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Abstract

Chapter 1: this paper studies the economic impact of president Xi Jinping's Eight Regulations of Austerity and coordinated anti-corruption campaign. Specifically, I examine the effects of this campaign on the pattern of household expenditures in China using a triple differences approach. I compare the expenditures of households with government employees with those households without government employees, before and after the anti-corruption reform, across commodities that are likely to be subject to corruption compared to those that are not. I show that in the post-reform period, government affiliated families spend relatively more on goods that they are likely to have obtained illegally through bribes before. In contrast, expenditure patterns for goods that are less likely to be subject to corruption do not exhibit a relative increase in the post-reform period. These expenditure changes are largest for low level officials' families and the bulk of the increase occurred for non-Chinese Communist Party member government employees and among those outside President Xi Jinping's powerbase. This suggests that those with the strongest ties to the party were able to avoid the effects of the anti-corruption campaign.

Chapter 2: While the Chinese government's stated position is religious freedom, the Chinese Communist Party (CCP) is officially atheist. Individuals who profess a faith are typically unable to join and members who practice a religion face expulsion and a loss of benefits. It is unknown exactly how much these policies play a role in shaping t religious affiliation in China. For instance, through assortative matching, non-religious individuals may simply have been those who would have joined the CCP regardless. This paper studies the extent to which the CCP's policies regarding religion may influence religious identification over the life cycle in China. To do so, I contrast changes in religious affiliation before and after retirement for CCP members and non-CCP members. In theory, individuals who were in the CCP but religious may have chosen to hide these beliefs while working in order to not lose out on party benefits. I find no evidence of any increase in membership after retirement – suggesting either: (1) individuals who are non-religious in the CCP simply choose to remain so after retirement or (2) some degree of lingering benefits associated with CCP membership even after government employment ends are large enough to disincentivize religious uptake.

Chapter 3: This paper investigates the impact of the Arab Spring protests on missing women in Egypt through a spatial Differences-in-Differences analysis. We compare the missing women in high protest intensity governates with those in low protest intensity governorates; before and after the Arab Spring

across different phases of the Arab Spring and across different age groups. The results reflect the different effects of different protest on missing women in the Arab Spring and effects in different age groups. The empirical results indicate that after the Arab Spring movement, the missing women significantly decreased in high protest intensity areas, suggesting that the Arab Spring saved many women. Furthermore, the missing women decreased more after the third phase of the Arab Spring. Last but not least, we find that the number of missing women decreased more in younger age group, specifically from 0 to 1 year old.

Chapter 1: How Effective is China's Anti-Corruption Campaign? Evidence from Consumer Expenditures

1.1 Introduction

Since the start of its free-market reforms in 1978, the Chinese government has faced an increasing and more wide-spread corruption problem, which accompanied its rapid economic growth and economic development process (Wedeman, 2012; Dong & Torgler, 2013). The effects of previous anti-corruption policies of the Chinese government is not significant compared with President Xi Jinping's anti-corruption campaign (Andrew Wedeman, 2012). This lack of accountability and enforcement of anti-corruption policies appears to have changed with President Xi Jinping's Eight Regulations of Austerity and coordinated anti-corruption campaign at the end of 2012.[1] On May 17, 2013, the Central Commission for Discipline Inspection (CCDI) began a new anti-corruption policy.[2] The partial effects of this reform can be seen in Figure 1, which shows a significant increase in the number of high-ranking government officials who have been convicted of corruption after 2012.[3]

Before President Xi Jinping's anti-corruption campaign, existing evidence suggests that a wide range of Chinese government system workers, including public servants, employees at state-owned firms, and government institutional staff, regularly received illegal benefits through two main channels (China Corruption Report, 2020). The first and most common form is gifts, such as outside free lunches or dinners, personal usage of government vehicles, free traveling, free movie tickets, free art performance tickets, and entertainment discount bonus ticket. These gifts substitute for regular expenditures government employees would have otherwise purchased out of their budgets. The second form of corruption is illegal sources of cash income, such as bribes from private sector firms or cash and other forms of embezzlement from public funds. In theory, and anecdotally, higher-ranked level government employees are more likely to get cash bribes, while lower ranked officials are more likely to receive free expenditure benefits, i.e., in-kind benefits, through bribery.

President Xi Jinping's Eight Regulations of Austerity sought to cut down on illegal benefits such

[1] Resolution of the 14th National Congress of the Communist Party of China, January 1997 Central Commission for Discipline Inspection convened eight meetings for anti-corruption. "Establishing and improving education, the legal system, punishment, monitoring and prevent corruption implement essentials" in 2005. "Establishing and improving punishment and prevent corruption system 2008-2012 work plan" in 2008.

[2] Eight Regulations of Austerity introduction is in Appendix page 1. The Eight Regulations of Austerity mainly focuses on reducing public funding loss which the government system people always use public funding for their private purpose and bribes from private companies. The CCDI inspected more than 270,000 bureaucrats at different levels May 2013.

[3] High ranking means provincial and ministerial level in this paper. In China, investigation process means that the investigated governors should stop work and in the house of detention.

as government system workers' receiving gifts, meanwhile additional corresponding anticorruption campaign rules focused on government system workers' cash bribes. The CCDI inspections, the supervision mechanism, checks whether Eight Regulations of Austerity and other coordinated anti-corruption policies are implemented well. According to academic studies and journalistic reports, the anti-corruption campaign directly sought to limit the government system workers' illegal subsidies and perks, such as meals, cars, travel, and outing (South China Morning Post 2019), also decrease the car and entertainment expenditures (Cai et al. 2004; Dong & Benno, 2013). In the empirical analysis, I classify consumption expenditures of these forms as susceptible to corruption (affected expenditure) and classify other forms of consumption expenditure as less susceptible to corruption (non-affected expenditure).[4]

In this paper, I use a set of differences to study whether President Xi Jinping's anti-corruption campaign affects expenditure behavior. To do this, I examine affected expenditure and non-affected expenditure, between government and non-government households, before and after the 2012 anti-corruption campaign. I show that in the post-reform period, government affiliated families spend relatively more on expenditure categories that they previously likely received illegal benefits from, while expenditure patterns for goods that are not easily subject to corruption do not exhibit a relative increase. To better understand the underlying changes across different segments of the society occurring as a result of this change, I also conduct a quintile analysis. This reveals that most expenditure changes occur among the lower-level officials and their families. I also divide the sample into Chinese Communist Party (CCP) members and non-members and show that only non-CCP member government officials were forced to increase their expenditures. Similarly, I find that those government officials in President Xi Jinping's traditional powerbase provinces were the least affected. This suggests that CCP members, those with the strongest ties to the government, might have avoided the anti-corruption campaign and continue to receive corrupt benefits after the reform.

Recent research also highlights the effect of the anti-corruption campaign on public worker expenditures on luxury items. Particularly, Ke, Liu, and Tang (2018) find that total expenditures on luxury alcohol and high-end hotels decrease significantly while expenditures on regular hotels remain unaffected after the campaign. Likewise, Qian and Wen (2015) study the effect of the anti-corruption campaign on imported luxury goods expenditures such as jewelry and find that these expenditures

[4] Affected expenditure comprises eating out, car expenditure, other private transportation expenditure, public transportation, tourism, entertainment, and durable goods expenditure. Non-affected expenditure includes health improvement expenditure, medical expenditure, education expenditure, communication expenditure, cloth, daily necessities, and cosmetics.

also significantly decrease as well (Qian and Wen, 2015). Xu and Yano (2016) also examine the effects of President Xi Jinping's anti-corruption campaign on economic growth through innovation and find that more private sources are used to research new production methods and development in companies with no political connections, non-state-owned enterprise, and younger firms.

This paper makes multiple contributions to the literature on the effectiveness of anticorruption campaigns. Through classifying the households into government affiliated families and non-government affiliated families and comparing the expenditures of households before and after this anti-corruption campaign, and using the information from the CFPS dataset, my first contribution is that I explore the effects of President Xi Jinping's anti-corruption campaign on household level expenditures, including a comparison between the affected and non-affected expenditures groups. My findings suggest that the campaign did significantly alter consumer behavior in ways that are consistent with a reduction in graft in the economy. The second contribution is clearly identifying how these changes occurred. I show that lower-level government affiliated families must spend more on anti-corruption affected goods, which were previously free or underpriced for them. The same is not true for higher ranking and higher income officials. While the extent of any cash bribes may have been influenced, the triple differences approach identifies only the associated increase in expenditure that should be observed should corrupt gifting be reduced. The third contribution is that I test if the source of increased affected expenditure of government affiliated households is from their legal income. Conclusively, the estimates clearly indicate that lower-ranked government households significantly spend more on the affected expenditure but not clear estimated results for higher-ranked government households. Perhaps most interesting, I show that CCP members and those residing in the traditional powerbase provinces – namely, those with the strongest ties to the government, may still be able to receive corrupt benefits after the reform. The government affiliated families have begun to use their own income for expenditures that they received for free before.

1.2 Background on anti-corruption scheme

Corruption is frequently linked with country development, productivity, political gradation, and social fairness. The traditional view on corruption is distortion and costly for economic development (Shleifer and Vishny, 1993). There is also substantial evidence that solving corruption problems can promote the country's economy and improve corporate innovation and productivity (Murphy et al.,1993; Veracierto, 2008; Anokhin & Schulze, 2009; Ellis et al., 2020; Wellalage et al., 2020). Many researchers also specify that corruption can cause lower investment, higher inequality and informal

economy (Murphy et al., 1993; Mauro, 1995; Johnson et al., 2000). Others point out that even though corruption is undesirable, at least it creates some informal rules which people can follow (Chen et al., 2016). These rules of the corruption game may informally help transactions because the bribes can be either the "grease" for a rigid bureaucracy and commerce (Lui 1985; Beck and Maher, 1986; Huntington, 2006) or the suboptimal allocation strategy (Lui 1985; Olson, 2000).

Previous research on President Xi Jinping's anti-corruption campaign have examined a host of other outcomes. Analyzing market supply side information, Ke et al. (2018) discovered that President Xi Jinping's anti-corruption policy counting the Eight Regulations of Austerity did not influence Chinese stock market shareholder's value, but it did negatively affect the level of luxury goods and luxury hotels expenditure. Chen and Kung (2019) discussed the role of collusion between political entities and cash bribes by using a land transaction data set from 2004 to 2016. The power side is the local governments who sell the land to "businessmen" at favorable prices.[5] The "businessman" in their analysis are members of China's supreme political elites - the Politburo. These individuals get large profits and local governors in return receive political promotions as kickbacks. After President Xi Jinping's anti-corruption campaign, they find that the Politburo pay more for land acquisitions and that the promotion rate of local governors decreases. Meanwhile other papers discuss the special crony capitalism in China, which reckons all big private companies connected with governors compete with each other at the beginning and then merge to share different local markets to increase the firm scale (Bai et al., 2014).[6] Fang et al. (2018) find that both corruption and innovation ability decide how Chinese provinces governments decide the allocation of government research and development subsidies. However, the anti-corruption effects of President Xi Jinping strengthen the relationship between innovation ability and the allocation of government research and development subsidies which increase research and development efficiency. This anti-corruption campaign also decreased the expenditures of imported luxury goods, such as imported jewelry (Nancy Qian and Jaya Wen 2015).

In China, President Xi Jinping's aggressive anti-corruption campaign, which launched on Dec 4th, 2012, has changed the political environment and the structure of the economy. Even though there were anti-corruption policies before President Xi Jinping's anti-corruption campaign, the effects of those policies were small as shown in Figure 1. Among reasons why previous anti-corruption campaigns were ineffective, weak inspection system, long time between inspections, no internal

[5] "businessman" refers to the top governors' family members. They can get many benefits to the big family.

[6] Crony capitalism, in China, means all the big profitable industries are controlled by top governors' families, e.g., top local governors' families, top provinces governors' families, and top central governors' families.

oversight of monitoring, a complex reporting system, and no highly visible prosecutions of high-level governors are cited (CCDI inspection team meeting, 2013; Regulations of the Communist Party of China on inspection work, 2015).

To improve the anti-corruption campaign efficiency, President Xi Jinping's anti-corruption campaign reorganized the CCDI inspection team and increased inspection frequency (Central inspection team meeting, 2012-2017). The inspection target, which was not very specific, was made more concrete such as a local government accounting record. The second innovation was that inspection teams change their leaders frequently. This prevents forming close relationships between the inspection team and the inspected department. The third development is that every monitoring activity needs confirmation from the Central Committee of the Communist Party of China. The fourth change is the addition of a simple and convenient online report system for all people (CCDI Inspection Team website, 2013, 2015, and 2017). The last development is the visible prosecution of high-level governors and other important government members, such as Xilai Bo, Member of Central Political Bureau; Zhou Yongkang, Politburo Standing Committee and Secretary of the Central Committee of Politics and Law; Boxiong Guo, members of the Politburo and vice president of the Central Military Commission; and Caihou Xu, Vice President of Central Military Commission.

1.3 Data set

To study this topic, I use the Chinese Family Panel Study (CFPS) from 2010 to 2018. This dataset includes disaggregated family level expenditures and individual demographic information in 2010, 2012, 2014, 2016, and 2018.[7] The CFPS is a tracking panel data set which randomly collects from twenty-five provinces and totally contains records on 54,568 households every other year. The family response rate is 81% and the tracking rate is 96.7%. The CFPS produces sample collection weights in different provinces because different provinces have their characters, such as population, environment and economics condition. As the 2010 wave does not have detailed expenditure categories, I just use the data set from 2012 to 2018 for basic regression and robustness check. However, for some robustness tests, I also include the 2010 data set because 2010 data set has the information on annually family total expenditure and government membership.[8] This dataset includes some specific

[7] More details on the CFPS is available from the user handbook, which is available online (Ding H (2012) Onsite sampling frame building in CFPS 2010 baseline survey (in Chinese). Technical Report, CFPS-2, Institute of Social Science Survey, Peking University, Beijing. Available at: https://opendata.pku.edu.cn/dataverse/CFPS).

[8] Placebo tests descriptions and results are in Appendix Tale A5.

expenditure categories, but it does not include all. Because some expenditure items in this survey are not very specific, I cannot identify the elasticity of substitution between various expenditure categories. For example, car expenditures and other transportation expenditures are lumped together, and "other transportation expenditures" may also include motorcycle and public transportation. I tested the income elasticity of demand for subcategories in affected expenditures and non-affected expenditures in Table 2 before the regression analysis. A positive income elasticity means that as total family income increases all of these expenditures also increase. Furthermore, Figure 3 shows the average total family income for both government and non-government households, suggesting a parallel trend during the period analyzed.

For identification purposes, it is more accurate to analyze household level expenditures because the individual expenditures could interact with the expenditures of other family members. This paper pools different expenditure categories into affected and non-affected expenditure groups using the existing expenditure information in the CFPS data set as well as previous research and news reports (Chen et al., 2017; Kung et al., 2019; Dong et al., 2013; Fang et al., 2018; Ke et al., 2018; Lin et al., 2016; Qian & Wen, 2015; Xu et al., 2017).[9] For example, *South China Morning Post* reported that "areas targeted for anti-corruption could include spending on meals, travel, stationery, and office plants, *People's Daily* reported. Civil servants at the bottom level have felt the impact. Wang says his department used to organize activities such as outings, meals, or gift-giving several times a year, but not anymore." However, in the robustness section, I also check the sensitivity of my results to the composition of goods selected into the affected and non-affected groups.

I classify households with at least one government member as government households. All households with no government members are non-government households. I use family level expenditure as the dependent variables and the household head demographic and households level information as control variables in the regression analysis.

Table 1 shows the pooled summary statistics of variables used in the regression analysis by government and non-government groups including the demographic information on the household heads and the households' level . The Chinese government system contains three different types of organizations in which individuals can work: the first group is comprised of public servants (also called civil servants) who directly works in the government administrative system, the second group are workers in the state-owned enterprise (SOE), and the third group are workers in public institutions,

[9] More details on the classification method are available in the Appendix.

such as hospitals, schools, and research centers. The "Job Characteristics" Panel indicates that the rate in the households with public servant household head is 0.02 in the full government system, the associated SOE household head rate is 0.04, and the institution household head rate is 0.03.

The "Education Levels" Panel contains information on the education level of the household heads, suggesting that it is significantly higher for families with a government employee as the head. In "Basic Information" Panel, several differences between government and non-government affiliated households stand out. First, the minority rate is higher in non-government households than in the government system households. More government system families are living in urban areas where basic utility and social welfare is better than in rural areas. The government system household heads are on average five years younger than the non-government system household heads. The percentage of household heads who are female is similar in both government system families and non-government system families. The family size and adult size of government system families are bigger than the non-government system families.

Different regions in China, like in most developing countries, have divergent economic conditions and display significant heterogeneity. The eastern part is closer to the ocean and is comparatively richer and include major cities such as Beijing, Shanghai, Jiangsu and Guangdong. The middle area is poorer than the east side of China, such as Anhui, Sichuan, and Henan. The western region is the poorest. To control for time invariant unobservable regional differences, in all regressions, I include a set of regional dummies.[10]

In addition to basic demographic information, the CFPS also contains information on annual total family incomes, expenditures and expenditure categories as shown in Table 2. Household expenditures are presented in real terms based on the 2010 consumer prices. I classify all expenditures into two expenditure groups, those that are easily and commonly used as open to corruption are presented in the first panel which I label as "affected expenditures" while those that are less susceptible to graft is presented in the next panel and are subsequently referred to as "non-affected expenditures." Expenditures are "affected" in the sense that we might expect them to change for households that were previously being given gifts that substituted for real consumption expenditure in those categories. To classify these categories, I rely on previous studies and newspaper reports (Lin et al., 2018; Qian & Wen, 2015; Cai et al., 2004; Ke et al,. 2018; Chen & Zhong, 2017; Zhang, 2019).

[10] Further details on demographics disaggregated by survey year are presented in Appendix Table A1.

From Table 2, the affected expenditure group includes eating out, car expenditure, transportation expenditures, tourism, and entertainment expenditures. On average, this affected real expenditure is 20,452 RMB (around 3,075 USD in 2020 exchange rate) in government households, which is significantly higher than overall affected expenditure in the non-government households. Non-affected expenditures contain health expenditures, medical expenditures, education expenditures, communication expenditures, clothing expenditures, other necessities expenditures, durable goods expenditures, and cosmetic expenditures. Even though the non-affected consumption expenditures of government households are also significantly higher than the related consumption expenditures of non-government households, the magnitude of this difference is smaller. Panel C reveals that annual total family consumption expenditures in government households are 48,754 RMB (around $7,330 in current dollars) which is much higher than 30,450 RMB (around $4,578 in current dollars), the associated total consumption expenditure in non-government families.

Table 2 reveals that all government household expenditures are significantly higher than the non-government household expenditures. In addition, the surveyed family's annual family income and the annual saving of the government system families are also significantly higher than the non-government families' values. Thus, on average, the government's family expenditures and economic conditions are better than the non-government families. I directly control for these observable differences in economic conditions in the analysis, although the differences approach should render them inconsequential as confounding factors since identification is driven by the differences within household type over time across sets of goods.

In addition to observable factors, another concern is the unobservable factors such as expenditure habits and behavioral trends. To check this, I draw Figure 2 which is the government and non-government household annual expenditure patterns from 2010 to 2018. From Figure 2, we see that the government system families' and the non-government system families' total annual family expenditures have similar trends over the entire sample which reduces the concern that we are simply picking up differential income paths for these two groups. Further summary information household expenditure, and household income and savings disaggregated by survey wave are presented in Appendix Table A2.

1.4 Empirical approach

1.4.1 Regression model

The main issue in estimating the relationship between the effects of anti-corruption policy and households' expenditures is that any expenditure changes by government system households might be correlated with age, education levels, or other unobserved factors. To solve this potential endogeneity problem, I use a difference-in-differences approach and compare across types of expenditure within households.

Furthermore, President Xi Jinping's anti-corruption campaign was unexpected for most economic agents and thus could not have been easily planned for. The 18th National Congress of the Communist Party of China focused on economic conditions and political reform. President Xi Jinping then suddenly announced the aggressive anti-corruption campaign just 18 days after the 18th National Congress of the Communist Party of China, when he became the president.[11]

Because President Xi Jinping's anti-corruption campaign containing Eight Regulations of Austerity targets only government system employees, I contrast expenditure patterns of families with at least one government system employee to those that do not have. In theory, if they are effective, the anti-corruption campaign should impact the first group's expenditure habits more than the second's one. More importantly, it should largely be visible in the form of increased relative spending by government households on the types of goods and services they previously received freely as gifts but not on other goods and services. Following Orrenius and Zavodny (2009), I also conduct a falsification test which I use an alternative group as the treatment group-the private companies affiliated families as the treatment group to access the validity of the DID estimation later.

The estimated anti-corruption effect on "affected" and "non-affected" expenditure in the difference-in-differences (DD) can be expressed as in Eq. (1):

$$\beta_3 = \left(Y^T_{post-2012} - Y^T_{pre-2012}\right) - \left(Y^C_{post-2012} - Y^C_{pre-2012}\right) \quad (1)$$

Where Y estimates the households' expenditures on the "affected" or "non-affected" expenditures. T refers to the treatment group which is the government affiliated households and C is the control group which is the non-government affiliated households. The term in the first parentheses estimates the difference in the expenditure of the government affiliated households (treatment group). The term in the second parentheses evaluates the difference in the expenditure of non-government affiliated

[11] The 18th National Congress discussed materials is from the Chinese Embassy in US and China.org.cn whose links are in the Appendix.

households (control group). The difference of these two differences signals out the impact of the anti-corruption campaign on the expenditures of government affiliated households.

Ultimately, to uncover the impact of the anti-corruption regulation I compare household expenditures across these two categories of goods, before and after 2014 which is the first year of CFPS dataset after 2012 and contrast these differences for both sets of families. So, the main method analyzing the anti-corruption campaign's effect on households' expenditures is following:

$$Y_{hh,p,t} = \alpha + \beta_1 gov_{hh} + \beta_2 post12_t + \beta_3 gov_{hh} * post12_t + X_{hh,p,t}B + a_t + b_p + \epsilon_{hh,p,t} \quad (2)$$

Where $Y_{hh,t}$ is the measurement of household level, *hh*, "affected expenditure", "non-affected expenditure", or "surveyed family total expenditure" at different time. gov_{hh} is a dummy variable equal to 1 if household, *hh*, is in the government affiliated household group, and 0 if household *hh* is in the non-government affiliated group. $Post12_t$ is a time dummy variable equal to 1 if the expenditure is observed after 2012, and 0 otherwise. Because President Xi Jinping's anti-corruption policy begun at the end of 2012, the policy effective time should start in 2014 which the information CFPS only has right after 2012. So, the time dummy variable $post12$ captures aggregate factors that affect both groups. $gov_{hh} * post12_t$ is the interaction term of the treatment group dummy and the time dummy. The coefficient of this interaction term β_3 estimates the difference-in-differences effect which is the effect of President Xi Jinping's anti-corruption.

$X_{hh,p,t}$ is a vector of household head demographic characteristics and household characteristics such as gender, age, education level, and households' size. a_t and b_p are the year fixed effect and the provinces fixed effect which can control for other unobserved province and year specific heterogeneities. To control unobserved influence in different households, I also control the household level fixed effects. Because some household heads change in different survey years and that some households also change home location, I can include household fixed effects in addition to province fixed effects and year fixed effects. β_1 captures the difference in spending between the government and non-government households over the sampling period. The coefficient, β_2, captures the changes in average family expenditure for all households before and after the policy shock.

When comparing results from equation (2) on affected and then on non-affected expenditures, we should expect to see affected expenditure changes by a larger margin only among the government

workers if the anti-corruption campaign is inducing different behavior or cutting down on illegal benefits.[12]

1.4.2 Baseline results

Table 3 presents the baseline results for affected expenditures in panel A and non-affected expenditures in panel B. Column (1) in panel A and panel B with no controls show that government households significantly spend more than the non-government households in both affected and non-affected expenditure groups, 0.288 and 0.055. In panel A and Panel B, column (2) with one more time dummy variable representing anti-corruption policy shock denotes that both government and non-government households spend more on affected and non-affected expenditures after President Xi Jinping's anti-corruption policy shock, then column (3) and column (4) add the DID interaction term and all controls including family size, household head age, household age squared, household head gender, family annual income, family annually saving, household minority, province fixed effects and year fixed effects.

