THE ECONOMIC CAUSES OF TERROR: EVIDENCE FROM RAINFALL VARIATION AND TERRORIST ATTACKS IN PAKISTAN*

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Abstract. This paper suggests a new channel of employment shocks and violence: the charitable donations channel. Tapping onto the charity market is a potentially less risky and less costly way to raise funds for terrorist operations. Especially if information asymmetry can be exploited, the state is weak in regulating and there are no natural resources to be exploited. Donating funds is also a less costly activity for those individuals that sympathise with the cause of the terrorists or for whom the opportunity cost of directly engaging in terrorism is high. The model predicts that in a societal context with well enforced charitable norms and terrorist presence in charity market, an employment shock will result not just in changing relative wages across the legal and illegal sector. There will also be a concomitant charitable donations channel. The overall effect of an exogenous employment shock on terrorist attacks is thus, ambiguous and depends on the relative strength of the donations and opportunity cost channel of violence. I test these predictions in Pakistan. Basing this study on Pakistan with a 62 percent rural economy and a vibrant religious donations market with militant presence, has allowed both a cleaner identification and the exploration of this channel. I use rural household employment and district level panel data on rainfall and terrorist attacks for the years 1998, 2001, 2005, 2007 and 2010 to identify the net effect of employment shocks on terrorist violence. Results suggest that opportunity cost is the more dominant channel. I find that overall as a household switches into employment, the number of terrorist attacks reduce by approximately 42 attacks. This is economically a very large effect and is in sharp contrast to the literature that suggests that economic conditions are not directly correlated with the onslaught of terrorism. In line with theoretical predictions for the donations channel, I also find that the effect of employment on terrorist attacks depends on the religiosity of the populace. For those districts that are religious the overall effect is in fact positive and large for both terrorist attacks dummy and intensity. Policy implications suggest focusing on regulating the charitable donations market among other things.

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"There are two things a brother must always have for Jihad, the self and money[1]*"An Al-Qaeda operative*

1. Introduction

What do studies testing the effect of income shocks on violence capture? Is it just the Beckarian (1968) opportunity cost channel with rational agents comparing relative wages across the legal and illegal sectors? Or are there other channels at play? Is there an opportunity cost channel at play in the specific case of terrorist violence?

The latter issue remains less problematic. According to Stern (2000) "One mid-level manager of Lashkar-i-Taiba...earns Rs.15,000 a month. Top leaders of militant groups earn much more...Operatives receive smaller salaries but win bonuses for successful missions". According to excerpts of a US Diplomatic cable appearing on the website Wikileaks in November 2008, it was reported, "the current average rate is approximately Rs 500,000 (USD 6,500) per son, for martyrdom". What remains to be seen is whether the opportunity cost is the only channel through which employment shocks effect terrorist violence.

There have been studies that account for other concomitant channels. It has been argued that the cost of obtaining counter-terrorist information rises as the labour market becomes tight on a positive shock. If the main constraint on terrorist organizations is the level of non-combatants' information sharing with the security forces this can result in an increase in terrorist attacks (Kalyvas (2006); Berman, et al. (2008, 2011)). Hendawi (2008) describes the effect of reduced presence of security establishment as another channel. Above average rainfall shocks can obstruct the establishment of checkpoints by the security establishments leading both to reduced disruption of the economy and an increase in the production of violence.

Theoretically, violence financing should be another important channel through which income shocks affect terrorism. Finance is an important constraint on a terrorist organisation's ability to produce violence. Much attention has been devoted to natural resources as a funding mechanism for violence (Collier and Hoeffler (1998, 2002); Dube and Vargas (2009)). However, the funding opportunities for terrorists organisations operating in countries with little natural resources remains unexplored.

Tapping into the charity market can be one such less risky and less costly way. Especially if the state is weak in regulating. Donating funds is also a less costly activity for those individuals that sympathise with the cause of the terrorists or for whom the opportunity cost of directly engaging in terrorism is high.

Empirically there has been evidence of violent groups using the charity market to raise funds, for example, NORAID (the Northern Aid Committee) and FOSF (Friends of Sinn Fein), the Irish-American fund raising bodies or local collections in pubs and clubs in Ireland (Horgan and Taylor (1999). Another example can be that of the US Somali community raising funds for Al-Shabaab, linked to Al-Qaeda (Peter and Davod (2013)).

In this study, using rainfall led rural household employment shocks, I describe the donations channel of terrorist attacks as an additional channel of income shocks on terrorist violence. To the best of my knowledge this is the first study describing such a channel. The main argument is: while a positive rural labour market shock raises the opportunity cost of terrorism and reduces violence, in a context with well enforced charitable norms, it also simultaneously

[1]US Government intelligence reporting, 2004

allows a greater flow of charitable donations to the charity sector. With the presence of militant charities in the market there should be some diversion of funds to violent activity, leading to an increase in terrorism.

