The impact of policy agricultural insurance on the production behavior of peasant households and a measurement of moral hazard[1]: A natural experiment research based on hog insurance

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Abstract

To better adjust pro-agricultural policies and the relevant fiscal subsidy policies, it is important to measure the impact of policy agricultural insurance on the production behavior of peasant households. Measuring moral hazard can be really tough since it is hard to peel heterogeneity of a sample. By natural experiment, this study separate moral hazard and adverse selection of insurance. The results find that the existence of agriculture insurance notably increase the death rate of hogs. Besides, having hog insurance will increase peasants' report willingness of severe epidemic situation, while decrease their efforts on risk management. This study provide experimental basis to better adjust policy agricultural insurance. Besides, the study peels heterogeneity of the sample, making its research results more accurate, which may theoretically expand the current researches.

Key Words: Agricultural insurance; Production behavior of peasant households; Moral hazard; Experiment economics

JEL: Q14, Q18, G22

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Introduction

To meet the requirement of Green Box Policy supported by WTO Agriculture, China has paid high attention to the role of agricultural insurance in pro-agricultural policies since 2004. In 12 years the No. 1 document from the national central government has put forward a series of requirements, including the establishment of policy agricultural insurance system, perfection of agricultural insurance mechanism and innovation of agricultural insurance products. Agricultural insurance includes crop insurance and breeding insurance. More specifically, the peasant households buy insurance for their crops or livestock. When it comes to natural disasters, part of their losses will be covered by the insurance company. In China, the premium income of agricultural insurance reached to ￥37.49 billion in 2005, 42.4 times to the number in 2006, and the average development speed is 51.65%, fastest in the world[1].Nowadays, the total premium income of Chinese agricultural insurance ranks the second most in the world, less than the USA. Such a quick developing speed of Chinese agricultural insurance can mainly attribute to two reasons, high premium subsidy and government's impelling. In 2005, the agricultural insurance subsidy from central, provincial and municipal governments has summed up to 76.82% of the total premium income. In the meantime, insurance companies can receive business tax exemption of agricultural insurance products and regulation fee exemption of agricultural insurance business. Up to now, policy agricultural insurance has become one of the main policies supporting agricultural production in China.

It should be noticed that the Chinese breeding insurance scale is the biggest in the world.The central government has offered premium subsidy to reproductive sow insurance since 2007, and further to hog insurance in 2008[2]. The hog insurance coverage is between 500 to 600 yuan, with the premium of about 6%. Up to now, the hog insurance subsidy from central, provincial and municipal governments has summed up to 80% of the total premium income, while the peasant households pays the rest 20%[3]. China produces more hogs than other countries. In 2014, 735.1 million hogs were sold, and 468.53 million hogs were remained in the end of the year[4], accounting for more than half of the world total hog production. In 2015, the total premium income of reproductive sow insurance was 1.42 billion yuan, and the insurance coverage was more than 60%. As for the hog insurance, the total premium income

[1] 庹国柱：把农业保险的研究做得更深入。智库动态， 2016 年第 9 期， P21， 2016 年 9 月 30 日，中国保险学会。

[2] At July 30th, 2007, the State Council issued《关于促进生猪生产发展稳定市场供应的意见》（国发〔2007〕 22 号）, providing fiscal support for the development of reproductive sow insurance and for the steadiness and expansion of hog production. In August of 2008, the Ministry of Finance issued《财政部关于开展育肥猪保险保费补贴试点工作有关事项的通知》（财金〔 2008〕 98 号）. In January of 2012, the Ministry of Finance issued《关于进一步加大支持力度做好农业保险保费补贴工作的通知》（财金〔 2012〕 2 号） to extend the premium subsidy of hog insurance to the whole country.

[3] The national policy of hog insurance premium subsidy is that, at the basis of at least 30% of the premium subsidized by the local government, the central government subsidized 50% for central and western regions and 40% for eastern regions.

[4] Data source: China Statistical Yearbook

was 4.01 billion yuan and the coverage was about 25%. About 3.781 million peasant households hasbought these insurances.

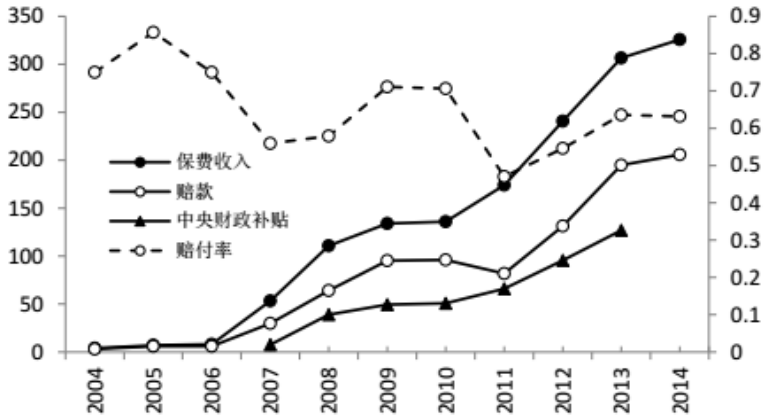

Figure 1 the development of Chinese agricultural insurance and the change of premium income, indemnity and loss ratio

Considered that the total subsidy for agricultural insurance provided by Chinese government has summed up to more than 100 billion yuan, it is extremely urgent to find out the impact of agricultural insurance on peasant households' production decision making. Empirical research in Chinese agricultural insurance can help the government better adjust agricultural insurance policies. Why should a huge amount of fiscal subsidy be invested in Chinese agricultural insurance? To what extent has these policy goals realized? Answering these questions will help develop the researches into the priority order of Chinese investment in agriculture (Thorat and Fan, 2007; Mogues et al., 2012).