The coefficients of interest are those on the interaction terms in columns (3) and (4) which are large and significantly positive in panel A and indistinguishable from zero (both in statistical significance and economic magnitude) in Panel B. These findings suggest that government household expenditures on affected commodities rose by 11.6 percentage points more than those for the non-government households after the anti-corruption campaign. No similar increase is observed for non-affected expenditure categories – namely, Column (4) of panel B indicates that changes in government household spending over the period are similar to those for non-government households across non-affected expenditure group. In other words, President Xi Jinping's anti-corruption campaign does influence government household expenditures in affected expenditure group and does not influence their expenditures in non-affected expenditure group. These results suggest that President Xi Jinping's anti-corruption policy was effective in cutting affected expenditure categories and therefore reducing graft occurring in everyday life.

1.4.3 Validity of the difference-in-differences method

To further check the validity of the difference-in-differences regression specification, I used the following 4 methods to do further tests.

[12] I confirm the results from Eq. (2) with a triple differences model in Appendix Table A4.

First, I use a fake effectiveness year of anti-corruption and assume that the effectiveness time of anti-corruption is 2012 instead of the true effectiveness year 2014, which is the first year right after the anti-corruption campaign. We should note that the anti-corruption campaign was implemented at the end of 2012 and therefore 2012 was not the time after the anti-corruption campaign started. However, I then need to use the total expenditures because of lack of subcategories of expenditures information in CFPS of 2010. All other regressors are the same as in Table 3 but setting the anti-corruption effective year as 2012. If the control group is comparable and the difference-in-differences is valid, the coefficient of the interaction term should be indistinguishable from zero. The insignificantly negative coefficient estimate, -0.035, of the DID interaction term in the left panel of Table A5 implies the validity of DID.

Second, as a placebo test, I run the same regression as in Table 3 but setting households only with private company employees as a treatment group and all the rest non-government employment households as the control group. The results are shown in the right panel of Table A5. The insignificant coefficients of interaction term mean that the anti-corruption campaign does not affect the expenditures of the private employment household group in both affected and non-affected expenditure groups.

Third, I check if there is a different trend in the expenditures between the government affiliated households and the non-government affiliated households before the anti-corruption campaign. CFPS data set in 2010 is different from the data sets in other years, because CFPS in 2010 does not contain the information on subcategories of expenditures, which we used to classify affected and non-affected expenditure groups. Therefore, to test the common trend assumption I use the mean family annual total expenditures from 2010 to 2018 and present the results in Figure 4, which indicates parallel trends before the anti-corruption campaign and a significant expenditure jumps in government affiliated household after 2014. The presence of a parallel trend indicates the significant influence of the anti-corruption campaign.

Forth, I conduct a manipulation test. The anti-corruption campaign was not predictable, because President Xi Jinping implemented this aggressive anti-corruption campaign in 18 days after becoming president. The short time gap between the new presidency and the new policies may imply the randomness of anti-corruption. In Figure A1, I checked the percentage of households with at least one government employee as a fraction of the total households from 2010 to 2018. I used the 2010 data set here, because the 2010 data set contains the government or non-government system employment information. Figure A1 indicates that after the anti-corruption campaign, which began in

December 2012, the rate of government households increased and reached a peak in 2016. This supports the randomness of the anti-corruption campaign.

1.4.4 Robustness check

In this section I examine the effect of other potentially confounding factors and whether the effect of the anti-corruption campaign is uniformly distributed across different levels of government affiliated households.

The first potential concern is possible changes in overall economic conditions. Therefore, I checked China's GDP, GDP growth rate, Chinese government revenue, and Chinese government annual final expenditures from 2010 to 2018 which are in Appendix Table A3. The results indicate all those indexes were increasing. This amplified Chinese government revenues and expenditures, increasing the potential pool of resources and opportunities for corruption for the Chinese government system workers. However, the basic regression results and all other robustness checks here show the opposite, a reduction in affected expenditures of households with government employees.

Another concern is the influential consistency of the anti-corruption campaign which is whether it had the same effect on all levels of government household expenditures. Therefore, I repeat Eq. (2) by using a quintile regression classifying five different ascent expenditure groups whose results are presented in Table 4. Because for government affiliated households, the answers to regular expenditure survey questions are more reliable than the answers to income survey questions, I use the expenditure of household as the classification standard to classify the ascent quintile groups. Therefore, according to the expenditure of households, I artificially classify affected expenditures into five ascent groups to do the DID analysis and did the same process for the non-affected expenditure. To check the consistence of affected and non-affected expenditures in different years, I draw the Figure A2 and Figure A3 indicating the very similar distributions of all households affected and non-affected expenditures in different years. In affected expenditures panel the DID coefficient is 1% significantly positive in the lowest twenty percentile expenditure group, 22.7%. Then the magnitude decreases to 10.6% at 10% significance level. From column (3) to column (4) the associated growth difference between government and non-government households before and after this anti-corruption campaign becomes insignificant. While there is possibly a large effect among the richest households too, that may not be precisely estimated. The results suggest that the largest reduction in corrupt behavior may have actually occurred among the lowest level (poorest) government system households. These

households began to spend more of their own income on the affected group expenditures which were likely free or discounted for them before the anti-corruption campaign began. In middle income and possible in higher level expenditure groups, this trend may suggest that the anti-corruption effects through the reduced illegal cash income channel could become more important or the anti-corruption campaign may not affect the higher-level government households.

In the non-affected panel, the coefficients of interaction term are insignificantly small negative numbers and do not change from column (1) to column (5). These results are consistent with those in Table 3 and suggest that the anti-corruption campaign does not affect the change in expenditures over the period on this group relative to non-governmental families, which is reassuring the causal interpretation of my findings.

To check for more information on how the anti-corruption campaign affected different government household expenditures, I divide the sample into the urban and rural areas. Because higher-rank government organizations tend to cluster in urban areas and lower-rank government organizations locate in rural areas in China, the effectiveness of the anti-corruption campaign may differ between different government employees and households depending on their location. Table 5 suggests, consistent with Table 4, that most of the reallocation likely occurred among lower level employees, this time in rural areas of the country.

An interesting question is the extent to which having ties with the CCP can buffer against the possibility of prosecution. Consequently, this paper classifies government households on the basis of whether or not the government household members are also CCP members. Normally CCP members in the government system have higher-rank positions. In fact, even when people who are not CCP members are promoted into the management level, the government will encourage them to join in CCP. Table 6 compares the results for CCP and non-CCP member households. The estimates suggest that expenditures in the affected category increased only among government households without CCP members after the anti-corruption campaign. In CCP households, the anti-corruption program does not seem to have any effect on consumption expenditures. This result could mean that the anti-corruption campaign does not influence higher level government households, or that those with stronger ties to the party were more likely to be insulated from prosecution and thus faced less incentive to change their behavior. Another potential possibility could also be that the households with government officials and CCP members were not corrupted or were much less corrupted since free-market reforms in 1978. According to the convicted top Chinese government officials in Figure

1, reports on other previous anti-corruption campaigns, the first explanation may make more sense (Deng, 2010).

It has also been suggested that President Xi Jinping's anti-corruption campaign is just a political tool to purge his political enemies (Chen & Kung, 2019). To analyze this question, I categorize CFPS data set into two subgroups: President Xi's political power base provinces group and provinces outside the powerbase. The promotion process of Chinese government political system is unique: before the president candidate becomes the President, this candidate needs to work in different provinces to get more experience and improve the capability. President Xi Jinping has administered Hebei (1982-1985), Fujian (1985-2002), Zhejiang (2002-2007), and Shanghai (2007), so I classify these four provinces as President Xi Jinping's political powerbase. Hence, I run Eq. (2) based on President Xi Jinping's powerbase. Then I repeat the same regression based on other rest provinces in Table 7. The results suggest that the anti-corruption campaign had far less impact, if any, in President Xi Jinping's powerbase, but instead influenced behavior in other provinces of China.

The first reason could be that in President Xi Jinping's political power base provinces government employees are not afraid of the anti-corruption campaign, because they are loyalists. In contrast, the effect of the anti-corruption campaign increased government households' expenditures on affected expenditure in other provinces. In non-affected expenditure group, both subgroups do not change a lot, lending credibility to the estimates. The second reason may be that because President Xi Jinping has been the leaders in those provinces or cities, those government officials obey President Xi Jinping's order better than other places. Or when President Xi Jinping was the leader in his power base, he already implemented anti-corruption policy locally. In the future, I need more information to check this point. According to the information in Figure 1 and the report of newspapers, the first explanation could be more reliable (Deng, 2010; Campbell, 2018; Shih, 2018).

I am also interested in the sources of increased expenditures in government affiliated households. I hypothesize that government affiliated households start using their legal incomes or savings to pay for the increased expenditures. Therefore, I now use annual household saving and household incomes as the dependent variables to run the same regression in Table 3. Next, I compare the change in savings and incomes between the two groups in Table 8. I find that savings in government households increased compared to non-government households after the anti-corruption campaign. However, I also find that income significantly decreases in government households compared to non-government households after the anti-corruption campaign.

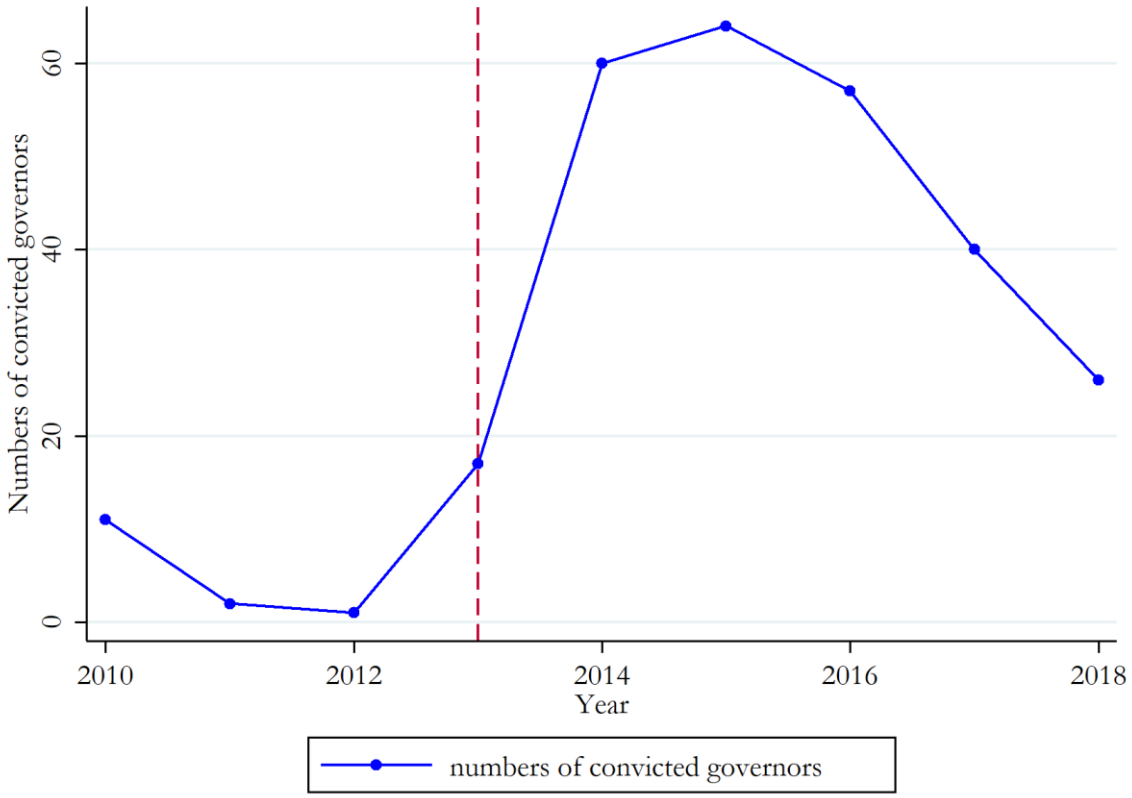
1.5 Conclusion

The anti-corruption campaign of President Xi Jinping is one of the most important events in recent Chinese history and provides a good opportunity for a random experiment to analyze its effects. At the same time there are serious doubts over its effectiveness and whether or not it is a political move to root out rival factions within the communist party rather than an economic one. This paper tries to answer some of these questions and to provide clarity on how the anti-corruption campaign affected different kinds of expenditures and what kind of government related families are influenced more.

To summarize, this paper examines President Xi Jinping's anti-corruption campaign using a novel test based on expenditure patterns – classifying commodities into those susceptible and those not susceptible to corruption through the difference-in-differences method. Beside the basic DID regression results, I also tested this anti-corruption effects on expenditures in different levels of government families, different triple DID and different subcategories as robustness checks.

The campaign appears to have forced some government households to pay more for products and services that they might have been receiving for free prior to the reform. Interestingly, these effects are not uniformly distributed. Higher level government households, those in the CCP and those residing in the traditional powerbase of the President, do not exhibit obvious effects from the anti-corruption campaign. Instead, the changes occur among lower-level government households. These results suggest that it is more reasonable to believe that the anti-corruption mainly affect lower-level government households' expenditures not the higher level and his own closer relationship government workers. Future research may estimate the benefits of reduced corruption as well as investigate these political economy characteristics further.

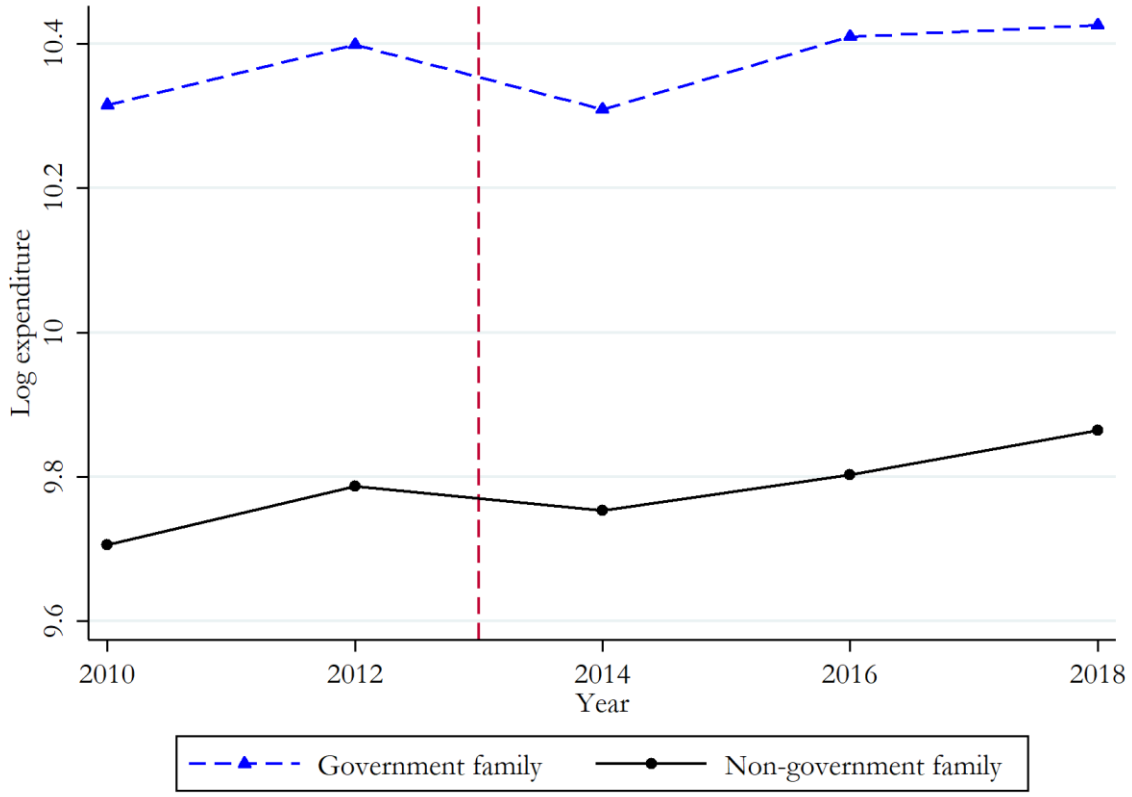
Figure 1. 1: Convicted provincial and ministerial level governors



Notes: the trend of high-level governors who are convicted into the jail or in house of detention during the investigating process in that specific year which is from 2010 to 2018. The y-axis shows the number of those convicted high level governors.

Source: Chinese government central inspection team website and author's calculations.

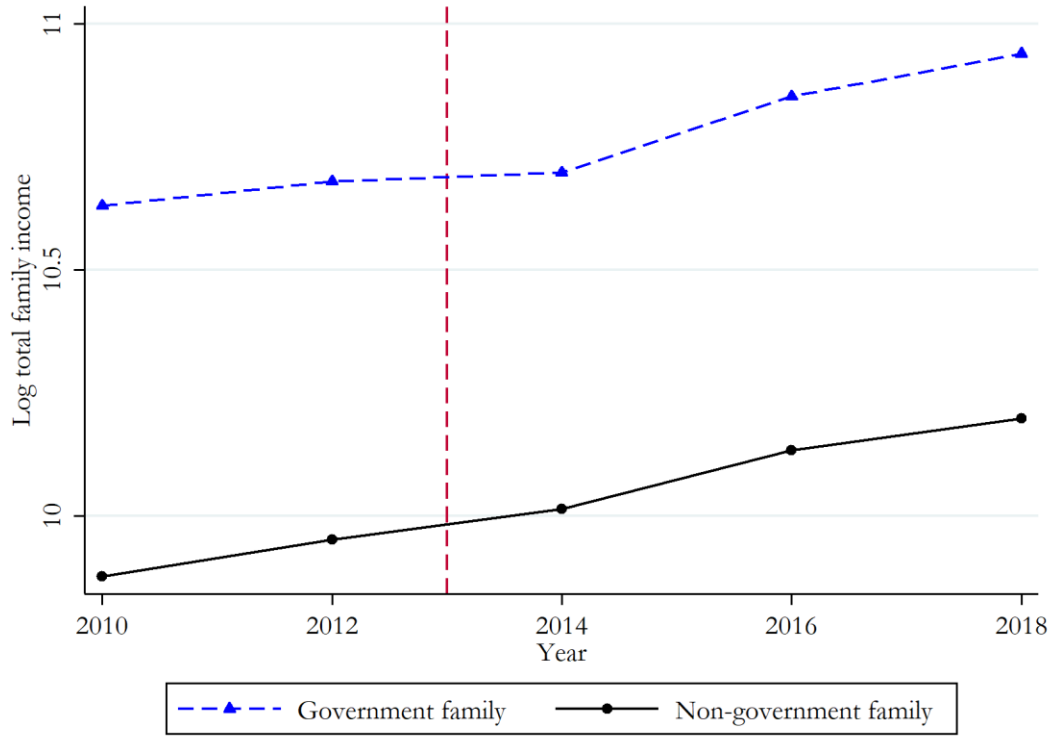
Figure 1. 2: Surveyed total family expenditure trend



Notes: CPFS surveyed family annually total expenditure ranging 2010, 2012, 2014, 2016, and 2018.

Source: Author's calculations.

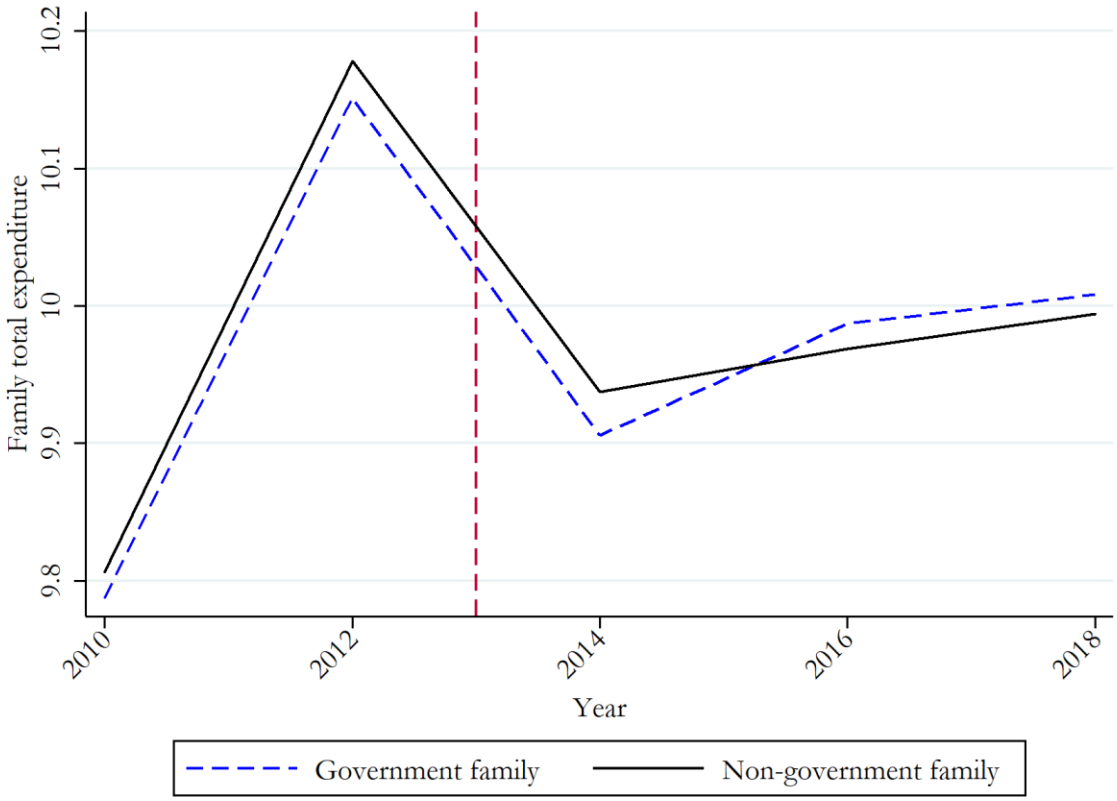
Figure 1. 3: Total family income trend from 2010 to 2018



Notes: CPFS surveyed total family total income ranging 2010, 2012, 2014, 2016, and 2018.

Source: Author's calculations.

Figure 1. 4: Total family expenditure common trend from 2010 to 2018



Notes: CPFS surveyed family annually total expenditure ranging 2010, 2012, 2014, 2016, and 2018.

Source: Author's calculations.

