is equal to 1 for the DPP party in 2008 election year, 0 otherwise. The vector x_i represents other exogenous determinants of the payments, including the individual farm production characteristics, weather and geographic conditions, etc. (Table 1). Regional heterogeneity is also controlled by including 23 dummy variables of the administrative districts in Taiwan to remove the unobserved variations in the allocation of the disaster payments across regions. z_i is a vector of the selected instruments (i.e. the lagged variables of the political factors), and ε_{1i} and ε_{2i} are the random errors. The linear equation system can be specified as:

$$\begin{aligned} DPP_i &= z_i'\alpha_1 + x_i'\alpha_2 + \varepsilon_{1i} \\ y_i &= DPP_i \times \beta_1 + x_i'\beta_2 + \varepsilon_{2i}, \end{aligned} \tag{1}$$

where, α_1, α_2, β_1 and β_2 are the parameters to be estimated. The parameter β_1 then captures the effect of the political factor on payments, after controlling for the individual farm's characteristics, weather and geographic heterogeneity, and the potential endogeneity. The consistent estimates α_1, α_2, β_1 and β_2 can be obtained by using the standard instrumental variable two-stage least-squares regression method (IV-2SLS).[12] Following Cole, Healy and Werker (2012), we also account for potential spatial correlation of error terms using the clustered standard errors in the township level.

A simple dummy variable DPP_i is specified for the political identification in equation (1). Although using a simple dummy variable explores the effect of different political effects on payments, it is not appropriate for further investigating the intensity of political effects on the allocation of payments. To overcome this drawback, a variable representing the vote ratio of the opposition party over the incumbent party in each town is defined (i.e. total votes of the DPP party/total votes of the KMT party). Our second empirical model can then be specified as:

$$\begin{aligned} vote_i &= z_i'\alpha_3 + x_i'\alpha_4 + \varepsilon_{3i} \\ y_i &= vote_i \times \beta_3 + x_i'\beta_4 + \varepsilon_{4i}, \end{aligned} \tag{2}$$

where α_3, α_4, β_3 and β_4 are the parameters to be estimated, and ε_{3i} and ε_{4i} are the random errors. A similar strategy used in equation (1) to correct for the endogeneity of the political factor is applied to equation (2). Because the vote ratio of these two political parties is used as the dependent variable in equation (2), we now use the lagged variables of the vote ratios of the previous presidential elections in 2004 and 2000 as the instrumental variables (z_i). The IV-2SLS method is used to estimate the parameters α_3, α_4, β_3 and β_4 in equation (2) with clustered standard errors in the township level.

6. Empirical results

Our empirical results are presented in several tables. Table 3 represents the estimation results of the payment equation in which the political identity is specified as a dummy variable (the variable *DPP Party*). As an alternative, Table 4 presents the estimation results of the payment equation using a continuous variable for the vote ratio of these two parties (the variable *Vote ratio*).

6.1. Validation of the selected instruments

Before discussing the estimates of the models, we report on some statistical evidence to support our instruments. The Hausman–Wu test was conducted to see whether the political variables are actually endogenous in the payment equation. The test results are 33.51 and 64.56 in Tables 3 and 4, respectively. Both of the models reject the null hypothesis that the political variable is exogenous at the 5 per cent significant level.

The second test we conducted is related to weak instruments. The F-test is used to test the null hypothesis that the instrumental variables are jointly

12 Detailed discussions of the IV-2SLS method can be found in Wooldridge (2010).

Table 3. Estimation of the payment equation (using a binary indicator of political party)