I base this study on Pakistan as the Pakistani context aids identification. Coupled with clandestine militant charities is the fact that 62 percent of Pakistanis live in rural areas, 80 percent of whom are in one way or the other linked to agriculture[2]. Agriculture is the largest employer, absorbing 45 percent of the country's total labour force[3]. Water in any agricultural economy is a potential determinant of productivity. If there is access to irrigation water, it dilutes the importance of rainfall in the agro-production function. In Pakistan, however, due to the political economy of irrigation water disbursement and a poor irrigation system, rainfall remains a potentially significant determinant of agricultural productivity and can potentially be used as an instrument for rural employment.

In addition, there is also ample exploitable variation in terrorist activity within Pakistan. For the years 1998, 2001, 2005, 2007 and 2010, within a district-year in Pakistan, on average, there have been approximately 3.5 terrorist attacks with a maximum of 86 attacks. The probability of a terrorist attack is approximately 50 percent.

Pakistan provides the additional opportunity to study the charitable donations channel as evidence suggests that (a) religious donations are employment elastic owing to 97 percent of Pakistanis being Muslims and religious in their beliefs and the state being a constitutional theocracy; (b) militants operate in the charity market[4]. Pew Research Centre in 2002 showed that 91 percent of Pakistani population viewed religion to be a very important factor in their lives. 77 percent of Pakistanis say their approach to religion is to observe religious code (Gallup Pakistan (2012)). In the hierarchy of religious code, 'Zakat' is the second most important worship ritual in Islam.

The employment elasticity of charity will be irrelevant if there was no way of it leaking out to the terrorist sector. Within Pakistan evidence suggests that this is not the case. First, the Pakistani middle class hold militants in higher regard than poor Pakistanis (Blair et al. (2013)). Second, there is evidence within Pakistan that proscribed terrorist organizations frequently change their identity and set up religious charities that are not ostensibly linked to them to raise funds via 'Zakat' (Rana (2012)). Evidence also suggests that frequent identity change leaves most Pakistanis ill-informed (Zia-ur-Reman (2012)). Information on the real identity of terrorist charities is also not easily available. Consider the case of the terrorist organization Jaish-e-Muhammad (JeM), which now operates under the name Tehreek-e-Khuddam-ul-Islam. JeM's charity wing Al Rehmat Trust, not openly linked to JeM, is reported to have raised Rs.600 million in charity in 2005 alone (Rana (2012)). Al Rasheed Trust, secretly linked to Jaish-e-Muhammad and Taliban indicates that the Trust's predominant source of funding is 'Zakat' (SATP website). It raised Rs.950 million in 2005 (Rana (2012)). In the same year, Al Asar Trust, which shows no links to its parent terrorist organization Harkatul Mujahideen raised Rs.280 million (ibid.). Falah-i-insaniyat Foundation Jamaat-ud-Dawa(JuD)'s latest clandestine charity wing, claims to have raised billions through private donations (ibid.).

Results suggest that while the overall effect is negative, districts that are classified as religious pay out more donations as households become employed. An employment shock in

[2]1998 Population Census and the Economic survey of Pakistan p.13

[3]Economic survey of Pakistan 2009-10, p.13

[4]As there is evidence of the use of the religious charity market by militants, I use that instead of secular charity market.

these districts also leads to an increase rather than a decrease in terrorist activity. Results are consistent with the theoretical predictions.

This study contributes to the literature on terrorism as it is potentially the first to discuss the charitable donations channel of violence. In addition, it uses sub-national variation in data. Most of literature on terrorism is either at a cross-country level or makes little attempt at exploiting exogenous variation to identify a causal effect. Apart from obvious omitted variable concerns, cross country studies potentially suffer from sample selection bias as 69.8 percent of terrorist attacks are associated with just twenty-one countries (Gassebner et al. (2011)). Using sub-national variation helps overcome identification concerns in the literature. While not the primary aim, the study also contributes to the literature on the motivation for religious charitable giving.

The paper proceeds as follows: Section 2 provides a discussion of the existing literature. Section 3 discusses the specific context of Pakistan in terms of terrorism and rural-agrarian labour market. Section 4 provides the theoretical framework, which is followed by the empirical strategy, key identifying assumptions and details of data used in section 5. Section 6 presents the main results and that is followed by section 7 which deals with identification concerns and robustness checks. Section 8 concludes.