Table 1.1: Pooled average demographic summary statistics

	(1) Full	(2) Government	(3) Non-Government	(4) Difference
Job Characteristics				
Public servant	0.02	0.11	0	0.11
SOE	0.04	0.25	0	0.25
Institution	0.03	0.17	0	0.17
Other	0.91	0.46	1	-0.54***
Education Levels				
< Primary	0.24	0.10	0.27	-0.17***
Primary	0.21	0.11	0.23	-0.12***
Middle school	0.28	0.25	0.28	-0.04***
High school	0.14	0.23	0.13	0.10***
Junior college	0.06	0.14	0.04	0.10***
College	0.04	0.13	0.02	0.11***
Graduate	0.00	0.01	0.00	0.01***
Basic Information				
Minority	0.01	0.01	0.01	-0.00***
Urban	0.49	0.71	0.45	0.26***
Hukou	0.29	0.57	0.23	0.36***
Female	0.50	0.50	0.50	-0.00***
Family Size	3.37	3.52	3.33	0.18***
	(1.65)	(1.53)	(1.67)	(0.03)
Adult Size	2.53	2.80	2.47	0.35***
	(1.22)	(1.25)	(1.20)	(0.02)
Age	46.77	42.40	47.67	-5.42***
	(16.96)	(14.49)	(17.29)	(0.26)
Regional Characteristics				
East	0.44	0.45	0.44	0.018
Middle	0.29	0.31	0.28	0.03***
West	0.27	0.24	0.28	-0.04***
N	54568	9228	45340	

Notes: Pooled household level sample spanning 2012, 2014, 2016, and 2018. Total number of observations is 54,568 for all years, 45,340 for the non-government household, and 9,228 for the government household. In Job Characteristics panel, public servant is government administer system workers. SOE means State Owned Enterprise. Institution is the government system research organizations, education, and social welfare organizations. < Primary means education experience is less than primary school. Primary infers primary school education. Middle school and high school imply the similar education experience in U.S. Junior college is the three years college or community university. Graduate means the master or PhD level education. Minority means minority rate among all households. Urban means the urban living household rate. Hukou means the urban household resident rate. Family size is the total number of family members. Adult size is the total number of adults in a household. Age is the household average age. East, Middle, and West are the household living areas in China. The difference column is the t-test for the difference between government and non-government groups. ***p<0.01, **p<0.05, *p<0.1

Table 1.2: Summary information on consumptions

A: Pooled family affected consumptions

	(1) Full	(2) Government	(3) Non-Government	(4) Difference	Income Elasticity
Affected Consumption Expenditure	11,720	20,452	9,943	10,508.7***	
Eating out	2,670	4,700	2,257	2,442.9***	0.655***
Car	3,499	6,052	2,980	3072.1***	1.0645***
Other Transportation	893	1,234	824	410.4***	0.431***
Public Transportation	2,001	3,036	1,791	1,245.8***	0.375***
Travel Expenditure	902	2,096	660	1,436.1***	0.745***
Entertainment	189	393	147	245.7***	0.757***
Durable Goods	1,565	2,941	1,285	1,655.7***	0.496***
B: Pooled family non-affected consumptions					
Non-affected Consumption Expenditure	12,781	16,857	11,951	4,906.1***	
Health	277	444	243	201.5***	0.654***
Medical	4,209	4,217	4,208	8.633	0.240***
Education	3,202	4,610	2,916	1,694.2***	0.329***
Communication	1,740	2,395	1,607	788.4***	0.278***
Cloth	2,138	3,383	1,884	1,498.4***	0.323***
Necessary	803	1,045	754	290.7***	0.286***
Cosmetic	412	764	340	424.2***	0.654***
C: Pooled Family Surveyed Total Values					
Total Expenditure	33,545	48,754	30,450	1,8304.3***	
Income	44,375	68,198	39,527	2,8671.2***	
Saving	31,835	57,038	26,705	3,0332.3***	
N	54,568	9,228	45,340		

Notes: Pooled sample spanning 2012, 2014, 2016, and 2018. All values are deflated to 2010 RMB prices by using 2010 CPI. Eating out means going to restaurant. Car is the car expenditure including mortgage. Other transportation infers other vehicle substitution expenditure instead of car expenditure. Public transportation is another substitution expenditure of car. Travel is the annually travelling expenditures which can usually spend bribes. Entertainment is the expenditures on recreation such as movie, and Karaoke. The Affected consumption expenditure is the summation of eating out, car, other transportation, public transportation, travel expenditure, and entertainment. Health is the spending on fitness or nutrition complements. Medical means the all-household expenditures on illness cure. Education is all household education expenditure not only for kids. Communication expenditure includes all postage and phone call. Necessary goods consumption is the daily expenditure excluding all above consumptions. Durable goods purchase infers the big electric furniture, such as TV and refrigerator. Cosmetic is the household spending on "face", like the face mask. Total number of observations is 54,568 for years sample, 45,340 for the non-government household, and 9,228 for the government household. The difference column is the t-test for the difference between government and non-government groups. ***p<0.01, **p<0.05, *p<0.1

Table 1.3: Baseline results

A: Affected Family Expenditure				
	(1)	(2)	(3)	(4)
Government	0.288***	0.269***	0.164***	0.041
	(0.025)	(0.025)	(0.043)	(0.042)
Policy Shock Year		0.336***	0.314***	0.423***
		(0.015)	(0.017)	(0.021)
Gov * Policy			0.129***	0.116***
			(0.043)	(0.042)
Controls	No	No	No	Yes
Province FE	No	No	No	Yes
HH FE	Yes	Yes	Yes	Yes
Adjusted R2	0.376	0.385	0.385	0.429
N	47,965	47,965	47,965	45,893
B: Non-Affected Family Expenditure				
Government	0.055***	0.039***	0.038	-0.027
	(0.015)	(0.014)	(0.025)	(0.024)
Policy Shock Year		0.290***	0.290***	0.335***
		(0.009)	(0.010)	(0.012)
Gov*Policy			0.001	0.020
			(0.025)	(0.024)
Controls	No	No	No	Yes
Province FE	No	No	No	Yes
HH FE	Yes	Yes	Yes	Yes
Adjusted R2	0.398	0.416	0.416	0.459
N	47,965	47,965	47,965	45,893

Notes: The data set in the regression spanning 2012, 2014, 2016, and 2018. All Standard errors in parentheses. Government is a group dummy variable; 1 means government group and 0 means control group. Policy Shock Year is a time dummy variable, 0 means before anti-corruption, 1 means after anti-corruption. Gov*Policy is the interaction term between government dummy and time dummy. Controls include household head age, gender, family size, family annually income, family annually saving living place, and educational affirming indicators. Province FE is all different province ID fixed effect. HH FE is all different family ID fixed effect. * $p<0.10$. **$p<0.05$, ***$p<0.01$.

Table 1.4: Quintile groups consumptions based on expenditure

	Affected expenditure				
	0-20%	**21%-40%**	**41%-60%**	**61%-80%**	**81%-100%**
	(1)	(2)	(3)	(4)	(5)
Government	0.070	0.168***	0.186***	0.196***	0.043
	(0.066)	(0.053)	(0.046)	(0.042)	(0.184)
Policy Shock Year	0.541***	0.569***	0.474***	0.318***	0.323***
	(0.035)	(0.028)	(0.024)	(0.022)	(0.097)
Gov*Policy	0.227***	0.106*	0.020	-0.036	0.193
	(0.074)	(0.059)	(0.051)	(0.047)	(0.206)
Controls	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes
HH FE	No	No	No	No	No
Pseudo R2	0.112	0.111	0.104	0.088	0.100
N	39,383	39,383	39,383	39,383	39,383
	Non-affected expenditure				
Government	0.138***	0.119***	0.121***	0.107***	0.304***
	(0.030)	(0.027)	(0.028)	(0.032)	(0.106)
Policy Shock Year	0.316***	0.293***	0.276***	0.224***	0.427***
	(0.017)	(0.015)	(0.015)	(0.018)	(0.059)
Gov*Policy	-0.013	-0.008	-0.012	-0.013	-0.190
	(0.034)	(0.030)	(0.031)	(0.035)	(0.119)
Controls	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes
HH FE	No	No	No	No	No
Pseudo R2	0.171	0.143	0.116	0.087	0.219
N	45,896	45,896	45,896	45,896	45,896

Notes: The data set in the regression spanning 2012, 2014, 2016, and 2018. All Standard errors in parentheses. For all variable's definitions including all kinds of fixed effects refer to Table 3. In this quantile regression, I dropped top 5% income group and top 10% affected expenditure group for affected regression. I did not drop any observation in non-affected expenditures regression. so, the number of observations is different with other regressions. * p<0.10. **p<0.05, ***p<0.01.

Table 1.5: Urban and rural expenditure

	Urban hukou		Rural hukou	
	Affected	**Non-Affected**	**Affected**	**Non-Affected**
	(1)	(2)	(3)	(4)
Government	0.111*	0.012	-0.028	-0.053
	(0.064)	(0.036)	(0.065)	(0.038)
Policy Shock Year	0.513***	0.353***	0.390***	0.333***
	(0.044)	(0.025)	(0.025)	(0.014)
Gov * Policy	0.076	-0.009	0.156**	0.025
	(0.062)	(0.035)	(0.069)	(0.040)
Controls	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
HH FE	Yes	Yes	Yes	Yes
Adjustment R2	0.488	0.462	0.380	0.441
N	13,622	13,622	32,271	32,271

Notes: The data set in the regression spanning 2012, 2014, 2016, and 2018. All Standard errors in parentheses. For all variable's definitions including all kinds of fixed effects refer to Table 3. * p<0.10. **p<0.05, ***p<0.01.

Table 1.6: CCP & government expenditure results

	CCP and government HH		Non-CCP and government HH	
	Affected	**Non-affected**	**Affected**	**Non-affected**
	(1)	(2)	(3)	(4)
Government	0.194***	0.035	-0.039	-0.052*
	(0.070)	(0.041)	(0.052)	(0.030)
Policy Shock Year	0.412***	0.336***	0.423***	0.339***
	(0.022)	(0.013)	(0.021)	(0.012)
Gov * Policy	0.013	0.018	0.174***	0.024
	(0.065)	(0.038)	(0.053)	(0.031)
Controls	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
HH FE	Yes	Yes	Yes	Yes
Adjusted R2	0.427	0.458	0.416	0.452
N	40,598	40,598	42,873	42,873

Notes: The data set in the regression spanning 2012, 2014, 2016, and 2018. All Standard errors in parentheses. For all variable's definitions including all kinds of fixed effects refer to Table 3. * p<0.10. **p<0.05, ***p<0.01.

Table 1.7: Powerbase check

	Powerbase provinces		Other provinces	
	Affected	**Non-affected**	**Affected**	**Non-affected**
	(1)	(2)	(3)	(4)
Government	0.160	-0.117	0.023	-0.005
	(0.131)	(0.078)	(0.048)	(0.027)
Policy Shock Year	0.566***	0.288***	0.401***	0.326***
	(0.075)	(0.045)	(0.022)	(0.013)
Gov*Policy	-0.079	0.113	0.131***	-0.008
	(0.132)	(0.078)	(0.047)	(0.027)
Controls	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes
HH FE	Yes	Yes	Yes	Yes
Adjusted R2	0.407	0.409	0.389	0.441
N	4,517	4,517	39,220	39,220

Notes: The data set in the regression spanning 2012, 2014, 2016, and 2018. All Standard errors in parentheses. For all variable's definitions including all kinds of fixed effects refer to Table 3. In this regression, I dropped top 5% income households for all households, because they are outliers. * p<0.10. **p<0.05, ***p<0.01.

Table 1.8: Increased expenditure channels

	Saving	Income
	(1)	(2)
Government	-0.536***	1.056***
	(0.133)	(0.068)
Policy Shock Year	-1.258***	1.235***
	(0.065)	(0.033)
Gov * Policy	0.956***	-0.939***
	(0.132)	(0.068)
Controls	Yes	Yes
Province FE	Yes	Yes
HH FE	Yes	Yes
Adjusted R2	0.275	0.229
N	45,893	45,893

Note: The data set in the regression spanning 2012, 2014, 2016, and 2018. These two regressions are same as the regression in Table 3. The dependent variables are Family Annually Saving or Income. All Standard errors in parentheses. Controls include household head age and age square, gender, family size, family annually income (for saving regression only), family annually saving (for income regression only), living place, and education indicators. Province FE is all different province ID fixed effect. HH FE is all different family ID fixed effect. * p<0.10. **p<0.05, ***p<0.01.

Appendix 1

1.A.1 Data cleaning method:

Because CFPS has three separate data set: adult data set, family data set, and children data set; I merged the adult data set and family data set by the same family ID. The family data set contains the annual family total income, annual family total expenditures, and other family expenditures, e.g., outside meal expenditure, car expenditure, and entertainment expenditure. The adult data set has all individual demographic information such as job characteristics, age, gender, ethnicity, education, et al. Therefore, this paper merges the family level data set and adult level data set by the same family ID.

1.A.2 Triple difference-in-differences model:

In addition to observing the anti-corruption effects on affected and non-affected expenditures, some may also be curious about the comparison between affected and non-affected expenditures. Thus, I ran the following triple difference-in-differences regression and quintile triple difference-in-differences regressions. The results are in Table A4.

$$Y_{hh,p,t} = \alpha + \beta_1 gov_{hh} + \beta_2 post12_t + \beta_3 affected_{hh} + \beta_4 gov_{hh} * post12_t + +\beta_5 gov_{hh} * affected_{hh} + \beta_6 affected_{hh} * post12_{hh} + +\beta_7 gov_{hh} * affected_{hh} * post12_{hh} + X_{hh,p,t}B + a_t + b_p + \epsilon_{hh,p,t} \quad (A1)$$

$Y_{hh,p,t}$ includes households affected and non-affected expenditures. $affected_{hh}$ is the dummy index for affected and non-affected expenditures. $affected_{hh} = 1$ means the affected expenditure and $affected_{hh} = 0$ means the non-affected expenditure. All other variable definitions are the same as in Table 3. Theoretical, the coefficient of the triple interaction, β_7, should capture the specific portion of affected expenditure undertaken by the government households after the anti-corruption campaign. The triple difference-in-differences coefficient indicates that after the anti-corruption campaign government household spending on the affected expenditure increases more than the non-government household spending growth, consistent with the set of difference-in-differences contained in the text.

1.A.3 Chinese government eight regulations of austerity

The eight-point rules, issued by the Political Bureau of the CPC Central Committee in December 2012, aim to reduce bureaucracy, extravagance and undesirable work practices of Party members. With

clauses focusing on various forms of corruption and unauthorized use of government cars, the rules have played a significant role in the country's anticorruption campaign.

1. Leaders must carry out in-depth inspections at the grassroots level so that they remain in contact with the people and understand the issues affecting society.

They must cut extravagance and do away with welcome banners, red carpets, floral arrangements and grand receptions for official visits.

2. Meetings and major events should be strictly regulated and simplified. Political Bureau members are not allowed to attend opening ceremonies, celebrations or seminars, unless they get approval from the CPC Central Committee. Official meetings should be economical and efficient, with no inconsequential or prolonged talk.

3. The number of official documents should be reduced to only those necessary.

4. Officials' visits abroad should be arranged only when necessary for foreign affairs, with smaller accompanying delegations.

On most occasions, there is no need for a reception by Chinese expatriates, institutions or students at the airport.

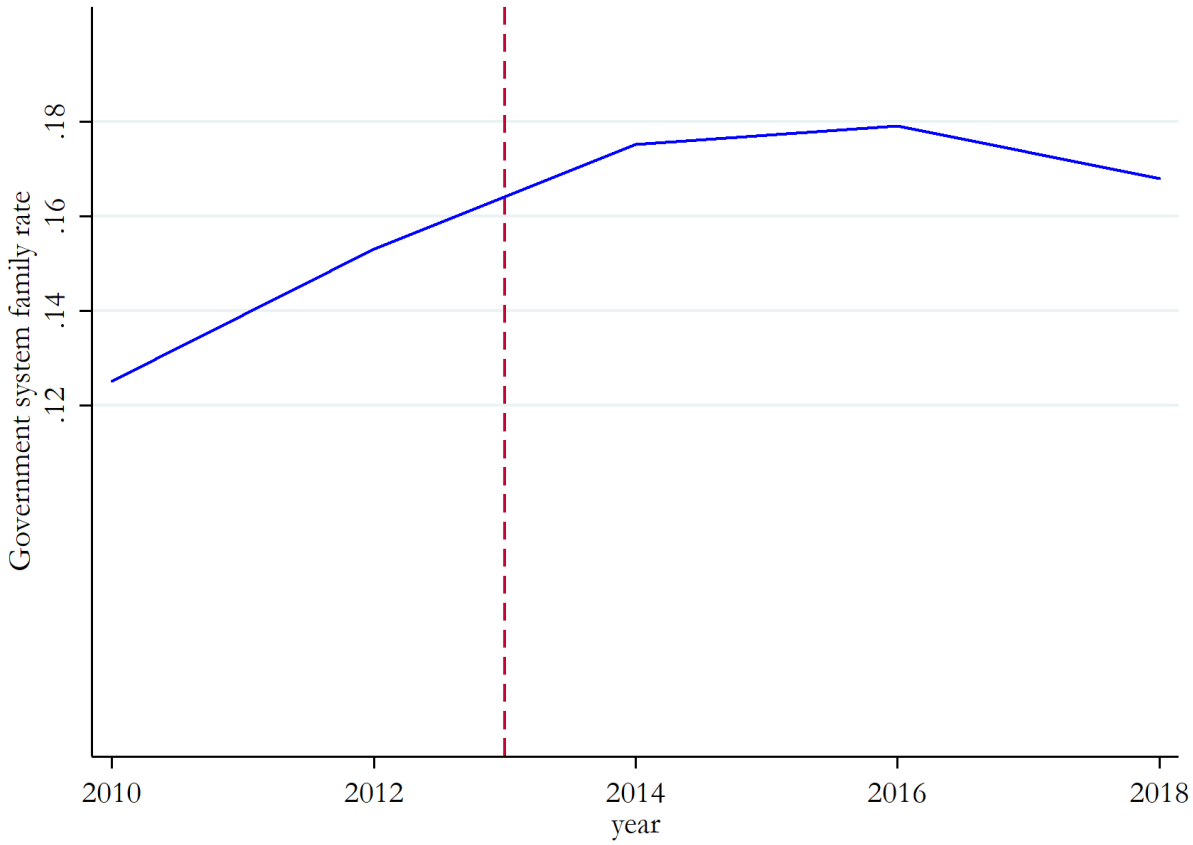
5. There should be fewer traffic controls when leaders travel by car to avoid unnecessary inconvenience to the public.

6. The media should consider the need, news value, and social impact of reporting on members of the Political Bureau, their work and their activities — the amount of time spent on such news items should be reduced and reports should be minimized in scope.

7. Leaders should not publish anything by themselves or issue any congratulatory letters in their own name unless an arrangement with the central authorities has been made.

8. Leaders must practice diligence and thrift, and strictly follow the relevant regulations on accommodation and cars.

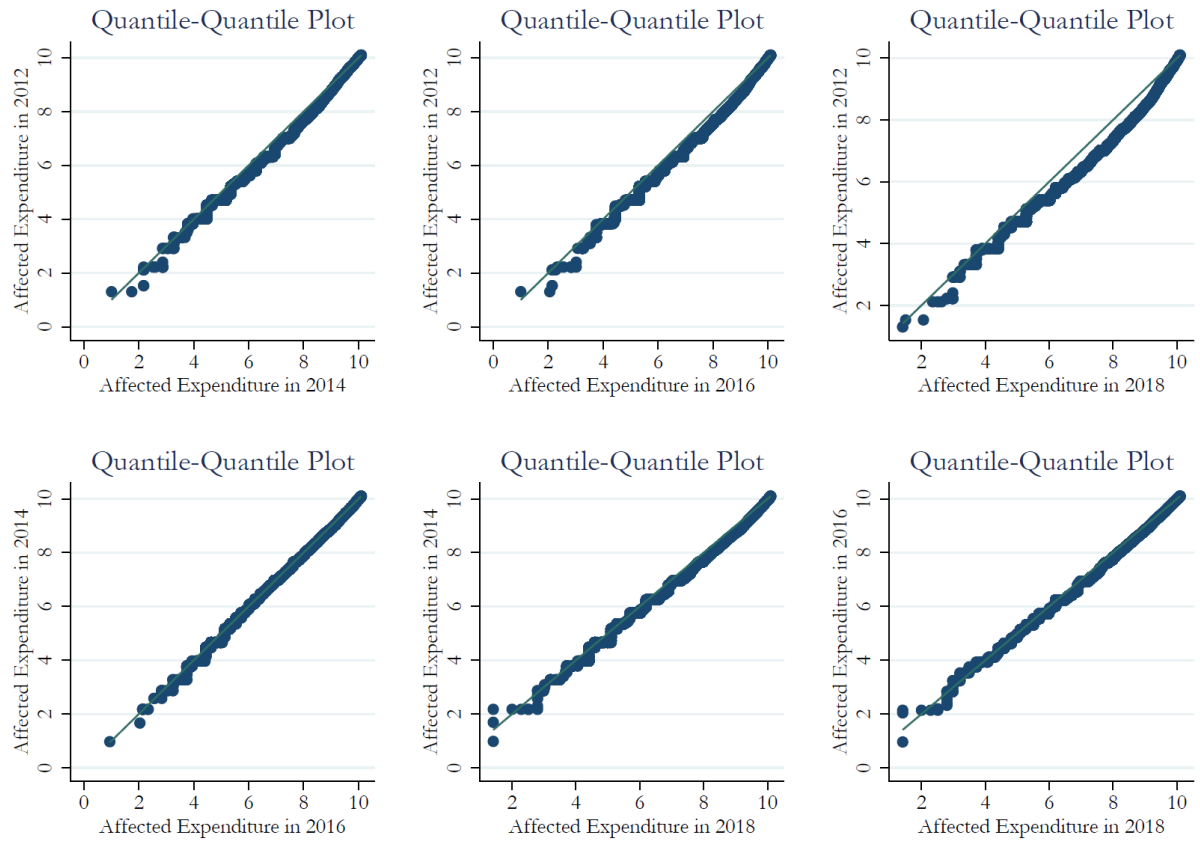
Figure 1.A. 1: Xi's anti-corruption randomness check



Notes: Government system family rate equals the number of government system families divided by total number of families.

Source: Author's calculations using CFPS.

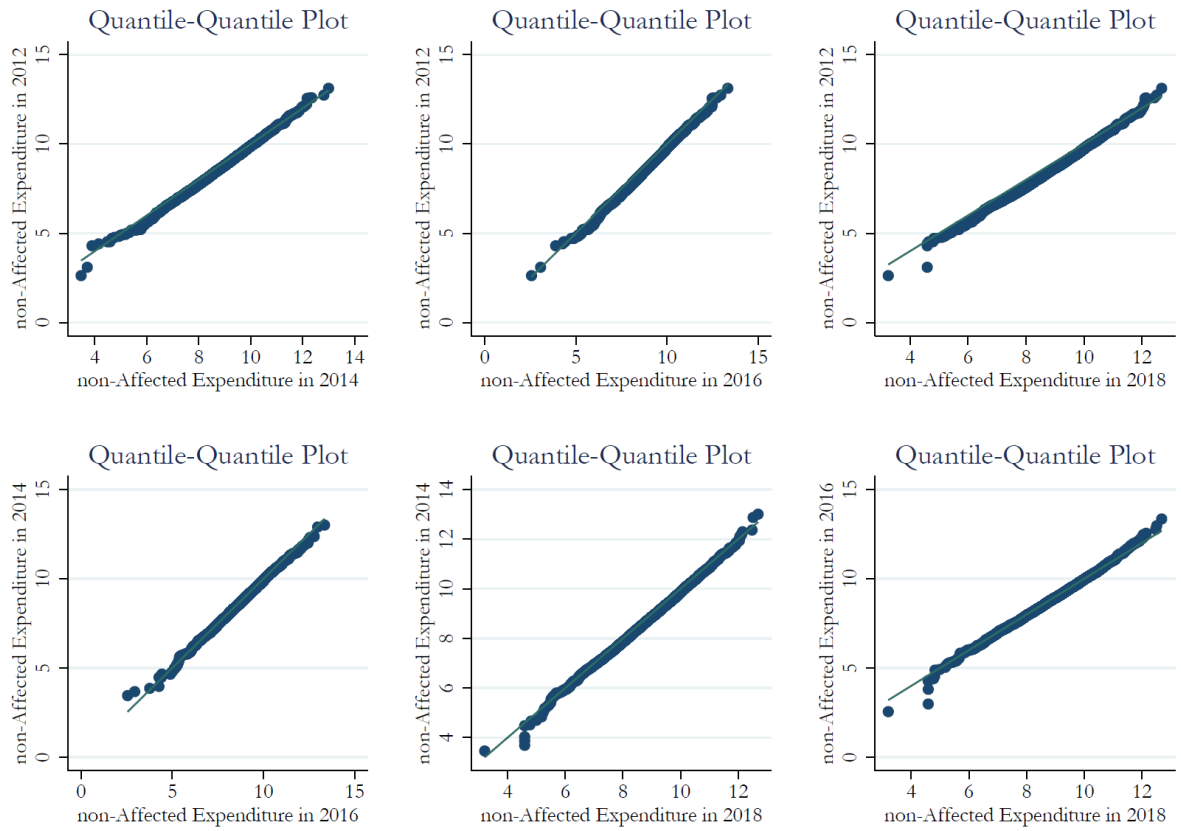
Figure 1.A. 2: Affected expenditure comparison in different years



Notes: These above graphs are comparing the quantiles of affected expenditure in one year with affected expenditure in the other year.

Source: Author's calculations using CFPS.

Figure 1.A. 3: non-affected expenditure comparison in different years



Notes: These above graphs are comparing the quantiles of non-affected expenditure in one year with non-affected expenditure in the other year.

Source: Author's calculations using CFPS.