Variable	First stage Coefficient	First stage SE	Second stage Coefficient	Second stage SE
DPP Party			−1.048**	0.523
DPP Party_lag 1	0.409***	0.050		
DPP Party_lag 2	0.392***	0.049		
Farm size	−0.017	0.013	45.700***	1.791
Disasters	0.006	0.006	0.023	0.041
Ratio_farms	0.628***	0.130	2.326***	0.905
Rainfall	−0.035	0.073	0.285*	0.157
Rainfall square	0.003	0.005	−0.024*	0.013
Wind	0.635***	0.249	2.616***	0.775
Wind square	−0.104***	0.042	−0.433***	0.133
Hilly land	0.140*	0.081	3.613***	1.148
Manufacture	0.099	0.168	0.335	0.305
Water preservation	−0.098*	0.054	−0.042	0.500
Protection zone	−0.049	0.103	−0.763	1.652
Slope	−0.001	0.004	0.014	0.027
Altitude	0.000*	0.000	0.003***	0.001
Special crop	−1.338***	0.492	−4.343	4.146
Fruit	−0.110	0.396	1.704*	1.009
Vegetable	0.076	0.369	15.168***	2.839
Other crop	−0.012	0.333	4.205	2.766
Special crop × rainfall	0.123	0.087	−0.438	0.326
Special crop × rainfall sq.	−0.007	0.006	0.034	0.023
Special crop × wind	0.700*	0.373	3.533	2.733
Special crop × wind sq.	−0.117*	0.065	−0.598	0.425
Fruit × rainfall	0.090	0.067	0.022	0.195
Fruit × rainfall sq.	−0.005	0.005	0.001	0.015
Fruit × wind	−0.031	0.283	−0.165	0.676
Fruit × wind sq.	−0.013	0.052	−0.092	0.132
Vegetable × rainfall	0.064	0.073	−1.379***	0.344
Vegetable × rainfall sq.	−0.004	0.005	0.067***	0.018
Vegetable × wind	−0.228	0.255	0.158	2.083
Vegetable × wind sq.	0.048	0.043	−0.207	0.355
Other crop × rainfall	0.037	0.079	0.990**	0.455
Other crop × rainfall sq.	−0.003	0.005	−0.024	0.026
Other crop × wind	−0.060	0.240	−3.755**	1.615
Other crop × wind sq.	0.015	0.041	0.554*	0.344
Constant	−0.965***	0.364	−1.606	1.140
Statistical tests				
Endogeneity test[a]	33.512			
Weak IV test[b]	134.487			

Note: DPP party = 1 if the DPP votes (opposition party) > the KMT votes (incumbent party). 23 dummy variables for administrative districts are included.
[a]H^0: The variable *DPP Party* is exogenous. The critical value is $x^2(1,0.95) = 3.841$.
[b]H^0: The variables *DPP Party_lag1* and *DPP Party_lag2* are weak instruments. The weak identification test critical value is 10 (Staiger and Stock, 1997).
***, **, * indicate the significance at 1, 5 and 10 per cent level.
Standard errors (SE) are clustered at the township level.

Table 4. Estimation of the payment equation (using a continuous variable for vote ratio)

	First stage		Second stage	
Variable	Coefficient	SE	Coefficient	SE
Vote ratio			−0.214***	0.084
Vote ratio_lag1	0.644***	0.050		
Vote ratio_lag2	0.109*	0.064		
Farm size	0.002*	0.001	45.082***	0.775
Disasters	0.003**	0.001	0.020	0.041
Ratio_farms	0.163**	0.069	1.558**	0.782
Rainfall	−0.078***	0.024	0.241*	0.127
Rainfall sq.	0.005**	0.002	−0.023**	0.011
Wind	0.148	0.114	1.671***	0.377
Wind sq.	−0.035	0.024	−0.266***	0.065
Hilly land	0.116***	0.026	3.539***	1.212
Manufacture	−0.013	0.033	0.209	0.267
Water preservation	0.005	0.019	0.076	0.494
Protection zone	−0.077***	0.030	−0.913	1.785
Slope	0.000	0.001	0.016	0.028
Altitude	0.000***	0.000	0.003***	0.001
Special crop	−0.535**	0.212	−2.887	3.871
Fruit	−0.312**	0.155	1.787**	0.809
Vegetable	−0.241	0.157	15.065***	2.830
Other crop	−0.132	0.149	3.933	2.908
Special crop × rainfall	0.070**	0.036	−0.559**	0.271
Special crop × rainfall sq.	−0.004*	0.002	0.040**	0.019
Special crop × wind	0.284*	0.157	2.813	2.526
Special crop × wind sq.	−0.042	0.031	−0.486	0.385
Fruit × rainfall	0.054**	0.025	−0.040	0.171
Fruit × rainfall sq.	−0.003*	0.002	0.004	0.014
Fruit × wind	0.184	0.146	−0.131	0.561
Fruit × wind sq.	−0.036	0.031	−0.088	0.112
Vegetable × rainfall	0.051**	0.024	−1.408***	0.320
Vegetable × rainfall sq.	−0.004*	0.002	0.069***	0.016
Vegetable × wind	0.097	0.131	0.408	2.064
Vegetable × wind sq.	−0.009	0.027	−0.267	0.349
Other crop × rainfall	0.055**	0.027	0.976**	0.477
Other crop × rainfall sq.	−0.004*	0.002	−0.022	0.027
Other crop × wind	0.051	0.114	−3.454**	1.661
Other crop × wind sq.	−0.015	0.024	0.491	0.354
Constant	−0.040	0.140	−0.266	0.603
Statistical tests				
Endogeneity test[a]	64.564			
Weak IV test[b]	93.625			
Linearity test[c]				