Empirical researches first focused on the system design of agricultural insurance (Zhu and Yu, 2009; Yu and Zhu, 2005; Zhang et al., 2006, 2007; Yu and Li, 2003; Li, 1996) and participation in agricultural insurance (Ning et al., 2006; Chen et al., 2007; Zhang et al., 2005; Li et al., 2007; Ning et al., 2006; Hou et al., 2010; Zhang et al., 2007; Chen et al., 2013; Wang et al., 2015; Liu et al., 2016.). Later, the focus of empirical study changes to the impact of agricultural insurance on peasant households' production decision making (Zong and Zhou, 2014; Xi, 2015; Long et al., 2014; Huang, 2015; Liu and Sun, 2016; Cai et al.,2015; Zhong et al., 2005). According to the principle of efficiency maximum of fiscal subsidy, the subsidy (investment) for agriculture is supposed to achieve policy goals to the maximum level. It means that the impact of agricultural insurance on agricultural production will provide both theoretical and empirical basis for further adjusting agricultural insurance subsidy policies. A lot of researches in America has focused on assessments of agricultural insurance subsidy since 1990s. Not only the impact of cost insurance in agricultural insurance on peasant households' production behavior and environment has been studied, but also impact of production insurance and income insurance. However, since most peasant households in China are in a small scale, the types and subsidy of Chinese agricultural insurance are remarkably different from America. As a result, empirical researches aimed to Chinese peasant households have strong practical significance. However, because of data limit, Chinese literatures mainly focused on the impact of crop insurance on peasants' behaviors, while many of them used cross-sectional data. Few

researches solved the endogeneity problem between buying insurance and peasant households' behaviors. Using the method of micro-econometrics, Zhong et al. (2007) measured the impact of buying insurance on pesticide and chemical fertilizer usage by cotton peasants in Manasi basin of Xinjiang. This is one of the prior normative researches in China. In an experimental economics manner, Cai et al. (2015) measured the impact of reproductive sow insurance on peasants' sow raising in Guizhou. This study found out that reproductive sow insurance can drive peasants raise more sows, and thus help develop agriculture production.

This study researches into the impact of hog insurance to peasant households' production behaviors through a strict natural experiment of hog insurance put forward in Jiyuan, Henan. The results find out that hog insurance prominently influence peasant households' production behaviors. For example, having hog insurance significantly decrease the usage of imported vaccines, increase the death rate of hogs, and increase the probability of reporting severe epidemic situation. Hog insurance has no significant influence on the sale of hogs. These results expand literatures about agricultural insurance. As few literatures about breeding insurance exist all over the world, this study expand researches in this field both in methods and findings, and provide convincing empirical results for further adjusting agricultural insurance policies.

The rest of this article is arranged as below. A literature review about this problem in this field is presented in the second part, while in the third part the study background and experiment design are introduced. Data and relevant descriptive statistics are presented in the fourth part. The last part is a conclusion.

Literature Review

Judging and measuring the moral hazard in agricultural insurance is an important research issue in the field of agriculture economics and insurance. In theory, the moral hazard in agricultural insurance has two main manifestations. One is that the risk guarantee offered by insurance contract leads peasant households to neglect producing management, increasing the risk of agricultural production. The other is that the risk guarantee makes peasants change former production behaviors to chase higher profit. In recent 10 years, abundant literatures has empirically studied whether agricultural insurance (crop) has influence on production behaviors of peasant households. However, few researches aiming to breeding insurance exists.

More agricultural insurance literatures exist in western world. The origin of Chinese agricultural insurance is the breeding insurance tried in Jiangxi since 1935, but it has not formed scale. America and Canada represent the development of western agricultural insurance, especially America. Since the implementation of The Agricultural Insurance Legislation in 1980, agricultural insurance has developed quickly in America (Coble et al., 1997). Up to now, it has become the second most important policies supporting agriculture, and the premium scale of agriculture insurance is the biggest all over the world. Similar to China, America has also experienced several researching phases, namely the reason of agricultural insurance market failure (Wright and Hewitt, 1994; Knight and Coble,1997), the problem of participation in

agricultural insurance and the impact of agricultural insurance on peasant households' production behaviors (Coble et al.,2013). Agricultural insurance products in western countries mainly aims at planting industry, especially staple crops, such as soybean, wheat, corn and cotton. Meanwhile American literatures mainly study agricultural enterprises, different from developing countries. Even so, these researches have strong reference significance. The existing results of researches into agricultural insurance find out that traditional agricultural insurance has small influence on planting industry, while significantly influence the usage of chemistry fertilizer and pesticide by peasants in planting process. At present the high-quality study about agricultural insurance has transferred its focus to meteorological index in developing countries and issues of other new agricultural insurance, such as the meteorological index insurance in Africa (Miura and Sakurai, 2015; Dercon et al.,2016). Except for Africa and few developing countries, developed countries and most developing countries rarely provide breeding insurance products, resulting in few literatures about breeding insurance.