Table 1.A. 1: Separate demographic summary statistics by year

	Government People				Non-Government People			
Year	**2012**	**2014**	**2016**	**2018**	**2012**	**2014**	**2016**	**2018**
				Job Characteristics				
Public servant	0.12	0.10	0.11	0.12	0	0	0	0
SOE	0.21	0.24	0.27	0.29	0	0	0	0
Institutions	0.15	0.17	0.18	0.18	0	0	0	0
Other jobs	0.52	0.49	0.45	0.41	1	1	1	1
				Education Levels				
< Primary	0.13	0.11	0.09	0.09	0.32	0.25	0.28	0.25
Primary	0.11	0.12	0.11	0.09	0.23	0.23	0.22	0.22
Middle school	0.25	0.26	0.24	0.24	0.28	0.28	0.27	0.30
High school	0.24	0.23	0.23	0.22	0.12	0.12	0.12	0.14
Junior college	0.14	0.14	0.14	0.17	0.03	0.04	0.04	0.05
College	0.12	0.11	0.13	0.18	0.02	0.02	0.02	0.03
Graduate	0.01	0.01	0.02	0.02	0.00	0.00	0.00	0.00
				Basic Information				
Family Size	3.45	3.83	3.39	3.62	3.27	3.68	3.17	3.51
	(1.44)	(1.58)	(1.57)	(1.74)	(1.59)	(1.80)	(1.63)	(1.86)
Adult Size	2.96	2.96	2.70	2.54	2.65	2.57	2.29	2.12
	(1.27)	(1.30)	(1.26)	(1.20)	(1.26)	(1.25)	(1.16)	(1.08)
Age	41.75	42.99	42.85	43.18	46.80	47.57	47.78	48.34
	(14.37)	(14.95)	(14.73)	(14.78)	(17.17)	(17.72)	(17.38)	(17.27)
Minority	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01
Urban	0.68	0.67	0.73	0.74	0.42	0.43	0.46	0.47
Hukou	0.61	0.58	0.57	0.54	0.25	0.23	0.22	0.21
Female	0.50	0.50	0.50	0.49	0.50	0.50	0.50	0.50
				Regional Characteristics				
East	0.46	0.46	0.47	0.43	0.43	0.44	0.43	0.44
Middle	0.32	0.31	0.30	0.31	0.29	0.29	0.28	0.28
West	0.22	0.23	0.23	0.26	0.28	0.27	0.28	0.28
N	2015	2382	2520	2311	11144	11209	11544	11443

Notes: Results calculated using the CFPS sample from 2010, 2012, 2014, 2016 and 2018 in different groups, government system workers and non-government system people. Standard deviation in parentheses are included where informative. This summary table is based on head of household. The left panel indicates the government group information based on government observations. The right panel is the nongovernment group information based on nongovernment observations. All education levels are the rate measurement in different years. Regional Characteristics are the measurement rates from different areas in different years. For variables definitions refer to Table 1.

Table 1.A. 2: Separate years effected family consumptions

	Government				Non-government			
	2012	2014	2016	2018	2012	2014	2016	2018
Effected Consumptions	20,607	16,880	23,366	20,819	9,489	7,738	10,852	11,627
Eating out	7,738	3,340	3,815	4,418	3,185	1,530	1,978	2,347
Car	6,233	5,458	6,454	6,068	3,001	2,174	2,914	3,815
Other Transportation	961	1,152	1,353	1,428	664	727	881	1,016
Public Transportation	2,421	2,880	3,164	3,596	1,376	1,681	1,890	2,202
Travel Expenditure	1,509	1,738	2,281	2,774	394	521	753	960
Entertainment	452	272	388	471	140	105	144	199
Durable Goods	1,293	2,040	5,912	2,065	729	1,001	2,292	1,088
Separate Years Non-Effected Family Consumptions								
	Government				**Non-government**			
Nonaffected Consumptions	13,825	15,790	18,081	19,266	9,646	11,103	12,994	13,974
Health	274	369	495	615	140	196	293	336
Medical	3,078	4,087	4,908	4,589	3,525	3,888	4,736	4,654
Education	4,041	4,143	4,680	5,510	2,461	2,662	3,027	3,494
Communication	2,160	2,365	2,517	2,500	1,311	1,543	1,746	1,818
Cloth	2,972	3,156	3,497	3,850	1,509	1,784	1,968	2,263
Necessary	797	972	1,186	1,180	559	710	832	907
Cosmetic	502	700	798	1,022	140	320	391	503
Separate Years Family Surveyed Values								
	Government				**Non-government**			
HH total Expenditure	49,828	43,466	50,883	50,948	31,319	28,239	30,466	31,754
Family Income	61,116	62,328	70,731	77,660	29,038	37,942	44,652	46,123
Saving	39,215	46,639	63,808	75,914	20,353	20,158	30,398	35,580
N	2,015	2,382	2,520	2,311	11,144	11,209	11,544	11,443

Note: Results are calculated by using CFPS samples from 2012, 2014 and 2016. Estimates are survey weighted. Standard deviations in parentheses are included where informative. Total number of observations is 54,825 for the full sample, 50,663 for the non-government group, and 3,457 for the government group. We calculated this summary table based one individual level. We account the family is government household if there are at least one government system workers. Government workers and other entities are calculated separately. All the variables definitions refer to Table 2. ***p<0.01, **p<0.05, *p<0.1

Table 1.A. 3: Economic condition in China

Year	RGDP/CAP	GDP growth rate	Revenue	Expenditure
2010	4550	10.636	11.231	12.846
2011	5323	9.551	11.239	13.217
2012	5832	7.860	11.139	13.475
2013	6343	7.769	10.956	13.589
2014	6754	7.300	15.874	13.375
2015	6990	6.905	16.110	14.036
2016	6892	6.737	15.764	14.386
2017	7355	6.757		14.522
2018	8038	6.567		14.676

Notes: RGDP/CAP means GDP per capital based on 2010 US dollars values. Revenue is Chinese government annual revenue percentage of GDP excluding grant. Expenditure is the government annual final expenditure percentage based on GDP.

Table 1.A. 4: Triple DID results

	Basic DID	Quintile regression				
	(1)	(2)	(3)	(4)	(5)	(6)
		20%	40%	60%	80%	100%
Government	-0.130***	0.090*	0.043	0.043	0.040	0.267*
	(0.032)	(0.046)	(0.038)	(0.037)	(0.038)	(0.149)
Policy Shock Year	0.295***	0.332***	0.295***	0.269***	0.202***	0.443***
	(0.015)	(0.023)	(0.019)	(0.019)	(0.019)	(0.075)
Affected	-1.091***	-1.607***	-1.242***	-0.908***	-0.563***	-2.299***
	(0.015)	(0.026)	(0.021)	(0.021)	(0.021)	(0.083)
Gov*Policy	0.004	-0.039	-0.031	-0.041	-0.040	-0.132
	(0.034)	(0.052)	(0.043)	(0.042)	(0.043)	(0.169)
Gov*Affected	0.233***	0.108	0.296***	0.321***	0.320***	-0.262
	(0.039)	(0.066)	(0.055)	(0.053)	(0.055)	(0.212)
Policy*Affected	0.076***	0.132***	0.215***	0.161***	0.054**	-0.232**
	(0.017)	(0.030)	(0.025)	(0.024)	(0.025)	(0.096)
Gov*Policy*Affected	0.127***	0.363***	0.147**	0.048	-0.029	0.389
	(0.044)	(0.075)	(0.062)	(0.060)	(0.062)	(0.242)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
HH FE	No	No	No	No	No	No
Adjusted/ Pseudo R2	0.449	0.243	0.188	0.142	0.094	0.277
N	83,121	83,121	83,121	83,121	83,121	83,121

Notes: The data set in the regression spanning 2012, 2014, 2016, and 2018. All Standard errors in parentheses. For all variable's definitions refer to Table 4. The dependent variables, expenditure, includes affected and non-affected consumption expenditures in one column. Gov*affected is the interaction term between the treatment index and affected consumption index. Policy*Affected is the interaction term between the anti-corruption campaign index and the affected consumption index dummy. Gov*Policy*Affected is the triple interaction term. I dropped the top 5% family income households in the basic regression panel. In the quantile regression panel, I dropped another top 5% consumption expenditure group. The reason of these drops is that in the entire distribution they are outliers. * p<0.10. **p<0.05, ***p<0.01.

Table 1.A. 5: Specification test

	Time Specification Test	Alternative treatment control group	
	Surveyed total	Affected	Non-affected
	(1)	(2)	(3)
Government	0.018	0.022	0.035
	(0.074)	(0.207)	(0.121)
Policy Shock Year	-0.402***	0.378***	0.346***
	(0.033)	(0.023)	(0.014)
Gov*Policy	-0.035	0.117	-0.054
	(0.072)	(0.209)	(0.122)
Other controls	Yes	Yes	Yes
Adjusted R2	0.412	0.671	0.684
N	66234	37595	37595

Notes: The data set in the regression spanning 2012, 2014, 2016, and 2018. All Standard errors in parentheses. For all variable's definitions including all kinds of fixed effects refer to Table 4. * p<0.10. **p<0.05, ***p<0.01.

Table 1.A. 6: All expenditure categories results

Effected consumption categories								
	Effected	**Eating out**	**Car**	**Other Transportation**	**Public Transportation**	**Tourism**	**Entertainment**	**Durable goods**
Government	0.042	-0.324***	-0.675***	-0.037	-0.034	-0.233***	-0.283***	-0.336***
	(0.042)	(0.103)	(0.082)	(0.099)	(0.081)	(0.076)	(0.066)	(0.104)
Policy Shock Year	0.425***	1.195***	1.253***	0.464***	0.467***	0.877***	0.858***	0.198***
	(0.021)	(0.049)	(0.039)	(0.047)	(0.038)	(0.036)	(0.031)	(0.049)
Gov*Policy	0.116***	0.724***	1.124***	0.203**	0.196**	0.622***	0.693***	0.598***
	(0.042)	(0.103)	(0.082)	(0.099)	(0.081)	(0.076)	(0.066)	(0.104)
Urban	0.325***	1.176***	0.336***	0.082	0.108*	0.558***	0.591***	0.070
	(0.030)	(0.073)	(0.058)	(0.070)	(0.057)	(0.053)	(0.047)	(0.073)
Family Size	0.066***	-0.108***	0.191***	0.191***	0.233***	-0.011	0.024***	0.082***
	(0.006)	(0.014)	(0.011)	(0.014)	(0.011)	(0.010)	(0.009)	(0.014)
Age	-0.003	-0.031***	0.028***	0.017***	0.031***	0.014***	-0.002	-0.002
	(0.003)	(0.007)	(0.005)	(0.006)	(0.005)	(0.005)	(0.004)	(0.007)
Female	0.020	0.092**	0.001	0.041	0.033	-0.021	-0.001	0.000
	(0.016)	(0.037)	(0.030)	(0.036)	(0.029)	(0.028)	(0.024)	(0.038)
Total Family Income	0.040***	0.087***	0.085***	0.085***	0.114***	0.059***	0.061***	0.067***
	(0.003)	(0.008)	(0.006)	(0.007)	(0.006)	(0.006)	(0.005)	(0.008)
Family Saving	0.026***	0.089***	0.028***	0.055***	0.051***	0.050***	0.047***	0.045***
	(0.002)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)
Adjusted R2	0.429	0.336	0.294	0.188	0.385	0.395	0.384	0.090
N	45,909	51,661	51,661	51,661	51,661	51,661	51,661	51,661

Note: The data set in the regression spanning 2012, 2014, 2016, and 2018. All Standard errors in parentheses. For all variable's definitions including all kinds of fixed effects refer to Table 3. The dependent variables are different subcategories under affected and non-affected expenditures. * p<0.10. **p<0.05, ***p<0.01.

Table 1.A. 7: non-affected consumption categories

	Nonaffected	Health	Medical	Education	Communication	Cloth	Daily necessities	Cosmetic
Government	-0.027	0.060	-0.000	-0.164	0.101**	0.106**	0.001	0.193**
	(0.024)	(0.052)	(0.000)	(0.118)	(0.046)	(0.048)	(0.033)	(0.086)
Policy Shock Year	0.335***	0.150***	0.000	0.966***	1.730***	0.478***	-1.394***	5.269***
	(0.012)	(0.025)	(0.000)	(0.058)	(0.022)	(0.024)	(0.016)	(0.042)
Gov*Policy	0.020	0.016	0.000*	0.064	-0.058	-0.062	-0.007	0.037
	(0.024)	(0.052)	(0.000)	(0.117)	(0.045)	(0.048)	(0.033)	(0.086)
Urban	0.102***	0.148***	0.000***	0.137*	0.164***	0.207***	0.098***	0.568***
	(0.017)	(0.037)	(0.000)	(0.083)	(0.032)	(0.034)	(0.024)	(0.061)
Family Size	0.131***	0.009	0.000***	0.706***	0.172***	0.092***	0.066***	0.105***
	(0.003)	(0.007)	(0.000)	(0.017)	(0.006)	(0.007)	(0.005)	(0.012)
Age	-0.002	0.005	0.000*	0.047***	0.011***	0.005	-0.001	-0.008
	(0.002)	(0.003)	(0.000)	(0.008)	(0.003)	(0.003)	(0.002)	(0.006)
Female	-0.017*	-0.023	0.000***	0.009	-0.006	-0.034*	-0.020*	-0.006
	(0.009)	(0.019)	(0.000)	(0.043)	(0.017)	(0.018)	(0.012)	(0.032)
Total Family Income	0.022***	0.013***	0.000***	0.064***	0.052***	0.074***	0.027***	0.079***
	(0.002)	(0.004)	(0.000)	(0.009)	(0.004)	(0.004)	(0.003)	(0.007)
Family Saving	0.006***	0.020***	0.000***	0.020***	0.016***	0.034***	0.009***	0.062***
	(0.001)	(0.002)	(0.000)	(0.005)	(0.002)	(0.002)	(0.001)	(0.004)
Adjusted R2	0.459	0.268	0.228	0.466	0.478	0.388	0.398	0.537
N	51429	51670	51670	51670	51670	51670	51670	51670

Notes: The data set in the regression spanning 2012, 2014, 2016, and 2018. All Standard errors in parentheses. For all variable's definitions including all kinds of fixed effects refer to Table 3. For all variable's definitions including all kinds of fixed effects refer to Table 3. The dependent variables are different subcategories under affected and non-affected expenditures. * p<0.10. **p<0.05, ***p<0.01.

Chapter 2: The Chinese Communist Party and Religious Identification in China: An Empirical Analysis

2.1 Introduction

Even though the Chinese government is tolerant of five official religions for non-CCP individuals, the members in Chinese Communist Party (CCP) must adhere to militant atheism. Membership in the CCP brings large material benefits for those who are able to join.[13] CCP members maintain an elevated position in society, a stable source of income, as well as subsidies and influence (Xu et al. 2017). The existence of these benefits to CCP members imply a large material cost to overt religious affiliation and practice in China.

This paper uses a difference in difference approach to study the extent to which the CCP's policies regarding religion may influence religious identification over an individual's life cycle in China. To do so, I contrast the changes in religious affiliation before and after retirement for CCP members in comparison to those before and after retirement of non-CCP individuals. In theory, individuals who were in the CCP but religious may have chosen to hide their religious beliefs while working in order not to lose out on party benefits. If this is the case, then we would expect to observe some degree of increase in religious identification or practice among the newly retired CCP members. I find no evidence of any discontinuous jump in religious membership after retirement. Instead, religiosity trends up among non CCP individuals and remains flat among CCP members over the life cycle, with no changes in trend around retirement.

These results suggest that either: (1) assortative matching drives individuals into the CCP who are initially non-religious and then remain so, or (2) some degree of lingering benefits associated with CCP membership even after employment ends are large enough to disincentivize religious uptake.

This paper makes multiple contributions to the literature on how government affects individuals' religious behaviors. This is the first paper to attempt to quantify how the Chinese government uses a strategy of economic incentives to influence religious belief. Even though many others comment qualitatively on how the Chinese Communist Party controls religious beliefs; no paper systematically discusses how the Chinese government controls or influences them through economic benefits (Office of International Religious Freedom, 2019). The second contribution is a new identification method through the changes of religious belief in the CCP group before and after the retirement because of the religious belief regulations in Constitution of the Communist Party of China.

[13] non-CCP individuals are allowed to do religious belief freely without penalty.

2.2 Background on religious belief

Previous research has focused on religion as a commercial commodity by using supply and demand principles (Iannaccone, Finke, & Stark, 1997). Recently other researchers also begun to focus on economics role in religion (Iyer, 2016). They think that religious belief is a public goods market and the econometrics methods should be used for identification. Different characteristics of places and people can influence same religion into different directions, such as Christian in West Europe, East Europe, and America (Brenner, 2016). In addition to research on how the Communist party affects religious beliefs, some papers have focused on the religious belief changes between East Germany ruled by the Soviet Union and West Germany ruled by U.S before and after collapse of Soviet Union. (Hardy, Skirbekk, & Stonawski, 2019; Konrad, 2015). They find that the number of people stating a religious belief in East Germany is much smaller than the West Germany. The number of religious youths in East Germany is also significantly smaller than the number of religious believers in West Germany. Even after the collapse of Soviet Union these young people's religious belief does not increase. They conclude that communist party can reduce people's preference for religious beliefs and that this effect can persist. For religion development in China, researchers have focused on how economics market reform influences the Chinese religious affiliation (Xu et al. 2017). Miller (2000) compared the effects of religious belief on people's behaviors in different societies. Religion can only influence individual's behaviors in Asia but affect entire society behaviors in Western world. This paper researched how a society policy affected people's religious behaviors in China.

During the 1950s, the CCP selected a number of cooperative religious leaders to build related institutional organizations, such as the Chinese Buddhist Association, the Chinese Islamist Association, the Chinese Daoist Association, and the Chinese Catholic Patriotic Committee. These were essentially efforts to better monitor and control religious activity. During the Cultural Revolution, many traditional temples and religious venues were destroyed (Lopez & Donald, 1996). After the death of Chairman Mao in 1976, they loosened the restrictions on regulations due to the policy on "Open Gate" policy. Since 1982, the Chinese government officially defines only five legal religions in the country -- which are Buddhism, Daoism, Islam, Protestantism, and Catholicism, but no other.[14]

[14] This was formalized in the edict, "The Basic Viewpoint and Policy on the Religious Affairs during the Socialist Period of Our Country," also known as "Document No.19" (Yang 2004).

Religious affiliation in China has increased significantly in past 30 years (World Values Survey, 2007). According to the Chinese General Social Survey (CGSS), the primary data set in this paper, the people of religious believers in China has increased 120% from 2005 to 2015. However, the religious belief rate in China is still much lower than other countries (Xu et al., 2017). This comparatively lower religiosity rate probably reflects, among other factors, the effects of long-term religious regulations on people's minds and behaviors (Hardy et al., 2019).

The Congressional-Executive Commission on China's Annual Report in 2017 argued that Chinese citizens have religious freedom. However, Document No.19 regulates that only non-CCP individuals have religious freedom. CCP members are not allowed to join any religious group by the Constitution of the Communist Party of China. The Constitution of the CCP regulates that any member of CCP can only believe in Marxism, Leninism, Mao Zedong Thought, and Deng Xiao-ping Theory (the Constitution of the Communist Party of China, 1949). They should use these theories to guide their work and life. Beside the regulation requirement, the United Front Work is responsible for the management of religions and for checking CCP members' religious conditions and spirit or CCP members' loyalty.[15]

2.3 Data description

The main source of data for this paper is the Chinese General Social Survey, a cross sectional survey conducted in 2003, 2005, 2008, 2010, 2011, 2012, 2013, and 2015 which was undertaken in 30 out of 36 provinces in China. It contains the stated religious affiliation of individuals as well as different measures of religiosity and demographic characteristics such as age, gender, education, income, and expenditure. A key advantage of this data set is that religious belief and religiosity are rarely collected in China. For example, it contains survey question "How often do you go to the religious places?" and "How much do you donate to this religious group?"[16] However, because of lacking religious information in 2003, I did not use the information in 2003.

Table 1 summarizes the basic demographic information for CCP and non-CCP member individuals. Many elements such as urbanization and cultural pluralism can affect religious affiliation (Casanova 2006; Gorski 2003). The CCP members percentage in this data set is 10.9. In the Employment panel, the percentage of CCP members who work in the government system, column

[15] United Front Work is an agency of the Communist Party that manages relations with various important and influential elite individuals and organizations inside and outside China.

[16] We do not analyze religious belief by using donation information owing many missing values.

(2), is significantly higher than the percentage of non-CCP individuals who worked in government system, column (3). This implies that, as expected, CCP members are tied with government system more than the non-CCP individuals. On average government jobs mean more materials benefits, stable income, and anecdotally, an esteemed reputation. The education level of non-CCP members' is significantly lower than the education level of CCP members. Education is one important element which affects people's religiosity, and is usually negatively correlated with it (Nord, 2014). Education also leads to more secularization in society (Liang & Dong, 2019). To understand more on how education affects religious belief in this paper, I draw Figure A1 in Appendix to indicate that as education levels increase, the religiosity decreases. The two parallel lines in Figure A1 also demonstrate that the effect of education on religious belief is estimated to be the same for both CCP and non-CCP groups.

In China there are 56 government recognized ethnicities with different and unique culture and religious characteristics. For simplicity I create an indicator for being from the majority population, Han. It is obvious that the other 55 ethnicities in the CCP comprise is less than that in non-CCP individuals, around 1.6%. In China, there are better social services such as higher quality schools and medical systems in urban areas. Table 1 shows that 76.8% of CCP members live in urban areas, which is much higher than that of non-CCP individuals.[17] Some papers argue that older people or women who are not the main labor sources have more time to participate the religious events, especially the old people concerning their health problems (McCleary & Barro, 2006). The female in CCP group. 26.6% of the sample of CCP members is female, which is significantly lower than that of 54.8% for non-CCP members workers. CCP members are relative older than non-CCP individuals on average. Family size is also smaller among CCP members. The distribution of CCP members and non-CCP individuals is similar in different regions, East, Middle and West.[18]

Religious information is summarized in Table 2. Overall, 11.2% of individuals report a religious belief. Despite being forbidden, 6.1% appear to answer that they are religious believers in this survey, which is much smaller than 11.8% religious' believers in non-CCP group.

In the Panel B of Table 2, I classify the religiosity into five groups according to the frequency of religious activities. The number of non-religious activities in CCP group is much more than that of

[17] It is better for us to use place of residence to classify the urban or rural places than using the Chinese hukou system, because people could be influenced by the place of residence.

[18] The separate years summary in Table A1-1 and Table A1-2 in the appendix also indicate the similar results e.g., higher urban rate, lower minority rate, and older age in the CCP system. The number of surveyed observations and the related proportion of CCP members is different in different years.

people in non-CCP group. Oppositely, all other kinds of religious activities participation in CCP group is much less than the same religious activities in non-CCP group.

CGSS also supports information on different religious affiliations: Buddhism, Daoism, Folk Religion, Islam, Catholicism, Protestantism and Others including Hindu, Orthodox, Judaism and other Chinese local Gods.[19] The "Religious classes panel" indicates the Buddhism is the most popular religion in China, which is 0.054 overall. The Buddhism belief is 0.028 in CCP group and 0.058 in non-CCP group. In other religions, more people in non-CCP group have religious belief than the people in CCP group.

Because governments formally recognize only a few religions and penalizes others, religious diversity is low in China (Iannaccone, Finke, & Stark, 1997; Stepan, 2000; Froese & Pfaff, 2005). To examine this issue, we calculate a religious pluralism index, which measures religious diversity, by using one minus the Herfindahl Index (sum of squares of religious adherence shares). The pluralism index measures the possibility of two randomly selected religious believers belonging to different religions. It equals zero when all randomly selected religious believers are in the same religion. Conversely, the pluralism index would be one when every randomly selected people are all in different religions. In Table 1 the pluralism is 0.710 in non-CCP group and 0.699 in CCP group indicating the abundant religions in China.

Table A1-1, Table A1-2, Table A2-1, and Table A2-2 in the Appendix demonstrate the summary information of demographic characteristics, religiosity, and religious diversity in separate years. They are consistent with the pooled summary information in Table 1 and Table 2.

Figure 1 illustrates the religious membership in CCP and non-CCP groups along the dimension of age. The black line is the percentage of religious believers among non-CCP individuals and the purple line is the percentage of religious believers among CCP members. The percentage of religious affiliation in non-CCP group is significantly larger than that in CCP group. Furthermore, religious affiliation of CCP members does not change with age, but religious affiliation in non-CCP group gradually increases with age. This result is different with our expectation about religious affiliation jump in CCP group and no change in non-CCP group after retirement.