Note: Vote ratio = total DPP votes (opposition party)/total KMT votes (incumbent party). 23 dummy variables for administrative districts are included.

[a]H^0: The variable *DPP Party* is exogenous. The critical value is $x^2(1,0.95) = 3.841$.

[b]H^0: The variables *Vote ratio_lag1* and *Vote ratio_lag2* are weak instruments. The weak identification test critical value is 10 (Stock and Yogo, 1997).

[c]H^0: The effect of vote ratio is linear.

***, **, * indicate the significance at 1, 5 and 10 per cent level. Standard errors are clustered at the township level.

equal to zero in the first stage equation of political factors. As suggested by Staiger and Stock (1997), an F statistic below 10 is cause for concern for weak instruments. The results of the F-test in Tables 3 and 4 are 134 and 93, which rejected the null hypothesis that the instruments *DPP_lag1* and *DPP_lag2* are jointly equal to zero.

6.2. Effects of the political factors on disaster payments

With respect to the effect of the political factors on received payments, our results point to a negative association between the opposition political party identification and the received payments (the variable *DPP party* in Table 3). Results show that farms in the DPP towns received lower disaster relief payments by NTD 1,048 compared with their counterparts of farms in the KMT towns, other things being equal.

Given the negative association between the opposition political identification and the received payments, we further explored the relationship between the intensity of political identify and the payments. Table 4 presents the estimation result of the payment equation when a continuous variable of vote ratio is defined as the political power for the opposition party over the incumbent party (the variable *Vote ratio*). Results presented in Table 4 confirm the primary finding in Table 3 of the negative association between the opposition party identification and the received payments. After controlling for other factors related to payments, it is evident that the effect of the vote ratio on disaster payment is −0.214 (the variable *vote ratio* in Table 4).

Our result of a negative association between the political identification of the opposition political party and the received disaster payments is consistent with the prediction of the *core voter* model in political economy studies. Cox and McCubbins (1986) argued that risk-averse politicians may target transfers or political resources to core supports because the responsiveness of swing voters to receiving transfers is less predictable than that of core voters. Nichter (2008) also found that targeting transfers to core supports produce greater electoral rewards if monetary transfers can affect the turnout of the voters.[13]

Our findings are also relevant to the growing political economy literature which highlights the importance of electoral rules and forms of government on the composition of government spending. Political economy theory predicts that majoritarian (vs. proportional) elections and presidential (vs. parliamentary) systems give the politicians greater incentives to target transfers to geographically smaller constituency groups (Persson and Tabellini, 2000,

13 The agreement of our findings with the *core voter* model should call for caution because it may depend on the financial budget of the incumbent government. With a limited financial budget, such as in our case, the incumbent government is more likely to succeed in supporting core voters. However, the story may differ if the incumbent government has enough monetary transfers. In this case, the incumbent government may support not only the core voters but also the voters who do not have stable political preferences (i.e. swing voters). We thank an anonymous reviewer for this observation.

2003; Rausser and Roland, 2010). Given that the agricultural disaster programme is a targeted programme and Taiwan has a semi-presidential system with plurality election rule of two competing political parties, our results point out that incumbent government would pay more disaster payments to the farmers located in the region dominated by the incumbent party, other things being equal. This result indicates a redistributive bias towards specific political groups which is more commonly to be observed in presidential (vs. parliamentary) or majoritarian (vs. proportional) systems. Our study provides empirical evidence of redistributive bias of political factors within the agricultural sector which complements most of the existing studies that only examined the distribution between agricultural and non-agricultural sectors (e.g. Anderson, Rausser and Swinnen, 2013).