There are three methods to study the moral hazard in agricultural insurance and the impact of agricultural insurance on peasant households' production behaviors. The first method is to useOLS or structural equation with cross-sectional data to study the relationship between having agricultural insurance and peasant households' production behaviors. For example, Horowitz and Lichtenberg (1993) found that having corn insurance would increase the usage of chemical fertilizer and pesticides. However, Smith and Goodwin (1996), Babcock and Hennessy (1996) found that having agricultural insurance would decrease the usage of chemical fertilizer and pesticides. Through an investigation of cotton insurance in Xinjiang province of China, Zhong et al. (2007) found that the impact of agricultural insurance on the usage of chemical fertilizer and pesticides is not all the same. Liang and Coble (2009) found that it is not certain whether the moral hazard in agricultural insurance is positive or negative in different conditions and different harvest patterns. However, such researches cannot solve the problem of sample selection bias, and can only try to solve this endogeneity problem by adjusting econometric methods.

The second method is to use DID model with panel data to do research. Roberts et al. (2006) used DID to study the relationship between agricultural insurance and crop production. This study found that agricultural insurance had significant influence on some crops' production, but it couldn't solve the endogeneity problem of whether peasant households chose to buy insurance. Fuches and Wolff (2011) used the panel data of Mexican most rainfall districts to study the relationship of pluvial index insurance and crop production. Since the Mexican pluvial index insurance is propelled step by step, Fuches and Wolff assumed that the choose of promoting pluvial index or not is random. So the districts having not promoted pluvial index can be used as a control group to study the issue of moral hazard in pluvial index insurance. This research method can be understood as approximate experimental economics. However, since there may exists heterogeneity which cannot be observed between districts having promoted pluvial index and the other districts, this study cannot completely solve these methodical and logical problems, either.

The third method is to use experimental economics to do research, which is most similar to the method used in this study. In 2007, Cai et al. (2015) put forward an experimental economics research into reproductive sow insurance in Guizhou. This study divided 480 villages into 3 groups, using different motivating patterns to motivate insurance salesmen, so as to achieve different insurance participation rate of three groups. According to the trace data, this study further explored the difference about the amount of remaining sows among three groups of villages. The study found that reproductive sow insurance significantly influenced the amount of remaining sows. However, since Cai's research used village data rather than peasant household data, the ultimate insurance effect included both the extensive margins and intensive margins of insurance. That is, because of the reproductive sow insurance, peasant households increased the amount of remaining sows, while in the meantime other peasant households would begin raising sows. Zhang et al. (2016) made use of policy change to study the behavior of peasant households after exiting hog insurance in Deqing county of Zhejiang province. The study found that after exiting hog insurance, the total number of hog sold decreased, while the death rate of hogs had no significant change.

In conclusion, the study of moral hazard in insurance becomes extremely difficult because of sample selection bias, control groups and adverse selections. Comparing these two researches, Cai et al. focused on the impact of sow insurance on the total number of remaining sows rather than the problems of moral hazard, while Zhang et al. studied the reaction of peasant households who exited hog insurance, which was different to normal consumers' behaviors of buying insurance products. This study utilized a natural experiment based on peasant household panel data to solve the self-selection problem generally concerned in the field of insurance and agricultural economics, and further analyzed the impact of hog insurance on peasant households' production behaviors. The study findings are richer than former researches, and the method is more precise as well.

Background and Methods

The Background of Selecting Points for Hog Insurance

The experiment was put forward in Jiyuan of Henan province. Jiyuanlays beside the Yellow River, with a population of 700,000 and an area of 1400 sq.km. It is a big county raising pigs in China, selling about one million pigs a year. In 2012, there are more than 10,000 households raising pigs, of which the scaling households (selling more than 100 pigs a year) covers 30%. Because of repeatedly happening animal epidemics since 2008, the price of hogs went up and down, significantly hurting peasant households' production enthusiasm. Since hog raising has become one of the main agricultural industries in Jiyuanand the source of income for some peasant households as well, it is important for the local government to consider the way of effectively spreading risks of raising pigs. China has implemented policy reproductive sow insurance since 2007 and policy hog insurance since 2008, offering fiscal subsidies. In some districts reproductive sow insurance were implemented in a small scale. However, Jiyuan,

with the coordination of the Jiyuan subsidiary company of China insurance company, has implemented unitive reproductive sow insurance all over the county since 2012, encouraging all pig farmers participating in it. In 2013, encouraged by documents from central government and local government of Henan, Jiyuan began to popularize hog insurance all over the county to secure hog production and to stabilize peasants' income. The hog insurance in Jiyuan is a kind of policy insurance, with 80% of the premium paid by central, provincial and municipal governments, and 20% paid by peasant households.