Figure 2 unravels a concern about whether the CCP members give up their CCP membership to believe in a religion after retirement, which can explain why percentage of religious affiliation in non-CCP group gradually increases with age. Yet, Figure 2 indicates that the percentage of CCP members

[19] Folk Religion means some local Chinese religions, such as fortune-telling, jingzu, baoying, mingyun, and Tian.

in each age group even increased. This means CCP members do not switch their CCP membership to believe a religion implying that the regression does not have this switching problem.

As I mentioned before, one of the contributions of this paper is to study how Chinese government uses economic incentives to influence people's religious affiliation. Therefore, I check these two groups' income and pension trend in Figure 3. This figure designates that the incomes and pension are higher in CCP group than that in the non-CCP group along all different age groups. This result is consistent with my research expectation, because the CCP members do have better income than non-CCP members. This material benefits could be the Chinese government's economic strategy to keep CCP members away from religious affiliation.

2.4 Analysis

The main challenge in estimating the relationship between the effects of retirement age and individual's religious belief is that any religious affiliation changes might be correlated with age, education levels, or other unobserved factors. To solve this potential endogeneity problem, I use a difference in difference approach. This limits the endogeneity problem, which would exist if these covariates had differential impacts on religiosity for CCP and non-CCP members.

The idea of the empirical analysis is as follows. The regulation on the religious beliefs of CCP members is very restrict by using economic benefits as the "penalty". CCP members are expected to have more religious freedom after retirement, because they cannot influence the CCP political system a lot and they do not need to worry about forgone economic benefits (or punishments). Therefore, my main identification strategy is based on testing any changes in the CCP members' religious affiliation near the retirement age. To uncover the impact of the religious affiliation regulation on CCP members, I compare individual religious belief across CCP members and non-CCP individuals, before and after retirement age. I mainly use the Linear Probability Model (LPM), Logit, and Probit model with many other robustness checks and placebo test whose results are consistent with all the main results. The main empirical specification is in Eq. (1):

$$E[y_i|ccp_i, retirement_i, X_i] = \mathrm{F}(\beta_0 + \beta_1 ccp_i + \beta_2 retirement_i + \beta_3 ccp_i * retirement_i + X_i) \quad (1)$$

This model equation means the conditional expected value of y_i to be a general function of the index function. F represents different functions, such as the LPM, Logit, and Probit models. *i* denotes different individuals. The dependent variable, y_i, is the religious belief dummy, $y_i = 1$ means

individuals have a religious affiliation, y_i=0 means they do not. The variable, ccp_i, is dummy variable, $ccp_i = 1$ means the CCP members and $ccp_i = 0$ means non-CCP individuals. The time shock dummy variable in above model is the retirement age, $retirement_i$, equaling one for male's aged 60 or older or female's aged 55 years or older. β_3 is the interaction coefficient of the interaction term between ccp_i and $retirement_i$. X_i indicates all control variables comprising ethnicity index, residence place, gender, family size, age, age trend in CCP group, father's CCP condition, mother's CCP condition, education fixed effects, spouse' CCP condition, education fixed effect and provinces fixed effects.

The expected hypothesis: according to all above information, the probability than an individual chooses to openly state a religious affiliation should increase after retirement age by a larger margin for CCP members than for non-CCP members, if the CCP incentives are strong enough to repress an underlying level of religious affiliation.

2.5 Empirical results

Column (1) of the LPM results in Table 3 indicates that, without any control variables, the probability of CCP members' having a religious affiliation is lower than that of non-CCP individuals. As more control variables are added into this regression, the probability difference of religious affiliation between CCP members and non-CCP individuals decrease and eventually become insignificant in column (6), suggesting that correlated observables drive the bulk of the observed difference across the two groups.

When we do not control for the underlying age trend in columns (4) and (5), then retirement can affect people's religious belief possibility reflecting the significant negative coefficients of "Interaction" in column (4) and column (5). However, after controlling the age trend, the coefficient in column (6) is insignificant, economically small and negative, -0.013. The results in Table 3 are opposite with the previous *expected hypothesis*. Thus, there is no evidence of any increase in religiosity after retirement.

I perform a number of robustness tests to make sure that the findings are not due to some nuance of the chosen specifications. LPM frequently has a problem in which it generates coefficients that do not make sense for probability, outside the bounds of 0 and 1. The bigger problem is that fitting a straight line to data with a dichotomous dependent variable runs the risk of misidentifying the relationship between the independent variable and the dichotomous dependent variable. Therefore, to further check the results, I also use Logit and Probit regressions which can solve the LPM's potential problem. The coefficients in column (2) and column (3) are average marginal effects in Table 4 and

coefficients of interaction term are insignificant and small which are consistent with the coefficients in Table 3 inferring the religious affiliation probability does not change between CCP members and non-CCP people before and after the retirement age. The insignificantly positive coefficient of retirement eligible indicates that retirement does not influence people's religious belief behaviors.

An additional concern is whether these individuals really retired after their legal retirement age. CGSS supports the straightforward information on retirement whose survey question is "Are you retired?" Then, in Table 5, given all same controls and fixed effects variables as in Table 3 and Table 4, we use this retirement information as the "retirement eligible" in regressions. The outcomes in Table 5 are similar with the results in Table 3 and Table 4. Coefficients of "Interaction" are consistent with the coefficients in Table 3 and Table 4 inferring no more religious affiliation in CCP group after retirement compared with non-CCP group. However, Table 5 indicates the significantly decreased coefficients on "Retirement Eligible" implying that even more CCP members choose no religious affiliation after retirement. Therefore, the results in Table 5 also show opposite direction compared with the main hypothesis.

Even though the income of CCP members is bigger than the income of non-CCP individuals which is showed in Figure 3, not every CCP member works in the government system, which is the main channel for material benefits. It is clearer to use the CCP members working in government system as the treatment group to estimate how the Chinese government successfully uses economic benefits to affect CCP members' religious affiliation. I classify CCP members with government system jobs as the treatment group and treat non-CCP individuals as control group in LPM, logit, and Probit regressions. Using these new measures of CCP membership in the previous analysis can now be seen in Table 6. The results are similar with the results in Table 4: coefficients on CCP, Retirement eligible, and Interaction term are all insignificantly negative small. Especially the coefficients of interaction term demonstrate that there is no difference in religious affiliation probability between CCP members and non-CCP individuals before and after the retirement age. Compared with coefficient of interaction term in LPM, the 10% significant -0.03, the coefficients in Logit and Probit models are more reliable as I explained before. These results are opposite with our hypothesis as well, but consistent with results in Table 3, Table 4, and Table 5 inferring that the regulations of religious belief on CCP members maybe not the reasons about few CCP members choose to believe religion.

Among religious believers, some of them go to religious activities more frequently than others do. Therefore, I use religiosity as the dependent variable to run all above regressions again whose results are in Table 7. For robustness checks, I also classify the dependent dummy variable as follows: treat

religiosity with the "<1 per year" whose religious activities is less than one time per year as zero and treat all the other religiosity whose religious activities is more than one time per year as one. All other regressors are as same as in Table 3. The interaction term is again insignificant. Because the surveyed sample size limitation in CGSS, I do not classify other religiosity groups to do more religiosity tests.

One may argue that CCP members do not change their religious affiliation immediately after their retirement or may change their religious affiliation before their retirement. Therefore, I use fake retirement age placebo test to do more tests in Table 8. Instead of legal retirement age, I set up age 50 as the retirement age in columns (1)-(3). The results are again very similar to those before. Next, I set age 65 years as the retirement age and find similar results.

One remaining concern is that because the analysis uses a repeated cross section, the nature of the survey may induce some measurement error into the data. Specifically, I do not observe the exact same individuals before and after retirement. This would matter because while some individuals may report being religious or non-religious, individuals surveyed after retirement who do choose to become religious may leave the CCP. This would then not be captured in the previous regressions. In order to test for this possibility, I undertake two exercises. First, I compare the share of the population who is a CCP across the retirement threshold on the basis of age. There is no significant change in the share of individuals reporting being members, which suggests this is not a large data issue. As a second step, I construct a synthetic panel using age cohorts and age and gender cohorts.[20] This allows me to construct a pseudo-panel in which I run a regression of the impact of retirement eligibility on religiosity controlling for religious affiliation. The results of this regression are presented in Table 10. As with previous analysis, the cohort panel method generates no significant change in religiosity, consistent with the previous analysis. There is no evidence of a large increase in religious affiliation after retirement.

2.6 Conclusion

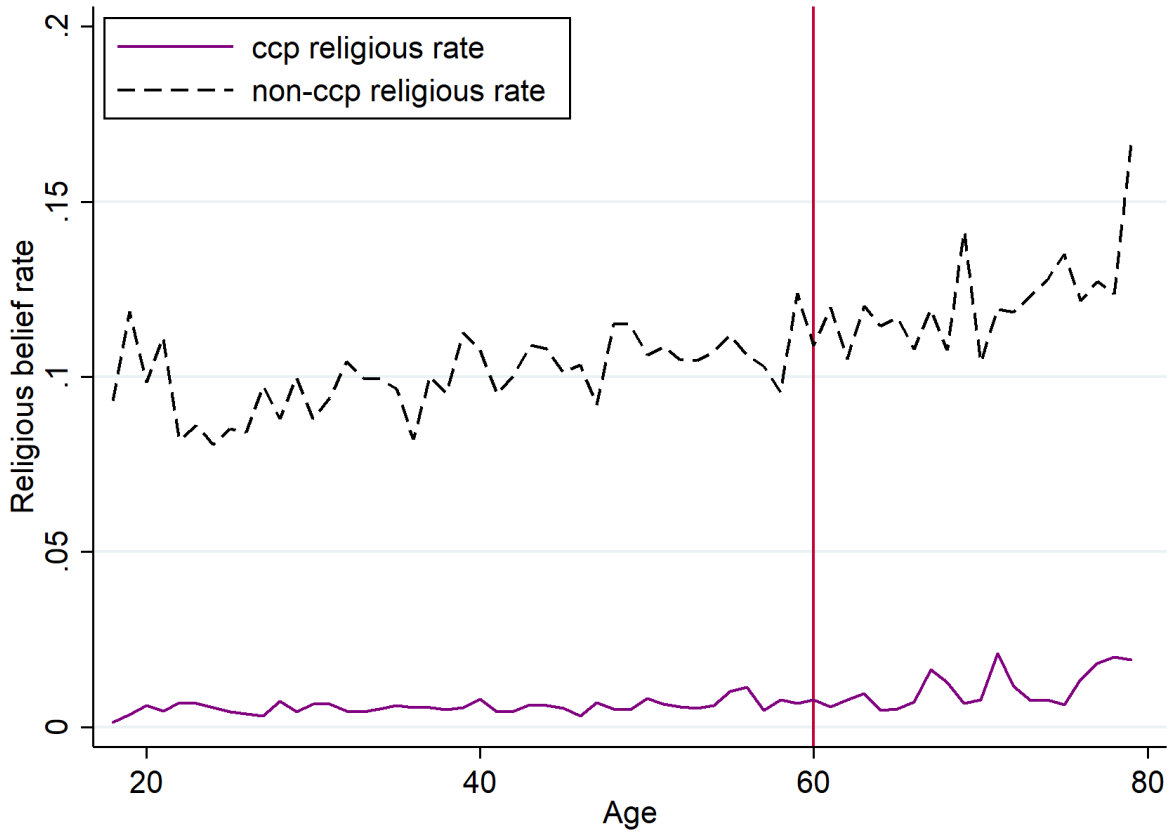
Even though China has globalized its economy and reduced the level of regulations on religious behavior in China, there are still many implicit regulations for members of the CCP party. Because the legal system of the Chinese government stipulates those Chinese citizens have religious freedom, the question is how to measure whether the Chinese government's policies can be empirically seen in survey data. This paper is a first attempt to answer some of these questions and provide clarity on

[20] Summary statistics for the sample size of these cohorts can be found in Appendix Tables A3 and A4.

how Chinese government uses the religious belief regulation in the Constitution of the Communist Party of China and economics benefits to affect people's religious affiliation.

To summarize, this paper examines Chinese government's economic strategy effects on religious affiliation using a novel test based on retirement age – classifying people into CCP group and non-CCP group through a difference in difference model. I find no significant difference on religious affiliation between CCP group and non-CCP group before and after the retirement age. What this paper can do is rule out that there is a large uptick in religiosity. Given this, the lack of an increase could reflect several things. Specifically, non-religious individuals select in the CCP, or individuals who are non-religious in the CCP for the majority of their lives become accustomed to this and remain so after retirement or perhaps there is some degree of lingering benefits associated with CCP membership even after government employment ends which is large enough to disincentivize religious uptake. All above reasons could be a future topic for research given the expansion of religious belief and practices in China and the existing tension between the government, party, and non-governmental institutions in the country.

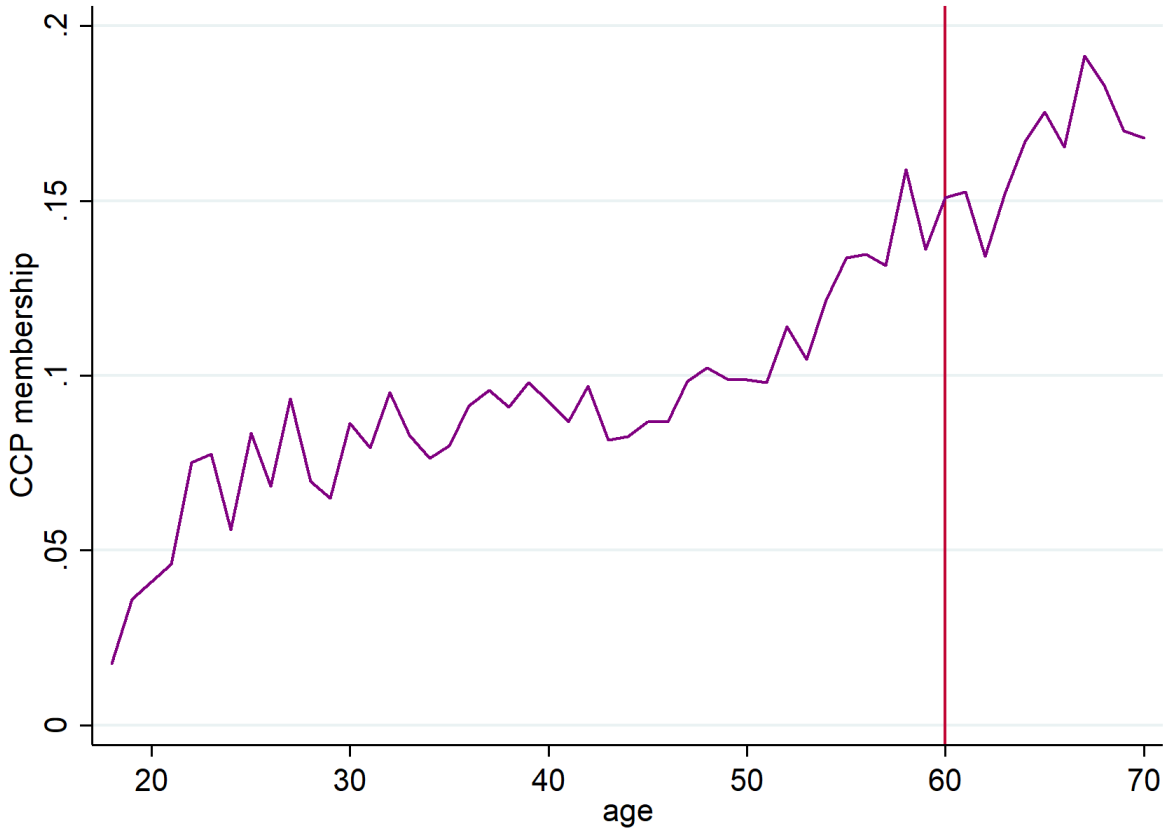
Figure 2. 1: Religious belief trend along age in both CCP and non-CCP groups



Notes: CGSS surveyed individuals' religious belief information ranging 2005, 2008, 2010, 2011, 2012, 2013, and 2015. The Y axis is the religious belief rate. The X axis is individual age. The religious belief rate in different associated CCP and non-CCP groups is calculated by using the number of religious believers in specific age group divided by the number of individuals in that specific age group. The religious belief trend in non-CCP group is much higher than the trend in the CCP group. The religious belief trend even does not change after the retirement age which is around 60 years old.

Source: CGSS website and author's calculations.

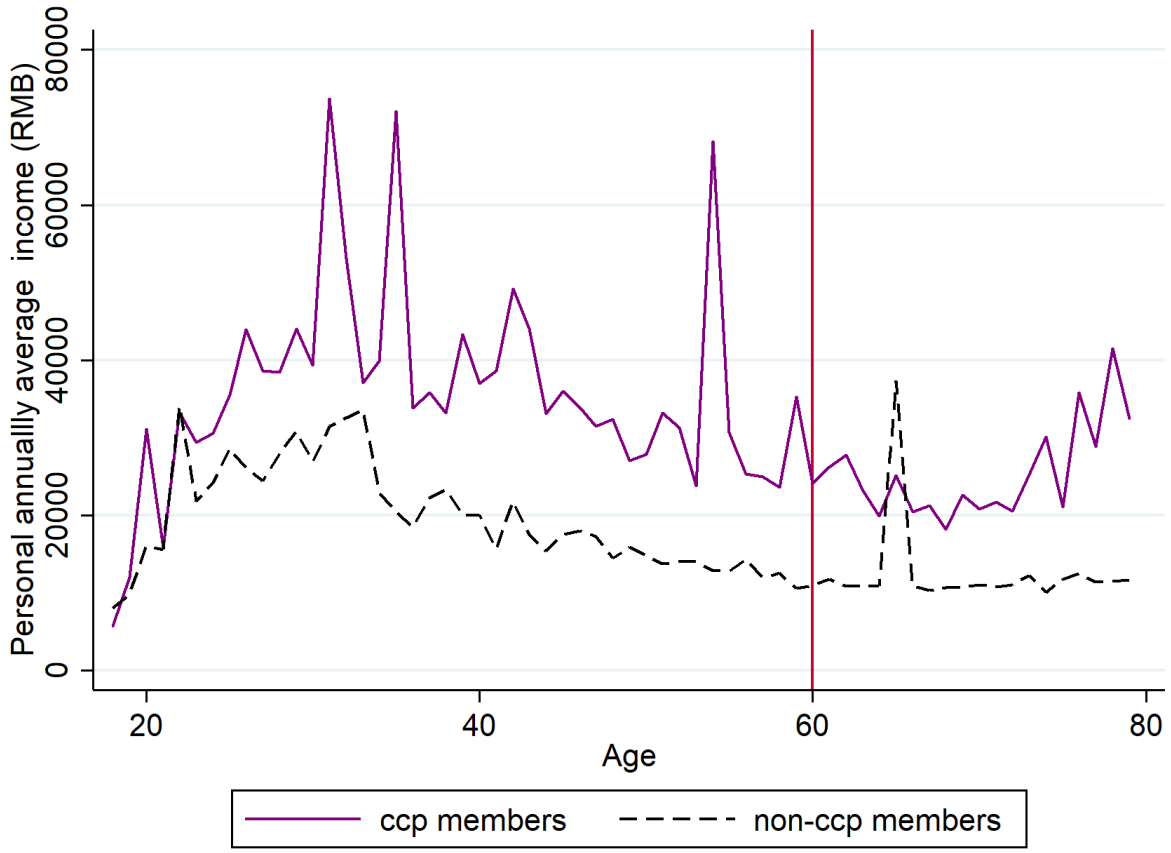
Figure 2. 2: CCP membership trend along age



Notes: CGSS surveyed individuals' CCP membership information ranging 2005, 2008, 2010, 2011, 2012, 2013, and 2015. The Y axis is the percentage of CCP members in different age group. The X axis is individual age group. The percentage of CCP members trend even increased around 50 years old.

Source: CGSS website and author's calculations.

Figure 2. 3: Aggregate CCP and non-CCP income and pension check



Notes: The Y axis is the personal annually average income whose measurement is RMB. The X axis is individual age. The black line is the non-CCP people's income trend. The purple line is the CCP members' income trend. We see a big gap between these two groups, even after retirement.

Source: Author's calculations using CGSS.

Table 2. 1: Summary statistics

	(1) Full	(2) CCP	(3) Non-CCP	(4) Difference
		Jobs Proportion		
Public servant	0.019	0.104	0.009	0.096***
SOE	0.129	0.243	0.115	0.128***
Institution	0.034	0.073	0.030	0.044***
Other	0.818	0.579	0.847	-0.267***
		Political Status		
CCP	0.109	1	0	1***
		Education Levels		
< Primary	0.128	0.041	0.138	-0.098***
Primary	0.230	0.109	0.245	-0.136***
Middle school	0.299	0.204	0.310	-0.107***
High school	0.125	0.141	0.123	0.017***
Secondary School	0.074	0.116	0.069	0.047***
Junior college	0.076	0.183	0.063	0.120***
College	0.062	0.180	0.048	0.132***
Graduate	0.006	0.027	0.003	0.023***
		Basic Information		
Minority	0.077	0.062	0.079	-0.016
Urban	0.582	0.768	0.559	0.209***
Female	0.517	0.266	0.548	-0.282***
Family Size	3.233	2.989	3.263	-0.275***
	(2.019)	(1.994)	(2.021)	
Age	46.760	52.277	46.088	6.189***
	(16.117)	(16.091)	(15.991)	
		Regional Characteristics		
East	0.405	0.492	0.394	0.098***
Middle	0.351	0.299	0.357	-0.058***
West	0.244	0.208	0.248	-0.040***
N	75909	8241	67501	

Notes: Results are calculated by using CGSS samples from 2005, 2006, 2008, 2010, 2011, 2012, 2013 and 2015. Estimates are survey weighted. Standard deviations in parentheses are included where informative. Total number of observations is 75,909 for the full sample, 67,501 for the non-CCP group, and 8,241 for the CCP group. CCP members and other entities are calculated separately public servant is people who works in the government administer system. SOE is the state-owned enterprise. Institution is government system owned organizations. CCP means China Communist Party. "<primary" infers education level is less than primary school. "Primary" is the primary school. "Middle school" and "High school" are similar education system in U.S. "Secondary school" is technical school. "Junior college" is the three years college. "College" is the four years college. "Graduate" means people with the graduate education, such as master and PhD. Minority means minority rate among all households. Urban means the urban living household rate. Female is the individual gender information. Family size is the total number of family members. Age is the individual average age. East, Middle, and West are the household living areas in China. The difference column is the t-test for the difference between CCP and non-CCP groups. ***p<0.01, **p<0.05, *p<0.1

Table 2. 2: Religiosity and religious classes summary statistics

	(1) Full	(2) CCP	(3) Non-CCP	(4) Difference
Panel A: Religious Belief Rate				
Belief	0.112	0.061	0.118	-0.007***
N	75909	8241	67501	
Panel B: Religiosity (Frequency Attendance)				
<1 per year	0.884	0.930	0.879	0.051***
>1 per year	0.073	0.052	0.075	-0.024
1 per month	0.007	0.003	0.007	-0.005
1 per week	0.025	0.010	0.027	-0.017***
>1 per week	0.009	0.004	0.010	-0.005
N	66675	7416	59092	
Panel C: Religious Classes Proportion				
Buddhism	0.054	0.028	0.058	-0.030
Daoism	0.002	0.001	0.002	-0.001***
Folk Religion	0.021	0.012	0.022	-0.010***
Islam	0.020	0.016	0.020	-0.004
Catholicism	0.002	0.001	0.003	-0.002
Protestantism	0.019	0.004	0.021	-0.017***
Others	0.001	0.001	0.001	-0
No Religion	0.879	0.936	0.872	0.064***
Pluralism	0.710	0.699	0.710	
N	65566	7126	58273	

Notes: The Results are calculated by using CGSS sample from 2005, 2008, 2010, 2011, 2012, 2013 and 2015. Estimates are survey weighted. Table 2 is about the pooled religiosity and the religious classes. Because there is religious belief in 2006 but religiosity and religious classes information, the number of observations is different in three panels. "Belief" is whether this people believe in any religion. "<1 per year" is the frequency of religious event participation less than one time per year including atheism people. ">1 per year" is more than one time per year containing one or several religious event participations per year. "1 per month" is one-time religious event participation per month. "1 per week" is the one-time religious participation per week, which also include two or three times per month. ">1 per week" is about more than one-time religious event participation. "Pluralism" is religious pluralism index which is calculated by using one minus the Herfindahl Index (sum of squares of religious adherence shares). "Folk Religion" means some local Chinese religions, such as fortune-telling, jingzu, baoying, mingyun, and Tian. "Others" includes Hindu, Orthodox, Judaism and other Chinese local Gods. The meaning of all other religion categories is same as their variable names. ***p<0.01, **p<0.05, *p<0.1

Table 2. 3: LPM basic regression results

	Religious Belief					
	(1)	(2)	(3)	(4)	(5)	(6)
CCP	-0.059***	-0.063***	-0.046***	-0.023***	-0.022***	0.027
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.017)
Retirement Eligible		0.034***	0.040***	0.024***	0.033***	0.007
		(0.003)	(0.004)	(0.004)	(0.004)	(0.005)
Interaction			-0.049***	-0.043***	-0.047***	-0.013
			(0.008)	(0.008)	(0.008)	(0.011)
Controls	No	No	No	Yes	Yes	Yes
Age trend control				No	No	Yes
Fixed effect				No	Yes	Yes
R-sq	0.003	0.005	0.006	0.047	0.126	0.127
N	75,712	75,712	75,712	68,316	68,316	68,312

Notes: The data set in the regression is spanning 2005, 2008, 2010, 2011, 2012, 2013 and 2015. All standard errors in parentheses. CCP is a individual dummy variable to classify treatment group, CCP members and control group, non-CCP individuals. Retirement eligible is the time shock dummy variable to classify before and after legal retirement age, 0 means that male is younger than 60 years and female is younger than 55 years, 1 means male is older than 60 years and female is older than 55 years. Interaction is the "CCP*Retirement eligible". Controls include ethnicity, living in urban or not, gender, family size, father's CCP condition, mother CCP condition, spouse CCP condition, age. Age trend control is the age trend influence on CCP members. Fixed effect includes education fixed effect and province fixed effect. R-square measures the model fitness. N is the number of observations. *p<0.1, **p<0.05, ***p<0.01

Table 2. 4: Nonlinear aggregate regression results

	LPM	Logit Marginal	Probit Marginal
	(1)	(2)	(3)
CCP	0.027	0.032	0.027
	(0.017)	(0.025)	(0.024)
Retirement eligible	0.007	0.002	0.003
	(0.005)	(0.005)	(0.005)
Interaction	-0.013	-0.003	-0.002
	(0.011)	(0.017)	(0.016)
Controls	Yes	Yes	Yes
Age trend control	Yes	Yes	Yes
Fixed effect	Yes	Yes	Yes
Adjusted R2	0.127	0.143	0.142
N	68,312	68,312	68,312

Notes: The data set in the regression is spanning 2005, 2008, 2010, 2011, 2012, 2013 and 2015. All standard errors in parentheses. Coefficients in Logit, and Probit models are marginal effects here. All variables' definitions including controls, age trend control, and fixed effect refer to Table 3. Adjust R square measures the model fitness. *p<0.1, **p<0.05, ***p<0.01.