6.3. Effects of other determinants on disaster payments

In addition to political factors, the production practices of a farm, weather condition and geographic heterogeneity, the distribution of farm population and other factors also matter in regard to disaster payments. The effects of these variables are pretty robust across models using different specifications of the political variables (Tables 3 and 4). In what follows, we briefly discuss the effects of the non-political factors on disaster payments based on the results presented in Table 4.

Consistent with our expectation, large farms received higher payments: an additional hectare increase in farmland area increased the disaster payments by NTD 45,082. It is also not surprising to see a positive association between the number of farm population and disaster payments (the effect is 1.558). The results also indicate that high value crop farms (such as vegetable and fruit farms) receive higher payments. Other things being equal, vegetable and fruit farms receive higher payments by NTD 1,787 and NTD 15,065, respectively, compared with rice farms (the reference group). As introduced in Section 2, the criteria of cash compensation made to farms were based on the production costs of the farm. As a result, it is not a surprise to see that farms growing different crops received different disaster payments.

The heterogeneity in weather conditions also plays an important role on payments. Precipitation and maximum wind speed significantly determine the disaster payments, and the effect is non-linear. Moreover, heavier rainfall and higher wind speed result in larger disaster payments, but at a decreasing rate. This finding is in accordance with that of Fronstin and Holtmann (1994) who studied residential property damage resulting from hurricane Andrew in the southeastern part of Florida in the United States in 1994. Results also show that disaster payments were unequally distributed to farmers located in an area of different geographic conditions. The altitude of the area where each farm is located is positively associated with the payments, since farms located in higher and steeper areas are more vulnerable to natural hazards. Similarly, farms located in the hilly land areas received higher disaster payments by NTD 3,539. Finally, the significance of the interaction terms between weather conditions and crop types confirms our hypothesis that different crops may have different resiliency to weather shocks.

7. Conclusions

Agricultural production has been adversely influenced by climatic variability and extreme weather, and the sensitivity of agricultural production to weather risks suggests the increasing need for agricultural disaster relief assistant programmes. Given the financial budget constraint of governments, determining how payments are distributed is an interesting policy question. If maximisation of social welfare is the only policy goal, the distribution of payments should be solely determined by the severity of the shocks. However, findings in political economy literature suggest that the political factor may be crucial in determining the distribution of the public resources. This paper contributes to this research topic by assessing the extent to which agricultural disaster payments are determined by political factors.

Using a unique data set that combines the national administrative farm profile of the disaster payments and the matched weather and geographic characteristics of Typhoon Morakot in Taiwan in 2009, this study reveals some interesting findings. First, our results point out the importance of the endogeneity bias between political factors and the distributed payments. Second, farms located in a town where the votes to the incumbent government are larger than those to the opposition party receive higher subsidies. This result demonstrates that the farms in a more politically loyal area receive higher payments. The policy implication of this primary finding is straightforward: incumbent governments use agricultural disaster relief payments as a political tool to favour their core supporters. Therefore, a more efficient management of the agricultural disaster relief system is needed to eliminate the political bias.

A few caveats of this study pertain. First, only the recipients of the disaster payments are included. If data of all of the applicants become available, we can examine how the political factors affect the likelihood of receiving payments. Second, it would be interesting to further control for the bias that the payments might have been lower than the true value of the damages if more detailed information became available. Another drawback of our study is the limited information of individual farm characteristics (such as household income, part-time farms etc.). Our results could be more robust if more such information were available. Moreover, if panel data became available, future research could investigate whether the incumbent government may not only target 'high', but also 'stable' political supporters. Finally, our results are drawn from the semi-presidential system with plurality election rule in Taiwan. Since political economy models predict that a different political system and election rule may affect redistributive policy in different directions, future studies could apply our analytical framework to other countries with different political systems to see how different electoral rules and forms of government may result in different findings. Moreover, our study is more related to the scenario of post-election competition. Therefore, we cannot comment on the allocation of disaster payments for the pre-election political competition.

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