Different from other cities, the farming bureau of Jiyuan wants to dispose with the dead pigs safely by popularizing hog insurance. After buying hog insurance, the peasant households will call the insurance company for compensation when there are dead pigs. Thus, the information about dead pigs will no longer be concealed. According to the cooperation agreement between the farming bureau of Jiyuan and insurance company, the settlement of insurance claim will be implemented in a way of "three presentations". That is, only with the presentation of the staffs from the insurance company, the epidemic prevention coordinator from the farming bureau of Jiyuan and the peasant households can the settlement of insurance claim be put forward. According to the death certification of hogs provided by the epidemic prevention coordinators from the farming bureau, the insurance company settles the insurance claims. Then the epidemic prevention coordinator supervises peasants to dispose with the dead pigs safely. (这段不太明白，瞎翻的) Since hog insurance can effectively solving the problem of the safe disposal of dead pigs, the farming bureau of Jiyuan tends to put forward an unitive hog insurance, encouraging all the pig farmers to participate in it. However, the insurance fiscal subsidy provided for the farming bureau of Jiyuan in 2013 is not enough for putting forward unitive insurance in all the 13 villages and towns of Jiyuan. As a result, they chose two towns, Chengliu and Sili to put forward the hog insurance trial. It made possible this study in an experimental economics way.

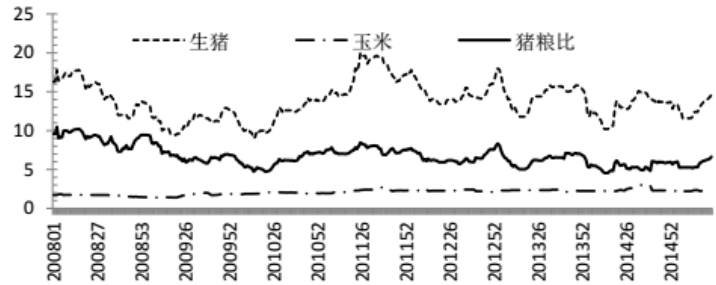

Figure 2 the price changing trend of hogs in Jiyuan County of Henan province
Data source: The Farming Bureau of Jiyuan County. The abscissa represents weeks, such as the 1st week in 2008.

The Coverage, Underwriting and Claims Settlement of Hog Insurance

The Jiyuansubsidiary insurance company of China Insurance Company burdened the hog insurance trail implemented in Jiyuan in 2013. The insurance company underwrites hogs of a weight more than 10kg, That is, only when the weight of dead pigs is more than 10kg can the loss be compensated, and the compensation criteria is 5 yuan per kilogram. The farming bureau of Jiyuan helps insurance company advertise agricultural insurance in villages and towns. The epidemic prevention coordinators provides technology support for insurance company in settling insurance claims. Besides, they help insurance company deal with the dispute with peasant households. Specifically, the institution design of hog insurance is stated as below:

a) Insurance coverage, fee rate and insurance period. The coverage of hog insurance is 500 yuan per hog and with the fee rate is 6%, which means that the premium is 30 yuan per hog accordingly. The insurance period is at most 1 year.

b) Fiscal subsidy and fund appropriation. The central, provincial and municipal finance respectively pays 50%, 15% and 15% of the total premium subsidy, and the farm pays the remaining 20%. That is to say, to buy insurance for a hog, 80% of the premium (24 yuan) is paid by governments at all levels, and the remaining 20% (6 yuan) is paid by peasants.

c) Insurance liability. The insurance liability of hog insurance is that insured objectives die of severe diseases, natural disasters and incidents[1]. In practice, it's difficult for insurance companies and epidemic prevention coordinators from the farming bureau to precisely identify the death reasons of hogs. As a result, in most situations the insurance companies compensate every time when there is a hog death.

This insurance policy is easy to understand for peasant households. 80% of the premium is subsidized by government, and when hogs die of varies reasons, the loss can be compensated according to hogs' weight.

[1] Specific insured liability includes: (1) severe diseases include: swine erysipelas, swine plague, swine pox, streptococcus suis, Porcine epidemic encephalitis, eperythrozoonosis, pseudorabies, porcine parvovirus, Swine infectious atrophic rhinitis, Swine mycoplasmal pneumonia, trichinosis, Cysticercosiscellulosae, Swine paratyphoid, porcine circovirus disease, transmissible gastroenteritis of swine, Clostridium westergren pig disease, foot-and-mouth disease, swine fever, high pathogenic PRRS and its compulsory immunization side effects; (2) natural disasters includes: rainstorm, flood (excluding the flood storage of government), wind damage, thunder, earthquake, hail and freeze disaster; (3) incidents include: landslide, debris flow, fire disaster, explosion, building collapse, air falling objects.

Experiment Design for Hog Insurance

The researchers has participated in the survey of hog insurance in Jiyuan of Henan province since October, 2012. During the coordination with the farming bureau of Jiyuan, researchers found out that there would be a hog insurance trail in Chengliu (for short A) and Sili (for short B) in the late July of 2013. After asking the farming bureau for advice, researchers chose Lilin (for short C) and Wulongkou (for short D)[1], the two towns similar to Chengliu and Sili, as control group (see Figure 3). Here are the reasons of choosing C and D as the control group of A and B. On the one hand, these two groups are similar in experience, while the geographic position and the distribution of pig farmers of these two groups of towns are similar. On the other hand, the closest distance between towns in these two groups is less than 5km, between which is the urban area of Jiyuan (county-level city). The specific T-test of peasant households' variables is presented in part4.