Table 2. 5: Aggregate regression results-retirement dummy

	LPM	Logit Marginal	Probit Marginal
	(1)	(2)	(3)
CCP	0.029*	0.020	0.017
	(0.015)	(0.023)	(0.021)
Retirement Eligible	-0.017***	-0.017***	-0.016***
	(0.006)	(0.005)	(0.005)
Interaction	-0.003	-0.017	-0.011
	(0.010)	(0.016)	(0.015)
Controls	Yes	Yes	Yes
Age trend control	Yes	Yes	Yes
Fixed effect	Yes	Yes	Yes
Adjusted R2	0.128	0.143	0.142
N	68,312	68,312	68,312

Notes: The data set in the regression is spanning 2005, 2008, 2010, 2011, 2012, 2013 and 2015. All standard errors in parentheses. Coefficients in Logit, and Probit models are marginal effects here. All variables' definitions including controls, age trend control, and fixed effect refer to Table 3. Adjust R square measures the model fitness. The retirement dummy variable is from the CGSS survey question's answer on retirement. Adjust R square measures the model fitness. *p<0.1, **p<0.05, ***p<0.01.

Table 2. 6: Group robustness check: GOV=1, CCP=1

	LPM	Logit Marginal	Probit Marginal
	(1)	(2)	(3)
CCP	-0.005	-0.037	-0.034
	(0.024)	(0.045)	(0.042)
Retirement Eligible	0.000	-0.004	-0.003
	(0.006)	(0.006)	(0.006)
Interaction	-0.030*	-0.054	-0.047
	(0.017)	(0.036)	(0.032)
Controls	Yes	Yes	Yes
Age trend control	Yes	Yes	Yes
Fixed effect	Yes	Yes	Yes
Adjusted R2	0.132	0.143	0.143
N	54,882	54,882	54,882

Notes: The data set in the regression is spanning 2005, 2008, 2010, 2011, 2012, 2013 and 2015. All standard errors in parentheses. Coefficients in Logit, and Probit models are marginal effects here. CCP here means CCP members in government system. All other variables' definitions refer to Table 3. *p<0.1, **p<0.05, ***p<0.01.

Table 2. 7: Religiosity robustness check

	LPM	Logit Marginal	Probit Marginal
	(1)	(2)	(3)
CCP	0.022	0.029	0.025
	(0.018)	(0.025)	(0.023)
Retirement Eligible	0.010*	0.006	0.006
	(0.006)	(0.005)	(0.005)
Interaction	0.000	0.019	0.015
	(0.013)	(0.018)	(0.017)
Controls	Yes	Yes	Yes
Age trend control	Yes	Yes	Yes
Fixed effect	Yes	Yes	Yes
Adjusted R2	0.095	0.111	0.111
N	61,872	61,872	61,872

Notes: The data set in the regression is spanning 2005, 2008, 2010, 2011, 2012, 2013 and 2015. All standard errors in parentheses. Coefficients in Logit, and Probit models are marginal effects here. The dependent variable is different religiosity classification, religious belief=0 when people go to religious activities less than one time per year, religious belief==1 when people go to religious activities more than one time per year. All independent variables' definitions refer to Table 3. *p<0.1, **p<0.05, ***p<0.01.

Table 2. 8: Fake retirement age placebo test

	Assumed 50 years old retirement			Assumed 65 years old retirement		
	Placebo 50	Logit50	Probit50	Placebo 65	Logit65	Probit65
	(1)	(2)	(3)	(4)	(5)	(6)
CCP	0.045***	0.048*	0.042*	0.033**	0.043*	0.037*
	(0.017)	(0.027)	(0.025)	(0.016)	(0.023)	(0.022)
Retirement Eligible	-0.005	-0.004	-0.004	0.016***	0.009*	0.011**
	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)
Interaction	0.010	0.018	0.018	-0.010	0.010	0.009
	(0.012)	(0.019)	(0.018)	(0.012)	(0.018)	(0.017)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Age trend control	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
N	68,312	68,312	68,312	68,312	68,312	68,312
Adjusted R2	0.127	0.143	0.142	0.128	0.143	0.142

Notes: The data set in the regression is spanning 2005, 2008, 2010, 2011, 2012, 2013 and 2015. All standard errors in parentheses. Coefficients in Logit, and Probit models are marginal effects here. In the first three column we change the legal retirement age to 50 years old. From column (4) to column (6), we change the legal retirement age to 65 years old. All variables' definitions including controls, age trend control, and fixed effects refer to Table 3. *p<0.1, **p<0.05, ***p<0.01.

Chapter 3: How Do Political Events Affect the Number of Missing Women? Evidence from the Egyptian Arab Spring

3.1 Introduction

The Arab Spring is the biggest political movement in Arab World in recent years. It started in Tunisia, then immediately spread the democratic protests and movements to other countries. In Egypt, the protest against President Mubarak and his party's autocratic regime started in January 2011. Many protesters were killed, injured, and arrested due to conflicts between the protesters and the Mubarak government during this period. The uniqueness of the Arab Spring is that many women had participated in the protests since the beginning (Shalaby, 2016). In the protest during 2011, people mainly focused on the food and social justice but not the women's rights (Costello et al., 2015). The Mubarak government fell quickly after the beginning of the protest. Then, the military ruled Egypt from February 2011 to June 2012. After the military rule, Egyptian people elected the Islamist Mohammed Morsi as the president. Because Morsi tried to implement the empowerment policy for himself and other policies against women, another big protest started from June to July 2013 (Acemoglu et al., 2018). This protest began to defend and maintain women's rights and continued until the time of president Adly Mansour (Zaki, 2015).

Our research focuses on whether the Egyptian protests during the Arab Spring reduced missing women, how missing women changed in different age groups, and the different effects of different protests on missing women. Women's participation in the Arab Spring protest may have helped them gain more empowerment through political participation and realize gender equality including but not limited to more respect, more medical care, and more food, etc., which could reduce the missing women in Egypt after the Arab Spring. Increased exposure of women to political activities could improve gender equality. Therefore, we investigate the missing women through the heterogenous protest intensities in different governorates. Then according to the heterogeneous protest intensity in different governorates, heterogeneous women's involvement in protests, and the information on missing women before and after the Arab Spring, we conduct a Difference-in-Differences analysis on changes of female death rates. We use the Egyptian Demographic and Health Surveys (DHS) in 2014 to estimate the missing women. This dataset contains the information on children and the family, including children's age, gender, birth year, birth order, the parents' work information, education, and household's location, etc. We focus on how the missing women changes in different protest intensity regions before and after the Arab Spring. We also analyze the effects of different protests in different

phases of the Arab Spring on missing women. The baseline results indicate that compared to the low protest intensity governorates, the missing women significantly decreased in those high protest intensity governorates after the Arab Spring. Furthermore, we also discovered that the effects of the Arab Spring started reducing the missing women in Phase 1 of this Arab Spring, then further reduced after Phase 3. We also found that the reduced the number of missing women is different in different age groups, with the strongest effect being present in the younger age groups. We argue that the reasons for the reduced missing women could be the improvement of food, medical care, and respect. In support of our findings, we also examined the sensitivity of the baseline results based on different controls and specifications. For robustness check, we also checked the structure of population and used the propensity score reweighting. All these robustness check results are consistent.

The remaining parts of the paper are organized as follows. Section 2 provides a brief literature review. Section 3 provides the measurement of missing women, treatment and control areas classification, and empirical model, and dataset information. Section 4 provides empirical results. Section 5 provides a conclusion.

3.2 Literature and contribution

Missing women first got attention from the estimation in Sen's paper in 1990, where he estimated more than 100 million missing women around the world in 1990s. In his definition, missing women is the number of women who would be alive in the absence of gender discrimination. Missing women are the sum of women missing at birth and excess female mortality through infanticide, neglect or poor treatment (Sen, 1990). Then, more papers studied the missing women though many different aspects such as gender discrimination, survival conditions, and nutrition in developing countries revealing a variety of negative conditions hurting women's survival rates (Kynch and Sen, 1983; Kynch, 1985; Sen, 1989; D'Souza and Chen, 1980). Even though more people and researchers are beginning to pay attention to missing women problem, and a growing international effort for gender equality as highlighted in the Millennium Development Goals of the U.N., according to the report from Our World in Data (Bongaarts & Guilmoto, 2015), the number of missing women increased to 136.1 million in 2015.

Missing women is a common and a growing problem in developing countries. Despite significant gains in economic development, discrimination of girls and women continue, and the increasing use of the gender selection tools to abort girls cause a persistence in missing women problem (Jayachandran, 2015). The smaller size and poorer families also prefer sons more than the larger size

and richer families in India (Clark, 2000). This kind of preference also leads to the worse health and food conditions for girls, which cause higher female mortality rate (Gupta, 1987). In addition to the gender discrimination of women, the women's income earning contribution to family could be another influential reason for excess women death. One reason that people do not want to have daughters could be the higher income earnings of men (Qian, 2008). In China, the missing women in the areas with more tea farms is less than the areas with other kind of farms, because the tea farms need more women to collect tea leaves which can improve the women's income in their families (Qian, 2008). In terms of income, the resource allocation is another important factor for girls' survival rate. According to the social pension program, when women distribute the resource and food in the family, the surviving girls significantly increase, while it does not influence the survival condition of boys (Duflo, 2021; Chen et al., 1981). Previous studies focused on the effects of political elements on the improvement of societal conditions of women. An interesting experiment was about how the exposure of women to the political activities improved the women political leaders' voting condition. In India, one research team randomly assigned some specific number of women leaders for leadership positions on village councils and observed them for around ten years. After this random assignment of gender quotas for leadership, people's attitude changed and accepted the women leadership which could improve the social welfare and demonstrate the advantage of women's leadership (Beaman et al., 2009).

In 2017, according to the report from United Nations Development Program, the gender inequality index of Egypt was 0.449 which ranks it 115 in 189 countries and where zero means perfect gender equality. In Egypt, 34% of women are subject to domestic violence and have comparatively worse health conditions (Diop-Sidibe et al., 2006; Zaghloul & Megahed, 2019). Meanwhile in Egypt the death rate of women is also much higher than in developed countries (Zaghloul & Megahed, 2019). When women claimed their rights during the Arab Spring, the conflict between the women's rights and conservative Islamist were large (Badran, 2019). Bargain et al. (2019) discussed how the Arab Spring democratic protest enhanced women's empowerment in family through various empowerment measurements.

Furthermore, previous research focused on the reasons and results of the gender inequality and how some experimental programs improve the women's societal conditions, empowerment in family, or political role. However, they did not discuss whether the societal political movements or women's participation in these movements can improve the gender equality.

Our paper is the first that directly examines how the social or political events affect the missing women. Many scholars have discussed how the Arab Spring affected liberty, food, corruption and

other social and economic problems. At the same time, these ideals can secure on improvement of women's rights or gender equality. Compared to the missing women in the low level of protest intensity regions, the missing women significantly decreased more in the high level of protest intensity regions after the Arab Spring. The second contribution of this paper is the missing women measurement which is originally from the paper of Anderson and Ray (2017). They only use that missing women measurement to estimate the missing women in different age groups in one year. We do not only use this measurement to measure the missing women in different age groups in one year, but also to measure missing women in the same age group in different years and compare the same age group of missing women in different years. The third contribution of this paper is that we examine protest heterogeneity and explore how different protests affect the missing women differently. The fourth contribution of this paper is that we analyze how Egyptian protests affected missing women in different age groups.

3.3 Data and Empirical model

3.3.1 Missing women measurement

To estimate the missing women in different age groups, in different regions, and in different years, we employ the calculation method on missing women from Anderson and Ray (2009). Their calculation method only estimates the missing women in different age groups in one year, but we extended this calculation to measure the missing women in different age groups across different years and to compare the missing women in same age group across different years. In the following equation, a refers to an age group, where $a = 1, \dots, n$. $a = 0$ indicates the birth group. When $a \geq 1$, a denotes information between the age $a - 1$ and a. At the same time $d_{it}^{m}(a)$ and $d_{it}^{w}(a)$ represent the death rates of men and women at the age group a in regions i which we are interested in and in the year t[21]. We also use the $\hat{d}_{t}^{m}(a)$ and $\hat{d}_{t}^{w}(a)$ as the death rates of men and women for the benchmark or

[21] $d_{it}^{m}(a) = \frac{n_{it}^{m}(a)}{N_{it}^{m}(a)}$ is the men's death ratio. The numerator is the number of dead men in region i, at age a, in year t from DHS. The denominator is the total number of men in region i, at age a, in year t from DHS. $d_{it}^{w}(a) = \frac{n_{it}^{w}(a)}{N_{it}^{w}(a)}$ is the women's death ratio. The numerator is the number of dead women in region i, at age a, in year t from DHS. The denominator is the total number of women in region i, at age a, in year t from DHS.

reference region at age a in year t[22]. Then we conduct the reference death rate of women at age a in the region of interest which is the following equation (1).

$$u_{it}^{w}(a) = \frac{d_{it}^{m}(a)}{\hat{d}_{t}^{m}(a)/\hat{d}_{t}^{w}(a)} \quad (1)$$

The missing women at age a in the region of interest i at a given time t equals the actual death rates of women minus the reference death rate of women, weighted by the number of women in that age group:

$$mw_{it}(a) = [d^{w}(a) - u_{it}^{w}(a)]\pi_{it}^{w}(a) \quad (2)$$

where $\pi_{it}^{w}(a)$ is the starting population of women at age a.

For the robustness check we also use the relative death ratio as the dependent variable. We use the female death rate divided by the male death rate.

$$\rho = \frac{d^{w}(a)}{d^{m}(a)} \quad (3)$$

According to the above calculation methods and the information from DHS, in our calculation, we classify observations into seven age groups in each year from 2007 to 2014 for the treatment and control areas. The first age group is from 0 to 1, which is called "age1" group. The second age group is from 1 to 4, which is called "age14" group. The third age group is from 5 to 9, which is called "age59" group. The fourth age group is from 10 to 14, which is called "age1014" group. The fifth age group is from 15 to 19, which is called "age1519" group. The sixth age group is from 20 to 24, which is called "age2024" group. The seventh age group is from 25 to 29, which is called "age2529" group. The missing women changes in different age groups are indicated in Table 8. Due to the limitation of the DHS data set, we cannot classify older age groups.

[22] $\hat{d}_{t}^{m}(a)$ is the number of dead men divided by the number of men, which is 100,000, at the age a in the year t. $\hat{d}_{t}^{w}(a)$ is the number of dead men divided by the number of women, which is 100,000, at the age a in the year t. The benchmark or reference region is the group of Established Market Economics as defined by the World Bank: Western Europe, Canada, United States, Australia, New Zealand, and Japan.

3.3.2 Treatment and control groups

We classify the treatment and control groups in two ways. Firstly, we classify the treatment and control groups based on the fatality, injury, and arrested information separately during the entire Arab Spring period. The group (or area) classification based on the fatality index during the Arab Spring is the same as the group classification based on the injured index and arrested people index during this period. This classification is used for the baseline result. Secondly, to check the different effects of different protests in different phases of the Arab Spring on the missing women, we use the fatality information in each phase of the Arab Spring to categorize treatment and control groups for each phase, given that there is no information on the injured and arrested people in Phase 1 and no information on the arrested people in Phase 1 and Phase 2 of the Arab Spring.

The Egyptian protest was influenced by the protests in Tunisia. To better understand our treatment and control groups classification and our main discussion in this paper, it is better to review all the important phases during the Arab Spring from 2011 to 2014. There are four phases, which are ruled through three different parties, Mubarak and his National Democratic Party (NDP), Military, and the Muslim Brotherhood, during Arab Spring (Bargain et al., 2019; Acemoglu et al., 2018; Egyptian Center for Economic and Social Rights, 2015). The stated goal of each protest in each phase is different from 2011 to 2014.

The protests in the first phase of the Egyptian revolution are about the Hosni Mubarak and his authoritarian and corrupt regime, lasting for 18 days from January 25, 2011, to February 11, 2011, and started right after the demonstrations in Tunisia in December 2010. The goal or reason of this protest was to call for equality and solve the corruption problem in Hosni Mubarak regime (Al Arabiya, 2011; Karagiannopoulos, 2012). Starting with this first wave of protests many women took an active participation and involvement in the protest movement (Frederiksen, 2011; Egyptian Center for Economic and Social Rights, 2015).

The second phase was after the fall of Mubarak and his National Democratic Party (NDP) and lasted from February 11, 2011, to June 30, 2012. During this time, the Supreme Council of the Armed Forces was responsible for the temporary ruling of Egypt. There were several big protests in this second phase as well. The goals or the reasons of these protests were about dignity demand, liberty, government election, and social justice (Egyptian Center for Economic and Social Rights, 2015; Ross & Scott, 2011; Schillinger, 2011). To get attention, in the second phase people crowded into Cairo's Tahrir Square.

The third phase was from June 2012 to the end of June 2013 during the Muslim Brotherhood ruled Egypt. Mohammed Morsi representing the Muslim Brotherhood was elected as the president of Egypt. However, Mohammed Morsi tried to implement many strict policies which were unpopular for large segments of the Egyptian population leading to further protests (Kirkpatrick & Sheikh, 2012; Taylor, 2017; Knell, 2012)[23]. Mohammed Morsi was also trying to resume the traditional Islamism requirements on women which lead to a protest to defend the gained women's rights (Egyptian Center for Economic and Social Rights, 2015).

The fourth phase was from July 2013 to June 2014 which was ruled by President Adly Mansour in Egypt. The military stayed in power until El-Sissi was elected as president in June 2014. In this phase, many supporters of Mohammed Morsi went to protest. Meanwhile, president Adly Mansour implemented the anti-protest policies. Therefore, there were also many protests and conflict during this phase. The killed, injured, and arrested protesters were even worse.

For the baseline analysis, to classify the treatment group and the control group, we mainly use the Egyptian Revolution Database from January 2011 to June 2014 which was collected by the Egyptian Center for Economic and Social Rights (2015). This data set contains the information on the number of killed, injured, and arrested in different phases of Egyptian revolution. For robustness check, we also use the Survey for Young People in Egypt (SYPE) to classify the treatment and control groups.

When we classify the treatment and control groups based on protest intensity, we dropped the five border governorates first[24]. The border governorates are occupied by Bedouins who have nomadic traditions. The reactions of these groups could be different from others in the inner cities (Bargain et al., 2019). These border governorates are deserts so according to the Egypt Census from 2010 to 2015 only around 2% of Egyptians were living in those governorates. Meanwhile, they have their own conflicts, such as the conflict between the Sinai Peninsula and the nearby Palestinian Gaza strip. For robustness check, we report results including these five border governorates in Table 6, which are consistent with the baseline result.

Then, we use the number of killed, injured, and arrested information at the governorate level during the entire Arab Spring and separately divide the average population of the related governorates from census information to obtain a measure of incidents per inhabitant which are represented by the vertical lines in Figure 1.

[23] For example, Mohammed Morsi implemented an Islamic-leaning constitution leading to a huge opposition. He also tried to implement a temporary presidential decree which could give himself a huge power.
[24] The five border governorates are Red Sea, New Valley, Mathroh, North Sinai, and South Sinai.

Aggregated level groups classification index:

$$I_{jk} = \frac{N_{jk}}{P_k} \times 100{,}000 \quad (4)$$

Even though there is no information on the injured protestors in Phase 1 and arrested protesters in the first two phases, we still use the existing information to calculate these two indexes. The reason is that we treat the Arab Spring as one big period. Therefore, according to equation (4), we separately calculate the index of fatality, index of injured protesters, and the index of arrested protesters for different governorates during the entire Arab Spring. In equation (4), the numerator, N_{jk}, is the total killed injured, and arrested protesters during the entire Arab Spring in different governorates in Egypt. The denominator, P_k, is the average of population from 2011 to 2014 in different governorates. j implies whether the calculation of index is for killed, injured, or arrested protestors. k represents different governorates. After calculating the fatality index, injured index, and arrested index, we pick related median fatality index, median injured index, and median arrested index. According to these three indexes, we classify the treatment and control groups three times, fatality index classification, injured index classification, and the arrested index classification. The treatment and control groups' classifications in these three indexes are 100% consistent, which are the different color vertical lines in Figure 1. The governorates with higher incident number than the median index are included in the treatment group and the rest are included in the control group. We mainly use this classification in this paper. The only two exceptions are when we check whether the protest intensity is consistent in different phases during the Arab Spring and check the different effects of different protests on missing women.

3.3.3 Alternative treatments based on different phases and women's participation

We only use the information on fatalities in different phases during the Arab Spring to classify the governorates into treatment and control groups to check the different effects of different protests in different phases and to check whether the treatment and the control groups are consistent in different phases during the Arab Spring, because the fatality information is consistent from Phase 1 to Phase 4. The calculation for the index of fatality in different phases is the equation (5). k represents the different governorates. t means the different years from 2011 to 2014. After getting different fatality indexes for different governorates in different phases during the Arab Spring, we select the associated

median fatality index among all governorates in each phase to classify the treatment and control groups. The classification in each phase is in Figure 2. It reveals that the treatment and control groups overlap around 70% between each phase in the Arab Spring. The classification in different phases is also 70%, consistent with the group classification in Figure 1.

Group classification index in different phases:

$$I_{kt} = \frac{d_{kt}}{p_{kt}} \times 100{,}000 \tag{5}$$

To further check the treatment and control groups' classification, we also get the Survey of Young People in Egypt (SYPE). SYPE includes the information on protest participation of women whose age is from 18 to 35 in non-border governorates and their attitude on protests. According to this information in SYPE, we conduct a governorate-level measure of women's participation in the Arab Spring protests. The classification variable equals to 1 if they participate any protest or support any protest in the Arab Spring, otherwise it equals 0. This classification, which is in Figure 3, is 70% overlapped with the classification from Egyptian Revolution Database in Figure 1.

3.3.4 Data set information

In addition to the equations (1) and (2), we use the information from Egyptian DHS in 2014 to calculate the missing women. The DHS also includes the household characteristics, children's features, health and living conditions, and parents' information. It includes the panel information on children from 1978 to 2014 at the household level. Because the missing women's information has a big fluctuation before 2007 and the information of DHS from 1978 to 2006 is too far away from the Arab Spring and cannot reflect the missing women condition very well near 2011, we only use the information from 2007 to 2014. From 2007 to 2010 the political situation was stable and no big changes in women's conditions were reported (Bargain, 2019). The data collection time of DHS is also good for our estimation because the collection time of DHS, which was from April to May 2014, was at the end of Arab Spring and the election time of El-Sissi. Due to the different culture and population density in border governorates which we mentioned in the last section, we do not include the households from border governorates in our main analysis. After the above dataset cleaning, the summary statistics are reported in Table 1. In the DHS dataset, the missing women information of children from 0 to 1 year old is stable, thus this paper mainly analyzes the missing women in this age

group. Therefore, the following discussions are mainly about the information of children from 0 to 1 year old.

The treatment and control groups classification in Table 1 is based on the aggregate-level classification which includes the fatality index classification, injured index classification, and the arrested index classification from equation (4). The summary information is at the household level. Table 1 reports the demographic information of respondents in the upper panel, their husbands' information in the middle panel, and the households' information in the lower panel. The upper panel shows that the women in high protest intensity areas get significantly higher-level education than those in the low protest intensity areas. Meanwhile, the rate of female labor participation in the high protest intensity areas is also significantly higher than that in the low protest intensity regions. Even though the average age of women in the high protest intensity areas, statistically speaking, is significantly higher, the difference in age is not very large. The number of children ever born is also similar. The middle panel presents the demographic information on respondents' husbands. The difference in husband's education between the high protest intensity and the low protest intensity regions is significant but very small. The low panel signifies the summary information of households. There is no big difference of women household head rate, religious belief, and households' average age. In the high protest intensity regions, however, there are more households in the urban areas than those in the low protest intensity regions. The household size (i.e., the number of household members) is significantly smaller in the high protest intensity areas than that in the low protest intensity areas. The women size, the number of women in a given household, shows significantly fewer women in high protest intensity areas than in the low protest intensity areas. The wealth in this table means the wealth indexes reported in the DHS and includes poor, middle, richer, and richest. The higher number of wealth means richer. We see the households are richer in high protest intensity areas than those in the low protest intensity areas.

Because our measurement on missing women in Egypt is from equations (1) and (2), we need to get the death ratio information of the benchmark or reference region and the death ratio information of Egypt. Therefore, all necessary information of indexes for missing women calculation are summarized in Table 2. In Table 2, the relative death ratio is equal to the death ratio of women divided by the death ratio of men in age1 group. Table 2 indicates that the death ratios of men and women in Egypt are three or four times higher than the related death ratios in the reference region. The relative death ratio in the reference region is smaller than one, meaning there is a higher boys' death ratio than

the girls' death ratio. Oppositely, the relative death ratio in Egypt is larger than one, which suggests a higher girls' death ratio than boys' death ratio.

In addition to the death ratio comparison between the reference region and Egypt in Table 2, we also compare the death ratio of women, the death ratio of men, the relative death ratio, the reference death ratio of women, and the starting population of women in age1 group, π, between the high level of protest intensity region and the low level of protest intensity region from 2007 to 2014 in Table 3 and Table 4. In Table 3 and 4, we see that all these ratios are smaller in higher level of protest intensity governorates than in the lower protest intensity governorates. Furthermore, the summary information of missing women trend from 2007 to 2014 is in Figure 4, indicating that the missing women has decreased in the treatment area. Meanwhile, the missing women did not change from 2011 to 2013 in the control area. However, the missing women also decreased after 2013 in the control area, arguably due to the protest focusing more on the women's rights in the whole country.

Figure 4 also suggests that before the Arab Spring, the number of missing women in the control area was higher than that in the treatment area and the trend of missing women in both treatment and control areas are similar. The similar trend before the Arab Spring implies that no major event influenced missing women in Egypt from 2007 to 2010. After the Arab Spring, the missing women in the treatment group decreased more than that in the control group, which is a flat line from Phase 1 to Phase 3 but decreases in Phase 4. We also observed that the missing women trend increased from 2009 to 2011 for both treatment and control groups. Even though the influence of the Arab Spring on the control group is not obvious, the flatter trend of missing women in the control group still hints at possible effects of the Arab Spring on missing women. The decreased missing women in the treatment group implies that the effect of the Arab Spring in the treatment group is bigger than that in the control group. Since the Phase 1 of the Arab Spring, many women participated in the protest, but in Phase 3, the protest focused even more on calling for the gender equality because of the reactions to previous Pres. Mori's policies (Egyptian Center for Economic and Social Rights, 2021). Therefore, after Phase 3 the missing women decreased in the control area as well.

3.3.5 Empirical model

We mainly use the Difference-in-Differences estimation for the regression analysis[25]. $Y_{ita} = mw_{it}(a)$ measures the missing women, calculated from equations (1) and (2), in the region of interest i in year t at age a. For robustness check, $Y_{ita} = \rho$ from equation (3) also estimates the missing women using the relative death ratio in the region of interest i in year t at age a. $TREAT_i = 1$ means the missing women in high protest intensity governorates and $TREAT_i = 0$ means the missing women in low protest intensity governorates. $POST_i = 1$ means the post-Arab Spring period from 2011 to 2014 and $POST_i = 0$ indicates the pre-Arab Spring period from 2007 to 2010. According to the children's information from 2007 to 2014 in DHS and missing women calculation, we use the following Difference-in-Differences model in Eq. (6).

$$Y_{ita} = \alpha + \beta_1 POST_i \times TREAT_i + \beta_2 POST_i + \beta_3 TREAT_i + \gamma X_{ita} + \epsilon_{ita} \quad (6)$$

The coefficient β_1 of the interaction term is the difference-in-difference estimation term, measuring the changes of missing women between the treatment and control groups before and after the Arab Spring revolution. β_2, the coefficient of $POST_i$ estimates the aggregate factors that affect the outcome in the same way for both groups. β_3 the coefficient of treatment variable estimates the differences between the treatment and control groups on average. X_{ita} controls the observable characteristics including wealth of households, work condition of respondents, urban or rural residence, number of children in the households, education of the respondents, age of respondents, age of husband, husbands' work condition, religion, and birth order of children. For sensitivity check, we also include the fixed effects at the municipality level. We cluster the standard errors at the municipality level in this model.

3.4 Results

3.4.1 Main results

Table 4 shows the analytical results from the empirical model, equation (6) in section 3.5, with the missing women calculated from equations (1) and (2), or (3). The upper panel is the main result with

[25] The estimations are done in Stata 17 using the Difference-in-differences command from Bargain (2019). The command is "quietly xi: areg ibp post_group post $xlist $xcoh, cluster(ID_2) absorb(ID_2)".

and without more control variables in different columns. The "Post x Treat" in this panel from column (1) to column (8) indicate that given the total average number of women in treatment and control areas, the number of missing women significantly decreased 2 more in the treatment area than that in the control area after the Arab Spring. In column (1) of Table 4, we only use the treatment dummy variable, the time dummy variable, and their interaction term. Then we put control variables in column (2) and cluster the standard errors at the municipality level. Column (3) is our baseline result, to which we additionally add the municipality fixed effects the analysis. The control variables could change as the time goes by, especially after the Arab Spring. The potential changes of control variables could influence the missing women. Therefore, to control the potential changes of control variables after the Arab Spring, we add $X_{ita} \times POST_i$ to the model yielding the following Eq. (7). The results are in column (4), column (6), and column (8). The analytical results in these three columns with $X_{ita} \times POST_i$ are still consistent with the baseline result in column (3). These results in these three columns indicate that the control variables do not change after the Arab Spring.

$$Y_{ita} = \alpha + \beta_1 POST_i \times TREAT_i + \beta_2 POST_i + \beta_3 TREAT_i + \gamma X_{ita} + \emptyset X_{ita} \times POST_i + \epsilon_{ita} \quad (7)$$

It could be too restrictive to put control variables in the regression analysis in a linear way. Therefore, we also relax the linear assumption on control variables. According to the reweighting method from Hirano et al. (2003) and the binary treatment variable, we use $p_i = P(TREAT_i = 1)$ to measure the probability of observation i in the high protest intensity areas, the treatment group, based on those control variables X_{ita}. Then we use the $\frac{1}{1-p_i}$ as weighting for observations in control group and use the $\frac{1}{p_i}$ as weighting for observations in treatment group. This is called propensity score reweighting (Hirano et al., 2003). According to this propensity score reweighting, the analytical results in column (5) and column (6) in Table 5 are also significant and consistent with all other results in Table 5. These findings imply that the linear form of X_{ita} already manages the differences in characteristics well between treatment and control groups. We also check whether the survey weighting influences the analytical results or not. So, we add the survey weighting in columns (7) and (8) with or without controlling the potential changes of control variables. The results in these two columns are still significant and consistent with the results in other columns.

We also use the relative death ratio calculated from equation (3) as the missing women measurement to further check the missing women reduction. These results are in the middle panel of

Table 5 and suggest that the missing women significantly and consistently decreased from column (1) to column (8), which is also consistent with the results in upper panel. All these results mean that compared to the men's death rate, the women's death rate significantly decreased around 15% after the Arab Spring.

3.4.2 Robustness analysis

To ensure the consistency of our findings, we implemented a number of robustness checks based on the baseline result model, which is the 3rd column in Table 5.

Placebo test. It is important to know whether other elements could possibly influence missing women in both treatment and control groups before the Arab Spring. Following the literature that researched the effect of the Arab Spring on women's empowerment in family (Bargain et al., 2019), we implement a placebo test by setting an artificial intervention event before 2011. In this placebo test, we use 2010 as the artificial "Arab Spring revolution" and only use the sample before 2011. We use the same analytical methods in upper panel of Table 5 to analyze the changes in missing women from 2007 to 2010. In this placebo test, we set $POST_i = 1$ for missing women observed in 2010 and $POST_i = 0$ for missing women observed from 2007 to 2009. If the control area is good for comparing and our difference-in-differences is a good estimation, we should see the coefficient of the difference-in-differences is not statistically different from 0. The lower panel in Table 5 is the results from this placebo test. The small and insignificant results from column (1) to column (8) reveal that no other possible elements might have influenced the missing women in both treatment and control groups before the Arab Spring. This result is also consistent with our common trend test in Figure 4.

Regional effects and standard error clustering. To additionally check the fixed effects and standard error cluster, we alternatively cluster standard errors at governorate level using different bootstrap approaches and use different regional level fixed effects. Column (1) in Table 6 is the replication of analysis in column (3) of Table 5. In column (2) of Table 6, instead of using the municipality fixed effects, we use the governorate fixed effects whose result even indicates more reduced missing women at the 1% significant level. The reason could be the larger difference of protest at the governorate level. The standard error does not change a lot in column (2) at the governorate level. Then, we keep the municipality fixed effects but repeat our analysis by clustering at the governorate level in column (3), producing very similar results as in column (1). Next, from column (4) to column (6) we use the bootstrap at 800 replications, 1000 replications, and the 'wild bootstrap' i (Cameron et al., 2008; Roodman et al., 2018). All results of these bootstrap analyses are consistent

with the main result in column (1). These results in Table 6 imply that the regional characteristics do not influence the missing women.

Alternative sample selection. The changes in marriage may also influence children's deaths (Amato & Anthony, 2014). To further check whether marriage also affects the missing women before and after the Arab Spring, we dropped observations whose marriage lasted less than 4 years. In other words, we dropped those observations who divorced during the Arab Spring. The result is in column (1) of Table 7 which is still very close to our baseline result in Table 5. This result indicates that the changes in marriage do not influence the missing women.

Respondents' age influence. The women's age can also influence the baby's health conditions (UNICEF, 2008). To further check this potential effect of age, we only use respondents' information whose age is from 20 to 40 which is 93.4% of sample observations. The new estimated result on missing women in column (2) of Table 7 is also consistent with the baseline result in Table 5.

Interview conditions. Because the missing women information was from the respondents' direct answers, the husband or other people present during the survey interview may influence the accuracy of missing women information. Their husbands or other family members may not want people to know existing bias or discrimination towards women. Therefore, we checked the potential influence from the presence of their husbands or other family members during the interview. We used the same analysis model, which is column (3) of Table 5, to analyze the subsample information without the presence of their husbands or any other family members, which is 70% of sample observations. The results in column (3) and column (4) of Table 7 are also significantly decreased and consistent with the main results in Table 5.

Border governorates. For all the above analyses, we do not include the border governorates, because they have different population. Bedouins with nomadic traditions mainly inhabited those areas, and their ideas on the Arab Spring could be very different from people in the inner governorates. Even though some Bedouins also lived in the suburbs of the Egyptian capital of Cairo, the population portion is very small. The population density in these border governorates is also very small, which is only around 2% of the total population from 2007 to 2015 according to the related Census of Egypt (Statistical Yearbook, 2015). People in these border governorates focus on their own conflict, which is different from that in the Arab Spring (Bargain et al., 2019). Now to check the sensitivity of our analysis and whether the border governorates can influence our results, we do the same baseline analysis with border governorates. Therefore, in column (5) of Table 7, we checked the effects of the Arab Spring on missing women including these border governorates. The magnitude of this result in

the last column of Table 7 is now significantly reduced. However, while the magnitude of this result is smaller than the baseline result in Table 5, it is consistent with the main result.

Groups' classification based on SYPE. We have used the protest incidents intensity, which is from the revolution dataset, to classify the treatment and control groups and discovered many interesting and consistent results in all above analyses. Another interesting method to classify the treatment and control groups is to use the governorate-level women's protest participation in the Arab Spring. Therefore, we use the 2014 Survey of Young People in Egypt, including around 10,000 women from 19 years old to 35 years old, not living in the border governorates. SYPE includes information about their protest participation experience and their attitude on all protests in the Arab Spring. We classify all women who had participated in those protests at least once and had a supportive attitude of those protests into the treatment group; otherwise, they are in the control group. This classification is 70% overlapped with the groups' classification in the baseline analysis. Then, we still use the model from column (3) of Table 5 and the missing women from equations (1) and (2). The result from SYPE classification is in column (6) of Table 7, which indicates that the result is still significant and consistent with the baseline result.

Missing women in urban and rural areas. During the Arab Spring, to get the government's attention, people gathered in cities and big towns. In our data 60% of the treatment group is in cities or big towns. Therefore, we test the effects of the Arab Spring on missing women in urban and rural areas separately. In columns (7) and (8), we see the effects of the Arab Spring on missing women in urban areas is slightly stronger than in the rural areas.

Different effects of different protests on missing women. Even though in Figure 2 the treatment and control groups' classifications in different phases of the Arab Spring are 70% overlapped with each other and more than 70% overlapped with the group classification in Figure 1, the demands of different protests in different phases were different. Hence, according to the treatment and control groups classification in different phases during the Arab Spring revolution, we use the same analytical model, in column (3) of Table 5, to check the different effects of different protests on missing women. Then, corresponding to the treatment and control areas' classification in Figure 2, we discovered the results in Table 8 indicating that the effects of protests in different phases are smaller than the main result, but they are still at the 1% significant level. These results are consistent with the news reports, which reported that different protests have different claims. Especially after previous Pres. Morsi tried to implement the decree giving him power to kill protesters and enforce some traditional Islamic requirements on women, protests focused more one maintaining and protecting

the gained women's rights (Knell, 2012). Therefore, we see the missing women significantly decreased more after Phase 3 in Table 8.

Missing women in different age groups. We only checked the missing women in age1 group, whose age is from 0 to 1, in all previous analyses. Because the effects of protests affect all women's living conditions, we checked the missing women in other age groups. There is no information on women who are older than 29, so we only test the missing women from 1 year old to 29 years old. We classify women in the following age groups: age1, the age of women from 0 to 1; age14, the age of women from 1 to 4; age59, the age of women from 5 to 9; age1014, the age of women from 10 to 14; age1519, the age of women from 15 to 19; age2024, the age of women from 20 to 24' age2529, the age of women from 25 to 29. Column (1) of Table 9 is still the baseline result from column (3) in Table 5, which can help us compare the missing women with the results in other age groups. The missing women significantly decreased in age14, age59 and age2024. The decreased missing women is greater at the 1% significant level in age1, age14, and age59, but not age2024. Meanwhile, the missing women even increased in age1014 and age2529, but the increased missing women is very small in the age1014 group. The increased missing women is not big in age2529 group. The conclusion is that the effect of the Arab Spring is obvious and bigger for women in younger age groups.

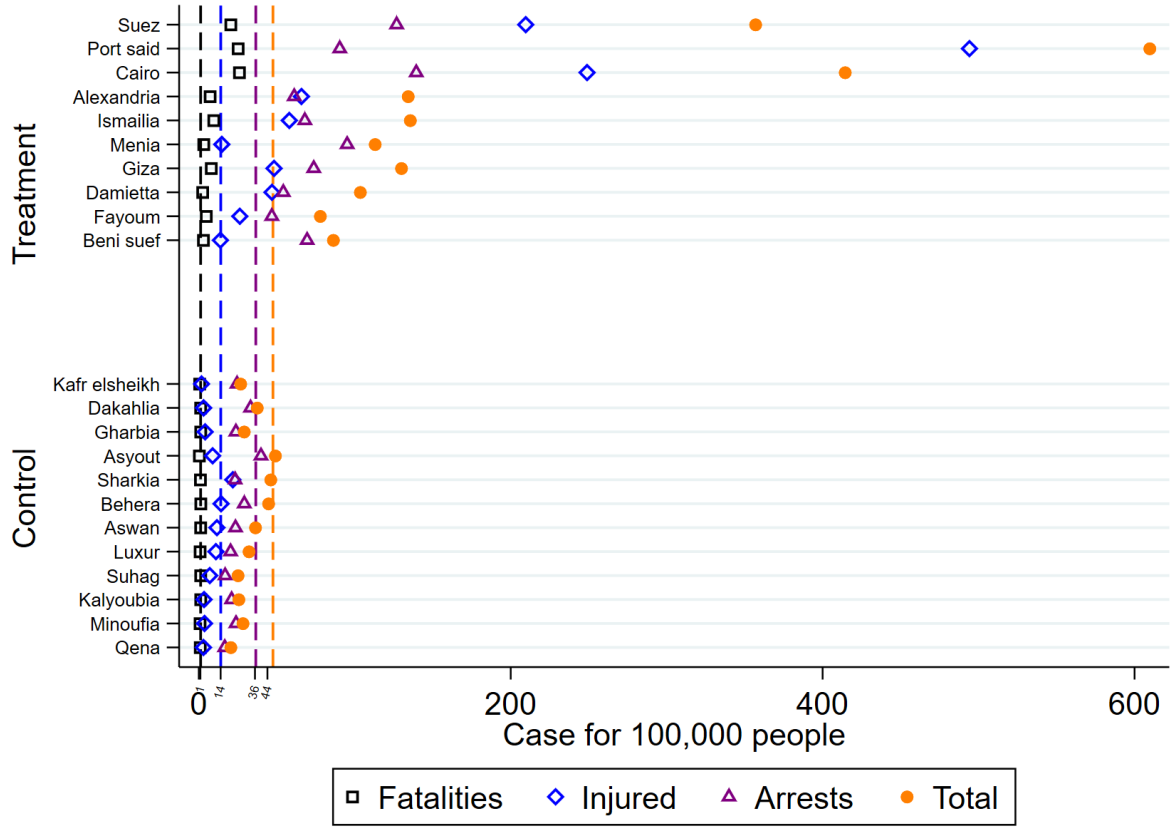
3.5 Conclusion

The Arab Spring is one of the most important events in recent Egyptian history and provides a good opportunity for a random experiment to analyze its effects on missing women. This paper firstly uses the missing women measurement, which was only used in one year, to estimate the effects of the Arab Spring across different years. This study is also the first attempt to study the heterogeneous changes in missing women during Egyptian Arab Spring based on geographical variation in the intensity of protests. This paper answers how the political protest affects the missing women and provides clarity on how different protests affect the missing women and how the Arab Spring affects the missing women in different age groups. The results point out that the Arab Spring causes 50% of the fall in missing women in the highly protest intensive areas.

To summarize, we used a novel test based on the missing women through geographical variation in the intensity of protests - the high protest intensity area and the low protest intensity area before and after the Arab Spring. Besides the baseline DID regression analysis, we also tested the effects of the Arab Spring on missing women in different subsamples, different classifications on the treatment and control areas, different protests in different phases in the Arab Spring, and different age groups.

All these results revealed that the effect is still significant and robust. Interestingly, it reduced more missing women after Phase 3 in the Arab Spring. These results are not uniform within different age groups. The younger age groups experienced stronger effects from the Arab Spring. In contrast, the effects on older age groups are relative smaller.

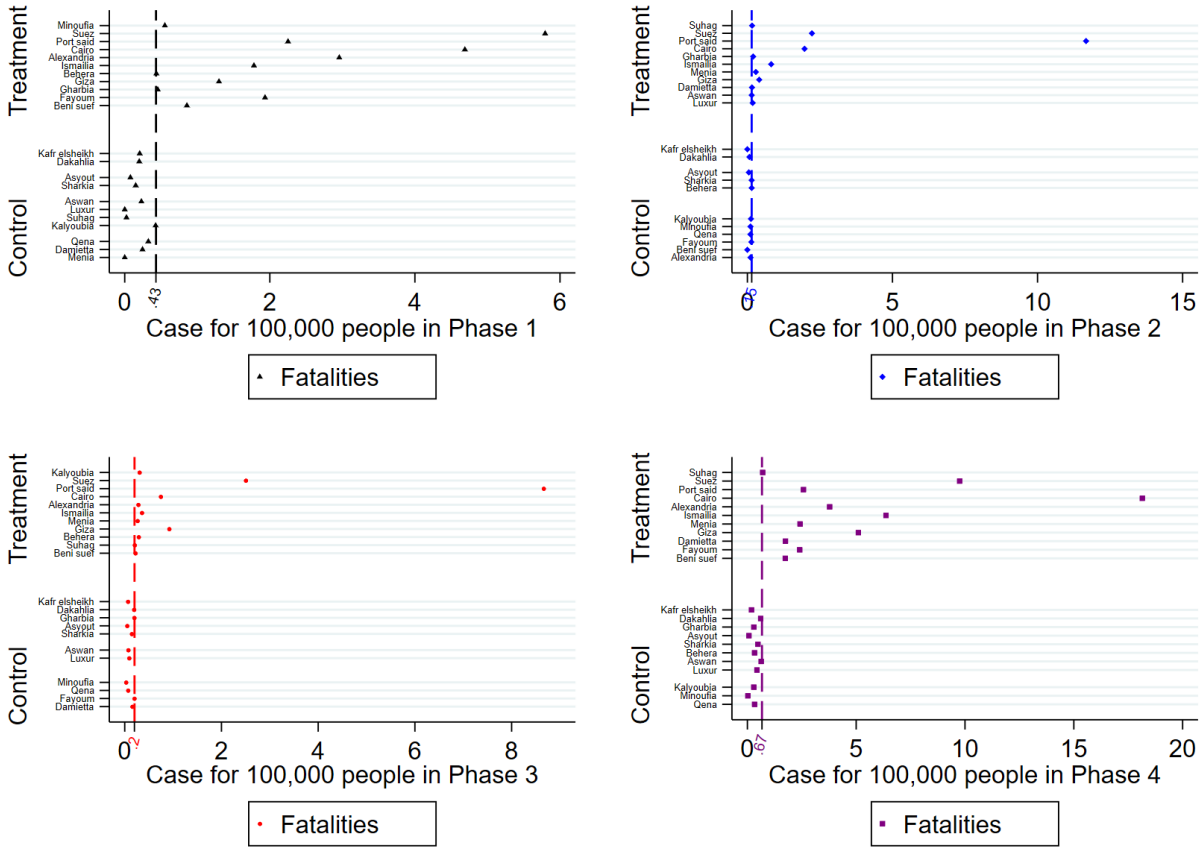
Figure 3. 1: Group's classification in baseline analysis



Notes: The baseline analysis treatment and control groups classification during the entire Arab Spring. This Figure does not include all border governorates which are Red Sea, New Valley, Matroh, North Sinai, and South Sinai.