Table 1 Experiment design

	2013(July)	**2014(July)**
A,B (Treatment Group)	Uninsured	Uniformly insured
C,D (Control Group)	Uninsured	Uninsured

Figure 3 the map of Jiyuan County, Henan Province (the control group and the treatment group)

Data Source and Questionnaire Survey

This study's data structure has three sources: firstly, a full sample of pig farmers all over the county provided by local government; secondly, a big-scale questionnaire survey of peasant households based on random selection; thirdly, documents of underwriting and claim settling (in a complete insurance cycle) provided by insurance companies. This study merged

[1] Since hog insurance trial was made in Chengliu and Sili, hog insurance cannot be bought in other villages and towns, i.e., no insurance products provided. Therefore, it's for sure that hog insurance cannot be bought in Lilin and Wulongkou.

these three data sources into one database, according to ID card number and phone number. The process of sampling and data obtaining is stated as below:

a) In December of 2012, the farming bureau of Jiyuan made a general survey of all the pig farmers in Jiyuan and obtained a full sample of the pig farmers (peasant households raising at least 1 hog) all over the county. The study ranked pig farmers in Chengliu (A), Sili (B), Lilin (C) and Wulongkou (D) according to farming scales, and made a random selection in a ratio of 3:1 (extract 1 peasant household every 3 households in order, using the random data given by computer). 681 samples were selected from the total 2043 pig farmers of these 4 towns.

b) Questionnaire survey of 681 randomly selected samples is made from June to July in 2013 (before the implementation of hog insurance). Since the dispersion of pig farmers and the need of epidemic prevention, it's difficult for strangers getting into their households to survey. With the help of the Farming Bureau of Jiyuan, the researchers hired about 40 epidemic prevention coordinators from the farming bureau as investigators to survey the samples. The questionnaire includes these information about peasant households: the basic demographic variables, the basic breeding situation, the usage of micro-finance (insurance and credit), the biographic safety of pig farms, etc. Most questions are objective, making it easier for peasant households to answer.

c) Follow-up survey of these samples were made from June to July in 2014. However, because of the new rural reconstruction implemented in Jiyuan in the latter half of 2013, in areas where pig raising were limited many peasant households' pig farms were banned. Meanwhile, because of a huge decrease of pig price since the former half of 2014 (see Figure2, the pig price wave curve and the pig food ratio wave curve between the 52nd week in 2013 and the 26th week in 2014), many peasant households retreated from the pig market. Some samples were lost because of these factors[1]. In 2013, the treatment group had 325 samples, while in 2014 the number of households still raising pigs were 135. As for the control group these two numbers were 356 and 231.

Table 2 Sample situation

	2013(July)	**2014(July)**
The treatment group (AB)	325	135
The control group(CD)	356	231

[1]Though some pig farmers dropped out of pig market, most of them can still be surveyed and these samples are not lost.

Peasant Households' Insurance Buying

Even though there are hog insurance products sold in town A and town B, and the local government encourages pig farmers to participate in hog insurance as well, some peasant households were still unwilling to buy insurance. In the survey sample of the treatment group (town A and town B), 122 of the total 135 peasant households (see Table 3) bought the insurance, and 13 didn't. In the control group (town C and town D), all 231 peasant households didn't buy the hog insurance (with no hog insurance products provided).

Table 3 Peasant households' insurance buying

	A+B Treatment	C+D Control
With insurance	122	0
Without insurance	13	231

Results

Descriptive Statistics

Table 4 Descriptive statistics (full sample)

Variable	Sample size	Mean value	Standard diviation	Minimum	Maximum
Age	366	51.686	8.860	28	86
Education	366	7.877	2.246	0	15
Hukou	361	0.017	0.128	0	1
Smoking	366	0.601	0.490	0	1
Years of hog raising	366	8.995	3.663	1	28
Income percentage	366	61.057	26.466	-30	100
Pig breeding stock	366	72.331	66.654	0	700
Epidemic reporting	351	0.724	0.448	0	1
Death rate of hogs	337	0.139	0.154	0	1
Epidemic concern	366	0.888	0.316	0	1
Natural disasters concern	366	0.317	0.466	0	1
Vaccine cost	366	5.787	4.044	0	38.8
Usage of imported vaccines	349	0.857	0.351	0	1
Work clothes wearing	364	0.887	0.317	0	1
Account recording	363	0.702	0.458	0	1
Specific tools for piggery	364	0.258	0.438	0	1

As shown in the Table 4, the two-year balanced panel has a sample of 366 peasant households, and some variables have data missing. The average age of the sample is 51.8, which means that peasant households still raising pigs in rural areas are mostly older farmers. The average education year is 7.8, the degree of second year of junior high school. Since technology is needed to raise pigs, the education status of pig farmers is statistically a little bit better than other peasant households (the average education year is between 5 to 6 years in experience). The years spent in raising pigs are about 9 years. Peasant households in this district has a tradition of raising pigs, so the pig-raising years are comparatively long. The pig-raising income covers 61% of the total income of peasant households, so the local government supports the hog raising industry as one of the mainstay agriculture industries. The average number of