Source: Author's calculations based on Egyptian Revolution Database.

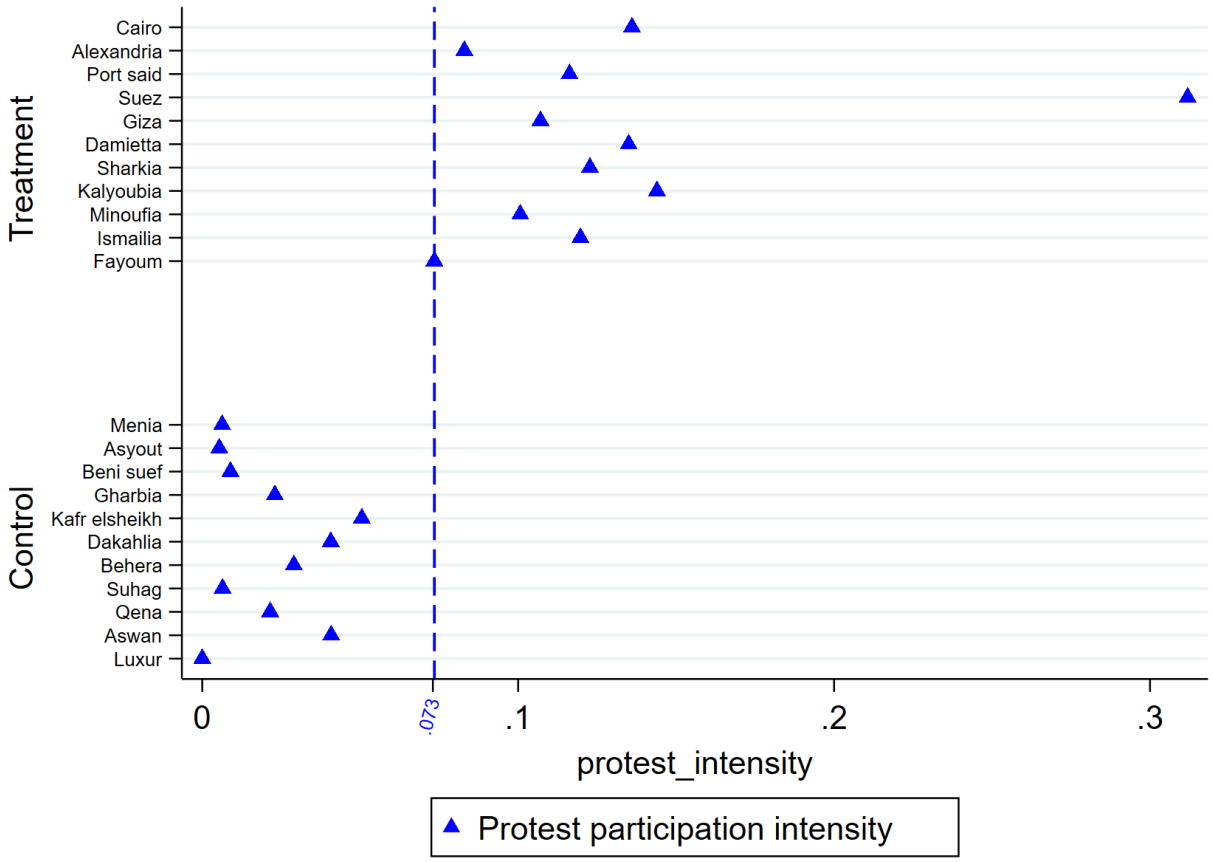
Figure 3. 2: Groups' classification in different phases



Notes: The treatment and control groups classification in different phases in the Arab Spring. This Figure does not include all border governorates which are Red Sea, New Valley, Matroh, North Sinai, and South Sinai.

Source: Author's calculations based on Egyptian Revolution Database.

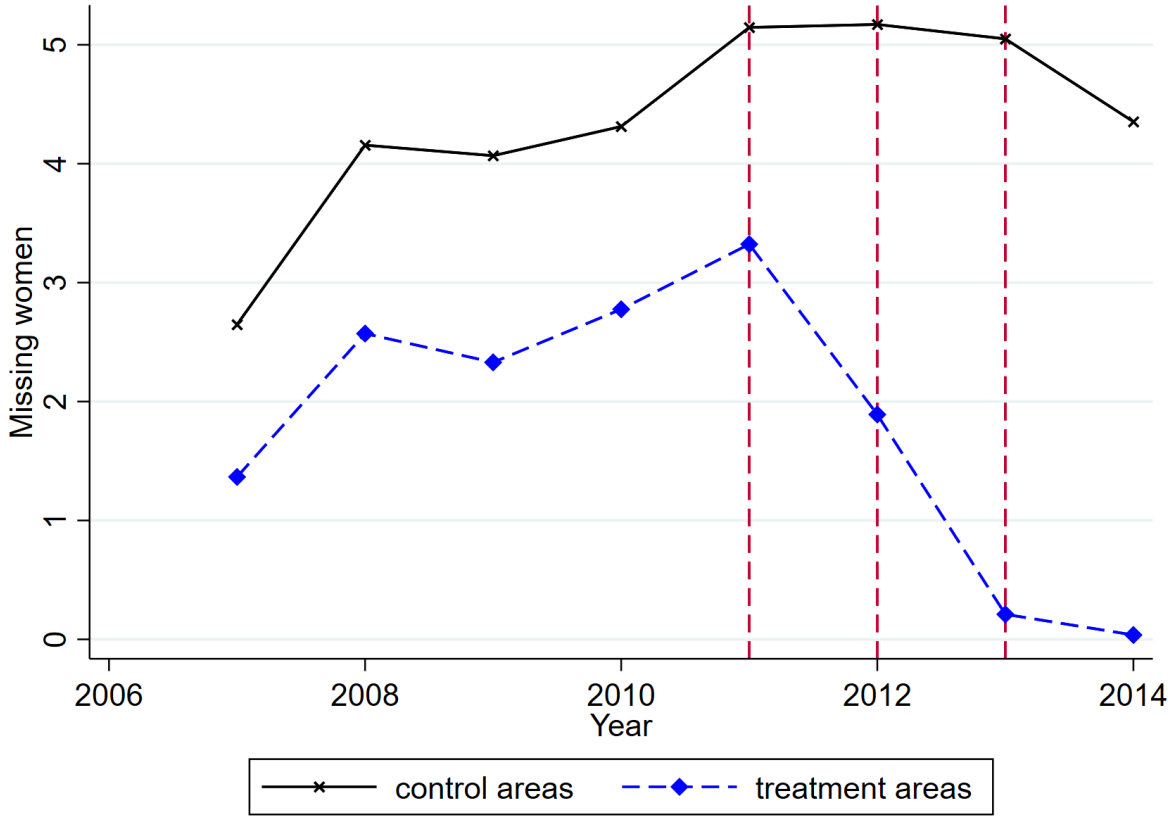
Figure 3. 3: Groups' classification from SYPE



Notes: The treatment and control group classification during the entire Arab Spring through SYPE dataset. This Figure does not include all border governorates which are Red Sea, New Valley, Matroh, North Sinai, and South Sinai.

Source: Author's calculations based on SYPE.

Figure 3. 4: Missing women trend before and after the Arab Spring



Note: These two lines represent the missing women from 2007 to 2014 in treatment and control areas for age1 group.

Source: Author's calculations based on DHS.

Table 3. 1: Summary statistics on demographic

	Aggregate	High Protest	Low Protest	Difference
		(1)	(2)	(3)
Female Respondent Information				
No Education	0.182	0.177	0.186	-0.009***
Primary Education	0.090	0.087	0.093	-0.005***
Secondary Education	0.570	0.559	0.579	-0.020***
Higher Education	0.158	0.177	0.143	0.035***
Work Rate	0.141	0.147	0.136	0.011***
Age	30	30.734	30.126	0.608***
	(6.51)	(6.537)	(6.487)	(0.132)
All Children Ever Born	2.787	2.823	2.766	0.056*
	(1.50)	(1.502)	(1.499)	(0.0299)
Husband Summary Information				
No Education	0.136	0.138	0.135	0.003***
Primary Education	0.131	0.138	0.126	0.012***
Secondary Education	0.564	0.545	0.579	-0.033***
Higher Education	0.169	0.178	0.161	0.017***
No Job	0.016	0.015	0.017	-0.002***
Tech Job	0.218	0.238	0.202	0.036***
Clerical	0.043	0.046	0.040	0.005***
Sale	0.049	0.048	0.050	-0.002***
Self-Agriculture	0.048	0.038	0.055	-0.018***
Employed Agriculture	0.072	0.063	0.079	-0.015***
Services	0.115	0.107	0.122	-0.015***
Skilled manual	0.341	0.344	0.339	0.006***
Unskilled manual	0.092	0.095	0.090	0.005***
Unknown	0.006	0.006	0.006	-0.0002***
Husband Age	37	37.668	36.969	0.699***
	(8.28)	(8.471)	(8.158)	(0.168)
Household Information				
Women HH Head Rate	0.049	0.044	0.054	-0.010***
Muslim	0.963	0.965	0.962	0.003***
Christian	0.036	0.034	0.037	-0.003***
Unknown	0.000	0.000	0.000	0.0002***
Urban	0.412	0.578	0.276	0.302***
Household Size	5.201	5.034	5.301	-0.267***
	(2.28)	(1.726)	(2.545)	(0.0406)
Women Size	1.099	1.066	1.120	-0.054***
	(0.42)	(0.289)	(0.481)	(0.00717)
Household Head Age	39.206	39.204	39.206	-0.002
	(10.70)	(10.398)	(10.875)	(0.212)
Wealth	3.039	3.472	2.780	0.692***
	(1.348)	(1.392)	(1.251)	(0.0265)
N	13634	6145	7489	

Note: No education infers observations do not get any education. Primary education means the highest education of the observation is the primary school education. Secondary education means the highest education of the observation is the secondary school education. Higher education infers that the highest

education of the observation is higher than the secondary education, for instance the college education, master level education, or the Ph.D. education. Work rate is the number of women with job divided by the total number of women. Age is the average age of observations. "All children ever born" implies the average total number of children born by female observation until the survey time. All jobs' classifications and information in this Table based on a country specific coding
scheme. "No Job" is the rate of husband without job. "Tech job" infers the rate of husband with technology job, professional jobs, and managerial jobs. "Clerical" is the rate of husband with religious jobs. "Sale" is the rate of husband with sale jobs. "Self-Agriculture" is the rate of husband with his own farmland. "Employed Agriculture" is the rate of husband worked in other people's farmland. "Services" is the rate of husband with service jobs. "Skilled manual" is the rate of husband with the manual skilled jobs. "Unskilled manual" is the rate of husband with the manual unskilled jobs. "Unknown" means no information on the husband jobs. "Women Rate" is the rate of households with women household head. "Muslim" is the rate of households with Muslim religious belief. "Christian" is the rate of households with Christian religious belief. "Unknown" is the rate of households without knowing the information of religious belief. "Urban" is the rate of households living in the urban areas. "Household size" is the average number of household members. "Women size" is the average number of women in a household. "Household Head Age" is the average age of the household head. "Wealth" is the wealth index at households including poor, middle, richer, and richest. In this Table, it is the average number of households wealth index, the bigger the richer. "N" is the number of observations. Standard deviation in brackets. This table is the summary information of DHS.

Source: Author's calculations based on DHS in Egypt.

Table 3. 2: Summary statistics on reference region and Egypt

	Reference Region			Egypt		
Year	Women DR	Men DR	Relative DR	Women DR	Men DR	Relative DR
	(1)	(2)	(3)	(4)	(5)	(6)
2007	0.004	0.005	0.812	0.016	0.016	1.019
2008	0.004	0.004	0.815	0.017	0.015	1.096
2009	0.004	0.004	0.817	0.015	0.011	1.334
2010	0.004	0.004	0.819	0.017	0.016	1.076
2011	0.004	0.004	0.827	0.016	0.012	1.347
2012	0.003	0.004	0.829	0.014	0.011	1.252
2013	0.003	0.004	0.833	0.013	0.012	1.128
2014	0.003	0.004	0.838	0.010	0.009	1.077

Note: Men DR, Women DR, and Relative DR represent men death ratio, women death ratio, and relative death ratio. Relative Death Ratio is calculated through Women Death Rate divided by Men Death Rate which is indicated in equation (3). In the reference region panel, we use the group of Established Market Economies as defined by the World Bank: Western Europe, Canada, United States, Australia, New Zealand, and Japan.

Source: Author's calculations based on DHS in Egypt and the information of Western Europe, Canada, United States, Australia, New Zealand, and Japan from WHO.

Table 3. 3: Summary statistics on different regions in Egypt

	High Protest Intensity						Low Protest Intensity					
Year	Women DR (1)	Men DR (2)	Relative DR (3)	u (4)	π (5)	Missing women (6)	Women DR (7)	Men DR (8)	Relative DR (9)	u (10)	π (11)	Missing women (12)
2007	0.010	0.010	1.064	0.008	553	1.366	0.020	0.020	1.006	0.016	673	2.647
2008	0.012	0.010	1.162	0.008	741	2.572	0.021	0.020	1.085	0.016	783	4.156
2009	0.014	0.012	1.200	0.010	506	2.330	0.015	0.010	1.464	0.009	603	4.067
2010	0.017	0.017	0.977	0.014	609	2.776	0.017	0.015	1.162	0.012	747	4.313
2011	0.013	0.009	1.412	0.008	605	3.323	0.018	0.013	1.322	0.011	770	5.146
2012	0.011	0.009	1.160	0.008	630	1.891	0.017	0.013	1.300	0.011	863	5.171
2013	0.009	0.011	0.862	0.009	665	0.211	0.016	0.012	1.298	0.010	869	5.050
2014	0.007	0.008	0.849	0.006	456.5	0.037	0.012	0.010	1.216	0.008	1151	4.353

Note: The definitions of Men DR, Women DR, and Relative DR, u, π refer to Table 2. u, calculated from equation (1), is the reference death rate of women in age1 group in different years in different interested areas. π is the starting population of women of age1 in different years in different interested areas.

Source: Author's calculations based on DHS in Egypt and the information of Western Europe, Canada, United States, Australia, New Zealand, and Japan from WHO.

Table 3. 4: Summary statistics on different regions in Egypt

	Differences in Different Protest Intensity					
Year	Women DR	Men DR	Relative DR	u	π	Missing women
	(1)	(2)	(3)	(4)	(5)	(6)
2007	-0.00998***	-0.0105***	0.0577***	-0.00851***	-120.0***	-1.282***
2008	-0.00972***	-0.00967***	0.0772***	-0.00788***	-42.00***	-1.584***
2009	-0.000827***	0.00159***	-0.262***	0.00130***	-99.00***	-1.738***
2010	0.00104***	0.00276***	-0.132***	0.00226***	-138.0***	-1.537***
2011	-0.00455***	-0.00407***	0.0884	-0.00336***	-165.0***	-1.823***
2012	-0.00601***	-0.00364***	-0.141***	-0.00302***	-233.0***	-3.280***
2013	-0.00695***	-0.00175***	-0.436***	-0.00146***	-204.0***	-4.839***
2014	-0.00559***	-0.00226***	-0.368***	-0.00189***	-694.5***	-4.316***

Note: The definitions of Men DR, Women DR, Relative DR, u, and π refer to Table 3.1. All these indexes are the differences between high and low protest intensity areas.

Source: Author's calculations based on DHS in Egypt and the information of Western Europe, Canada, United States, Australia, New Zealand, and Japan from WHO.

Table 3. 5: Main results, relative death ratio, Placebo

Effect of Arab spring events on missing women: Main results.

Missing women	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Period of interest: 2007-2014								
Post x Treat	-2.009***	-2.010***	-1.994***	-1.995***	-1.999***	-2.007***	-1.984***	-1.998***
	(0.0150)	(0.0154)	(0.0164)	(0.0177)	(0.0165)	(0.0170)	(0.0200)	(0.0210)
Observations	43,323	43,240	43,240	43,240	43,240	43,240	43,240	43,240
R-squared	0.761	0.764	0.774	0.778	0.786	0.790	0.784	0.788
Alternative missing women measurement: relative death ratio								
Post x Treat	-0.146***	-0.146***	-0.142***	-0.143***	-0.143***	-0.145***	-0.141***	-0.144***
	(0.00281)	(0.00296)	(0.00315)	(0.00343)	(0.00320)	(0.00335)	(0.00375)	(0.00393)
Observations	43,323	43,240	43,240	43,240	43,240	43,240	43,240	43,240
R-squared	0.231	0.240	0.269	0.277	0.270	0.280	0.272	0.281
Placebo: 2007–2010								
Post x Treat	-0.004	-0.003	0.002	-0.006	-0.002	-0.009	0.004	-0.009
	(0.0170)	(0.00784)	(0.00896)	(0.00943)	(0.00950)	(0.0104)	(0.0109)	(0.0112)
Observations	21,030	20,985	20,985	20,985	20,985	20,985	20,985	20,985
R-squared	0.707	0.718	0.735	0.737	0.693	0.696	0.724	0.726
Individual Controls	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipalities	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Post x Xi	No	No	No	Yes	No	Yes	No	Yes
PS reweighting	No	No	No	No	Yes	Yes	No	No
Survey weighting	No	No	No	No	No	No	Yes	Yes
Cluster	No	Municip.	Municip.	Municip.	Municip.	Municip.	Municip.	Municip.

Note: Linear estimations based on 2014 DHS. Estimation of missing women is from the missing women calculation in equation (1). The treatment group are those governorates whose protest intensity is above-median protest intensity (based on the Egyptian Revolution database and defined as the governorate-level proportion of fatalities, injured, and arrested information). Control covariates includes wealth of households, work condition of respondents, urban, number of kids in the households, education of the respondents, age of wife and husband, husbands' work condition, religion, and kids birth order. We use different specifications: Column (1)- baseline result only with treatment group dummy, time dummy, and the interaction term of group dummy and the time dummy. Column (2)-adding individual control covariates and municipality cluster; Column (3)-based on column (2), adding municipality fixed effects; Column (4)-based on column (3) adding interactions between POST and the controls; Column (5) & column (6)- use propensity score reweighting; Column (7) & column (8)- use DHS survey weighting. Standard errors in parentheses are clustered at municipality level. ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively.

Table 3. 6: Alternative standard error clustering

Effect of the Arab Spring on Missing Women: Alternative Standard Error Clustering

	(1)	(2)	(3)	(4)	(5)	(6)
Post x Treat	-1.994***	-2.011***	-1.994***	-1.994***	-1.994***	-1.994***
	(0.0164)	(0.0153)	(0.0159)	(0.0149)	(0.0149)	(0.0153)
Observations	43,240	43,240	43,240	43,240	43,240	43,240
R-squared	0.774	0.764	0.774	0.774	0.774	0.774
Cluster	Municip.	Municip.	Govern.	Govern.	Govern.	Govern.
Fixed effect	Municip.	Govern.	Municip.	Municip.	Municip.	Municip.
Bootstrap	No	No	No	800 rep.	1000 rep.	Wild BS.

Note: Linear estimations based on 2014 DHS. Estimation of missing women on the treatment, i.e., above-median protest intensity (based on the Egyptian Revolution database and defined as the governorate-level proportion of fatalities). We use a specification including the following controls: wealth, urban, education of the wife, education of the husband, age of wife and husband, husband in work, religion, birth cohort, interactions between POST and the controls. Fixed effects: we additionally control for municipality dummies ("Municip.") or governorate dummies ("Govern."). Cluster: standard errors in parentheses are clustered at the municipality level ("Municip.") or governorate level ("Govern"). Clustering based on standard bootstrap (800 or 1000 replications) or wild bootstrap. ***, ** and *indicate significance at the 1%, 5% and 10% levels respectively.

Table 3. 7: Robustness check

Effect of Arab spring events on missing women: Robustness check.

	Marriage >3 years	Women aged 20 - 40	Interview: no husband	Interview: alone	Including border governorates	SYPE classification	Urban	Rural
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post x Treat	-1.832***	-1.975***	-1.988***	-1.984***	-1.854***	-1.110***	-2.027***	-1.977***
	(0.0183)	(0.0170)	(0.0166)	(0.0186)	(0.0268)	(0.0508)	(0.0235)	(0.0241)
Observations	37,780	40,411	40,682	30,760	43,240	43,240	17,061	26,179
R-squared	0.752	0.775	0.774	0.771	0.759	0.711	0.722	0.788
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect	Municip.	Municip.	Municip.	Municip.	Municip.	Municip.	Municip.	Municip.
Cluster	Municip.	Municip.	Municip.	Municip.	Municip.	Municip.	Municip.	Municip.

Note: Estimation model, missing women estimation, control variables in this table are same in column (3) in main result table, Table 4. Subsample in column (1) is the marriage of respondents' longer than 3 years. Subsample in column (2) is the age of respondents from 20 to 40. Subsample in column (3) is the interview condition without husband appearance. Subsample in column (4) is the interview condition for the respondent alone. Column (5) includes the border governorates. Column (5) includes all border governorates (Red Sea, Matrouh, New Valley, North Sinai and South Sinai) for analysis. Column (6) used the SYPE data set to classify the treatment and control groups. Standard errors in parentheses are clustered at the municipality level. ***, ** and * indicate significance at the 1%, 5% and 10% levels respectively.

Table 3. 8: Time variation check

Effect of the Arab spring events on missing women: Time variation check.

	Phase 1	Phase 2	Phase 3	Phase 4
	(1)	(2)	(3)	(4)
Post x Treat	-0.890***	-1.107***	-1.286***	-1.618***
	(0.0593)	(0.0756)	(0.0773)	(0.0393)
Observations	43,240	43,240	43,240	43,240
R-squared	0.712	0.711	0.739	0.731
Individual Controls	Yes	Yes	Yes	Yes
Municipalities	Yes	Yes	Yes	Yes
Survey weighting	Yes	Yes	Yes	Yes
Cluster	Municip.	Municip.	Municip.	Municip.

Note: Linear estimations based on 2014 DHS. Estimation of missing woman is same in Table 1, i.e., above-median protest intensity in different protests phases (based on the Egyptian Revolution database and defined as the governorate-level proportion of fatalities). We use the specification of model 4 in Table 1 (controls include wealth, urban, education of the wife, age of wife and husband, husband in work, religion, municipality dummies, interactions between POST and the controls). Standard errors in parentheses are clustered at the municipality level. ***, ** and * indicate significance at the 1%, 5% and 10% levels.
Phase 1, Protest against Mubarak's autocratic regime referring to column (1).
Phase 2, Military rule from February 2011 to June 2012 referring to column (2).
Phase 3, Muslim Brotherhood's rules, the president Mohammed Morsi, from June 2012 to July 2013 referring to column (3).
Phase 4, Post Islamist rules, from July 2013 to June 2014 referring to column (4).

Table 3. 9: Different ages

Effect of Arab spring events on missing women: Different ages

Missing women	age1	age14	age59	age1014	age1519	age2024	age2529
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Period of interest: 2007-2014							
Post x Treat	-1.995***	-0.167***	-0.609***	0.0722***	-0.0358***	-0.0843***	0.119***
	(0.0177)	(0.00418)	(0.00137)	(0.00141)	(0.00173)	(0.00104)	(0.00367)
Observations	43,240	82,766	87,982	71,574	50,631	28,228	9,520
R-squared	0.778	0.255	0.345	0.292	0.340	0.506	0.273
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect	Municip.	Municip.	Municip.	Municip.	Municip.	Municip.	Municip.
Post x Xi	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Survey weighting	No	No	No	No	No	No	No
Cluster	Municip.	Municip.	Municip.	Municip.	Municip.	Municip.	Municip.

Note: Estimation model, missing women estimation, control variables in this table are same in column (3) in main result table, Table 4. Standard errors in parentheses are clustered at the municipality level. ***, ** and * indicate significance at the 1%, 5% and 10% levels.

age1, the age of women from 0 to 1.
age14, the age of women from 1 to 4.
age59, the age of women from 5 to 9.
age1014, the age of women from 10 to 14.
age1519, the age of women from 15 to 19.
age2024, the age of women from 20 to 24.
age2529, the age of women from 25 to 29.

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