remaining hogs of peasant households is 72. The scale plots of hog raising in Jiyuan were planned well. Most peasant households raised hogs in the hog raising plots together with 4-5 other households rather than in their own backyards, making it easier for the government to curb environmental pollution. Peasant households are active in reporting severe epidemic situations. 72% peasant households choose to report severe epidemic situations, such as foot-mouth disease, hog cholera and porcine reproductive and respiratory syndrome, to the government. It helps decrease disease spreading and control the risk of epidemic situations. Since the hog insurance in Jiyuan insures hogs with a weight more than 10kg, the death rate of hogs heavier than 10kg is measured as the ultimate death rate here (as is different from tradition insurances which insure hogs heavier than 20kg, the death rate measured here is different accordingly). Since the death rate of hogs is comparatively higher after weaning, and decreases to a low level of 4-5% when the hogs have a weight of more than 20kg, the statistical results in Jiyuan shows that the average death rate of hogs heavier than 10kg is 13.9% that year. Most peasant households are concerned about animal epidemics, and as shown88.8% peasant households are concerned about the risk of animal epidemics most. Only 31.7% of peasant households are concerned about the risk of natural disasters, such as rainstorm, debris flow (some villages lie beside mountains) and thunder striking, which has a low probability to happen. When it comes to the usage of vaccines, peasant households usually select among imported vaccines, domestic vaccines and free vaccines offered by the government. Generally, they believe that the quality of imported vaccines is better than domestic vaccines, while the quality of domestic vaccines is better than free vaccines offered by government[1]. The descriptive statistics shows that peasant households have an average vaccine cost (mostly vaccines for pseudorabies and porcine reproductive and respiratory syndrome) of 5.78 yuan per hog. In the meantime, 85.7% of peasant households use imported vaccines in varying degrees. The questionnaire survey finds out that peasant households have some knowledge about piggeries' biological safety. For example, strangers are not allowed to go into the piggery, and pig farmers rarely pay a visit to others' piggeries, at most playing mahjong on the streets outside the piggeries or rooms far from the piggeries. 88.7% of peasant households will wear work clothes in the piggery. 70.2% of peasant households have accounts to record the anti-epidemic measures, such as feeding hogs medicines and having inoculations. It helps risk management. Since most peasant households in Jiyuan are in a small scale, they still mix up tools of different pigsties, such are shovels and spoons. The survey finds out that 25.8% don't mix up tools of different pigsties, while 74.2% do. Mixing up tools may lead to the disease spreading among different pigsties.

[1]The reason why peasant households choose different vaccines is another researching topic of the author.

T-test between the treatment group and the control group

Table 5-1 the statistical description and t-test of the treatment group and the control group

Variable	Control group(C\D)	Mean value	Treatment group(A\B)	Mean value	MeanDiff
Age	231	51.351	122	52.107	-0.756
Education	231	8.169	122	7.959	0.21
Hukou	228	0.013	120	0.025	-0.012
Smoking	231	0.632	122	0.549	0.083
Years of hog raising	231	8.766	122	9.402	-0.635
Income percentage	231	62.571	122	59.861	2.711
Pig breeding stock	231	74.848	122	71.27	3.578
Epidemic reporting	225	0.782	113	0.628	0.154***
Death rate of hogs	210	0.125	117	0.157	-0.032*
Epidemic concern	231	0.861	122	0.943	-0.081**
Natural disasters concern	231	0.212	122	0.508	-0.296***
Vaccine cost	231	5.674	122	5.907	-0.233
Usage of imported vaccines	228	0.781	109	1	-0.219***
Work clothes wearing	230	0.909	121	0.835	0.074**
Account recording	231	0.615	119	0.857	-0.242***
Specific tools for piggery	230	0.139	121	0.471	-0.332***

t statistics in parentheses

* p<0.10, ** p<0.05, *** p<0.01

In this study, to analyze the difference between the treatment group (town A and town B) and the control group (town C and town D), one of the most important things is to ensure homogeneity between these two groups. As shown in Table 5-1, we first analyzed whether the variables are homogeneous between the treatment group and the control group. The t-test shows that there are no significant differences between these two groups in indexes such as age, education, hukou, smoking, years of raising pigs, income proportion, pig breeding stock and vaccine costs. As for the percentage of peasant households choosing to report severe epidemic situations, the number in the control group (CD) is significantly higher than the treatment group (AB). The death rate of hogs of the control group (CD) is higher than the treatment group (AB), significant at p<.10. The concern for the epidemic situations of the control group (CD) is lower than the treatment group (AB), significant at p<.05. Peasant households in the control group (CD) is less concerned about natural disaster than the treatment group (AB), significant at p<.01. Meanwhile, compared to peasant households in the treatment group (AB), the peasant households in the control group (CD) use more imported vaccines, less get changed into work clothes, less record the account and less use special tools for piggeries. All these differences are statistically significant.

In the baseline survey, there were some deviations between the treatment group and the control group in some concerned variables. Besides, whether to buy hog insurance in the treatment group (AB) has strong exogeneity. So this study can use DID and PSM to make a comparison of the same samples in two periods, and eliminate the time effect of the dependent variable. It means that the effect of factors not change over time but influence peasant households' behaviors can be eliminated. Utilizing PSM can at the maximum level match the control group and the treatment group to eliminate heterogeneity.

Table 5-2 statistical description and t-test of households with and without insurance (in towns and villages of the treatment group)

Variable	Without insurance	Mean value 1	With insurance	Mean value	MeanDiff
Age	13	53.692	122	52.107	-52.107
Education	13	7.308	122	7.959	-7.959
Hukou	13	0	120	0.025	-0.025
Smoking	13	0.538	122	0.549	-0.549
Years of hog raising	13	9.231	122	9.402	-9.402
Income percentage	13	45.385	122	59.861	14.476**
Pig breeding stock	13	37.538	122	71.27	33.732*
Epidemic reporting	13	0.538	113	0.628	-0.628
Death rate of hogs	10	0.231	117	0.157	-0.157
Epidemic concern	13	0.846	122	0.943	-0.943
Natural disasters concern	13	0.385	122	0.508	-0.508
Vaccine cost	13	6.65	122	5.907	-5.907
Usage of imported vaccines	12	1	109	1	-1
Work clothes wearing	13	1	121	0.835	-0.835
Account recording	13	0.846	119	0.857	-0.857
Specific tools for piggery	13	0.385	121	0.471	-0.471

This study examined the differences between peasant households with and without hog insurance in the treatment group (AB) as well. The t-test found that in the treatment group, the proportion of hog raising income in the total income and the pig breeding stock is significant respectively at p<.05 and p<.10. It indicates that peasants with a less proportion of hog raising income and raising less hogs are less inclined to buy hog insurance. It conforms to our acknowledgement of insurance participation.

Discussion

As stated above, this study uses DID (Card and Krueger, 1994) and PSM (Propensity Score Matching) (Rosenbaum and Rubin, 1983) to study the impact of hog insurance on peasant households' production behaviors and the measurement of moral hazard.

The impact of hog insurance on peasant households' pig breeding stock, epidemic situation reporting and hogs' death rate

Table 6 the impact of hog insurance on pig breeding stock, epidemic situation reporting and hogs' death rate

	D. Pig breeding stock	D. Pig breeding stock	D. Epidemic situation reporting	D. Epidemic situation reporting	D. Death rate	D. Death rate
With insurance	-1.103	-0.88	0.276***	0.182**	0.051***	0.059***
	(-0.241)	(-0.187)	-3.498	-2.317	-2.648	-2.946
Pscore		-4.926		2.012***		-0.159
		(-0.203)		-5.037		(-1.462)
_cons	5.325**	6.991	-0.094**	-0.776***	-0.012	0.041
	-1.98	-0.807	(-2.044)	(-5.447)	(-1.070)	-1.066
N	353	353	322	322	316	316
R-sq	0	0	0.037	0.108	0.022	0.028

t statistics in parentheses

* p<0.10, ** p<0.05, *** p<0.01

As for the impact of hog insurance on pig breeding stock, this study draws different conclusions from results of Cai et al. (2015) and Zhang et al. (2016) (see Table 6). This study finds no significant positive impact of breeding insurance on production (pig breeding stock). Through in-depth investigation, the study finds that price of hogs has decreased continuingly since 2014 and the pig food ratio has been lower than 6.5 (see Figure 2). Because of that, more pig breeding stock means more losses to peasant households, making them unwilling to sell more hogs. Though having hog insurance will motivate peasant households to sell more hogs, this kind of motivation could be suppressed in such a market situation. Since the researching time point of this study is significantly different from that (2010-2011) of Zhang et al. (2016), it indicates that the impact of hog insurance on peasant households' production behavior is different in varying macro background. This is one of the main findings of this study.

However, according to hogs' death rate data, buying hog insurance has a significant positive influence on the death rate of hogs. After buying hog insurance, the death rate of hogs increases by 5.9%, which means that notable moral hazard exists in hog insurance. This result is different from Zhang et al. (2016) either, in which they found that having hog insurance had no impact on hogs' death rate. Similar reasons stated above can be used to explain such differences. While the price of hogs are increasing, as the hog insurance coverage is low (500-600 yuan per hog) and the market price of hogs is comparatively high (2000-2500 yuan per hog), the moral hazard of peasant households are greatly suppressed.

As for the epidemic situation reporting, the study finds that the willingness of peasant households with hog insurance to report epidemics is 18.2% higher than those without. It is because that whenever there are epidemic situations, the losses of death pigs can be compensated by the government and insurance companies, regardless of death reasons. Without hog insurance, the compensation obtained by peasant households are usually uncertain, while with insurance the amount will be certain. Therefore, peasant households will be motivated to report epidemic situations to the government. Besides, the compensation standard of insurance companies, which is 5 yuan per kilogram, is higher than the price of death pigs (1-2 yuan per kilogram) in the black market. It can be one of the reasons why peasant households choose to report epidemic situations to the government.

The impact of hog insurance on peasant households' risk acknowledgement

Table 7 the impact of hog insurance on peasant households' risk acknowledgement

	D. Epidemic concern	D. Epidemic concern	D. Natural disasters concern	D. Natural disasters concern
With insurance	0.052	0.056	-0.214***	-0.206***
	-1.129	-1.19	(-4.104)	(-3.830)
Pscore		-0.098		-0.186
		(-0.402)		(-0.670)
_cons	-0.052*	-0.019	-0.056*	0.007
	(-1.920)	(-0.215)	(-1.834)	(-0.067)
N	353	353	353	353
R-sq	0.004	0.004	0.046	0.047

t statistics in parentheses

* p<0.10, ** p<0.05, *** p<0.01

Since peasant households are surrounded by all kinds of production risks, this section concerns about whether having a socially risk diversification tool as hog insurance will change their acknowledgement of risks. Peasant households are faced with three kinds of risks during hog production: price risks, epidemic risks and natural disaster risks. Since price risks are not considered in traditional hog insurance, this study only concerns about epidemics risks and natural disaster risks. As the statistical description showed (see Table 4), approximately 89% of peasant households are greatly concerned about epidemic risks, while only 31.7% peasant households are concerned about natural disaster risks. The study finds that hog insurance has no significant impact on the peasant households' acknowledgement of risks, but it significantly decrease the worry about natural disaster risks. Therefore, the result can be explained in this way. Peasant households have enough acknowledgement of risks, and since hog insurance cannot disperse huge epidemic risks, it cannot decrease the concern about it. However, hog insurance is enough to disperse natural disaster risks, so having insurance can decrease the worry about this kind of risk.

The impact of hog insurance on peasant households' production behavior

Table 8 the impact of hog insurance on the usage of vaccines

	D. Vaccine cost	D. Vaccine cost	D. Imported vaccines	D. Imported vaccines
With insurance	0.027	0.159	-0.239***	-0.265***
	(-0.045)	-0.255	(-5.459)	(-6.702)
Pscore		-4.111		0.773***
		(-1.275)		-3.507
_cons	0.031	1.422	0.228***	-0.033
	-0.088	-1.239	-9.487	(-0.423)
N	353	353	314	314
R-sq	0	0.005	0.087	0.122

t statistics in parentheses

* p<0.10, ** p<0.05, *** p<0.01

To study the impact of hog insurance on the usage of vaccines, this study uses some indexes to describe production behaviors, including the usage of hog vaccines, the dressing of work clothes, the account recording and the usage of specific tools for piggeries. Changes of these indexes will directly influence outcome variables which can be observed, such as the pig breeding stock (the pig selling) and hogs' death rate.

This study finds that hog insurance has no significant influence on the total cost of hog vaccines, but significantly influences peasant households' enthusiasm in using imported vaccines. Peasant households with hog insurance are 26.5% less probable to buy imported vaccines than those without insurance. Since the total cost has not changed, the study conjectures that peasant households may replace some imported vaccines for domestic vaccines. The vaccine is a beforehand risk-manage tool as well, and it means that hog insurance and the usage of imported vaccines can replace each other. However, during the researching process no exact evidence from animal experiments existed to prove that imported vaccines are more valid than domestic vaccines. The questionnaire asked the reasons why peasant households buy imported vaccines. Except for "introduced by others", the most important

factor is that peasant households believe that imported vaccines are "more valid", which can explain the calculation results to a certain extent.

Table 9 the impact of hog insurance on other production behaviors

	D. Working clothes	D. Working clothes	D. Account recording	D. Account recording	D. Specific tools	D. Specific tools
With insurance	-0.113** (-2.510)	-0.138*** (-2.993)	-0.416*** (-6.459)	-0.421*** (-6.302)	-0.201*** (-2.928)	-0.177** (-2.516)
Pscore		0.536** -2.221		0.093 -0.274		-0.526 (-1.452)
_cons	0.080*** -3.006	-0.101 (-1.180)	-0.204*** -5.475	-0.235* (-1.944)	0.235*** -5.845	0.413*** -3.197
N	345	345	339	339	344	344
R-sq	0.018	0.032	0.11	0.11	0.024	0.04

t statistics in parentheses

* p<0.10, ** p<0.05, *** p<0.01

The study finds that buying hog insurance makes peasant households less likely to change into work clothes, record the account and use specific pig-breeding tools. This result completes the logic chain of the moral hazard in hog insurance. After buying hog insurance, peasant households may neglect risk management and then results in moral hazard. This is similar to moral hazard studied in crop insurance (Smith and Goodwin, 1996; Knight and Coble, 1997).

To make the results more robust, this study uses pilot villages as an instrumental variable (IV) and controls relevant variables to reanalyze issues stated above. Study results are roughly alike (see Adjunct 1, Table 10, Table 11). Therefore, the research method of this study is reliable.

Conclusion

Through the natural experiment made in Jiyuan of Henan province, this research studies the impact of policy hog insurance on peasant households' production behaviors. Different from former literatures (Zhang et al., 2016), this study finds that there are notable moral hazard problems in hog insurance. Since the price of pigs decreased rapidly during the researching period (especially from January to July, 2014), the rational production strategy is decreasing the pig breeding stock to avoid risks. This study is contrast to Zhang et al. (2016). Zhang et al. (2016) made their study in 2010 when the price of pigs were increasing. Therefore, increasing the pig breeding stock would increase the income, so that peasant households would utilize insurance to avoid risks. These two different experiments demonstrate that the moral hazard in hog insurance has different manifestations in different macro environments (price), enriching the study of moral hazard in insurance. The problem is not about the existence of moral hazard, but that moral hazard will be more notable in appropriate conditions.

This study has several enlightenments for policy-making. Firstly, policy hog insurance may help the local government deal with the problem of "dead pigs" escaping into market. An institution of "telling the truth" completely changed the behavior of selling dead pigs in private.

Secondly, policy agricultural insurance can increase the willingness of peasant households to report severe epidemic situations such as foot-mouth disease to the government. This means a lot for government to prevent and control animal diseases. Thirdly, though hog insurance elicits moral hazard and changes peasant households' production behaviors, the insurance mechanism helps avoid production risks in the period when pig price is decreasing (more hogs produced, more losses). Fourthly, there should be a dynamic management of hog insurance coverage. Providing higher coverage when the pig price is high and lower coverage when the price is low can decrease the moral hazard in hog insurance.

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