2. Literature Review

2.1. **Labour Supply or Opportunity Cost Channel.** Most empirical studies confirm the operation of an opportunity cost channel in the case of civil wars and insurgencies (Collier and Hoeffler (1998, 2002);Elbadawi et al. (2000, 2002); Fearon and Laitin (2003); Miguel et. al (2004); Dube and Vargas (2009); Berman et al. (2011)). The evidence on terrorism is contrary to that of civil wars. Piazza (2006), Krueger (2007) and Krueger and Laitin (2008) among others show that economic conditions are not directly correlated with the onslaught of terrorism. Berrebi (2007) uses biographies of 285 'martyrs' from 1987 to 2002 and finds that suicide bombers are less likely to come from poor families and are more likely to have completed high school and attended college than the general Palestinian population. Krueger and Malecˇkova (2003) focus on international terrorism using public opinion polls data and biographical evidence and find similar results. An attempt at a cleaner identification, albeit in a cross-country way, is by Abadie (2006). Abadie (2006) instruments income by geographic land-lock and finds that once the level of political freedom is controlled for, terrorist risk is not significantly higher for poorer countries. Evidence also suggests that there is qualitative effects of income shocks on terrorism (Benmelech et al. (2012)).

Contrary evidence in the case of opportunity cost channel of terrorism shows that conclusions from the civil wars literature might not be directly applied to terrorism. Having said that, simple OLS, cross-country studies based on descriptive statistics and biographical accounts do not account for causal channel identification. These conclusions on opportunity cost need to be investigated further.

2.2. **Financial or Religious Charity Channel of Terrorism.** According to excerpts of US Diplomatic cable appearing on the website Wikileaks in November 2008, it was reported, "a network (of terrorists are)....being strengthened through an influx of charity ('Zakat')".

'Zakat' is the second most important tenet in Islam and is mentioned in the Quran in over thirty verses:

"Take zakāh from their wealth in order to purify them with it". (Quran (9:103))

"give away what is due of them upon the harvest day" (Quran (6:141))

'Zakat' is due at the rate of 2.5 percent annually on income or wealthn due after basic needs are fulfilled. According to the Quran, 'Zakat' is a prerequisite for an individual to become a Muslim (Quran (9:11)). Non-payment of this charity has been held in high contempt in the (Quran (9:34-35). Interestingly, 'Zakat' is due not just to ones kin, orphans, needy, wayfarers and for the ransom of slaves but also to "those who ask" (Quran; 2:177), a phrase which is potentially exploited by many a militant charities.

This discussion is particularly relevant in the Pakistani context. Pakistan is constitutionally a theological state. According to the 1998 Population Census there are 96.28 percent Muslims in Pakistan and the religiosity of its populace, especially the relatively better off, has been on the rise. A number of studies have shown that Pakistanis followed a conservative thought pattern that may be construed by some as bordering on radicalism (Noor (2008)). Gallup World conducted a survey in 2006, 2007, and 2008 in 143 countries and Pakistan stands in the most religious country category. Pakistanis viewed religion as an important part of their daily lives. Zaidi (2010) argues along similar lines.

In such circumstances compulsory religious tenets like 'Zakat' will potentially be followed by a majority of the population. The National Survey of Individual Giving by Agha Khan Development Network found that Pakistanis gave the equivalent of Rs 70 billion in donations during 1998 mostly directed towards religious organizations. Pakistani Muslims annually contribute billions of rupees or animal hides as part of 'Zakat' specifically on religious occasions Zia-ur-Rehman (2012)).

While the State collects 'Zakat' under the 'Zakat' and 'Ushr' Ordinance 1980 and there are other benign charities in the field, as already discussed evidence suggests that proscribed militant outfits set up religious charities and exploit asymmetric information about their true identity to collect 'Zakat' throughout Pakistan.

3. Terrorism & The Labour Market-The Specific Context of Pakistan

3.1. **Terrorist Attacks in Pakistan.** Pakistan has experienced terrorism of varied types, however, the latest most significant onslaught has been from Al-Qaeda and the Taliban. Since Pakistan's alliance with the US in 2001, terrorist attacks have been on the rise. There is ample exploitable within district variation in terrorist activity. The average number of attacks for the years 1998, 2001, 2005, 2007 and 2010 is 3.5 in a district year in Pakistan with a maximum of 86 attacks. There have been on average 45 attacks in Quetta, 23 in Peshawar, 12 in Kohat and 7 in Lahore.

3.2. **Significance of Rural-Agricultural Sector in the Economy of Pakistan.** Since Pakistan is still a predominantly rural society and agriculture is by far the dominant economic activity for the bulk of the rural population, fluctuations in weather constitute important economic shocks. According to the 1998 Population Census approximately 80 percent of the rural population is linked in one way or the other to agriculture (see appendix A2 for rural areas and appendix A3 for cropped areas of Pakistan). To substantiate the significance of agriculture in the economy, I reproduce an excerpt from The Economic Survey of Pakistan 2010:

> "Agriculture is the second largest sector....and the largest employer, absorbing 45 percent of the country's total labour force. Nearly 62 percent of the country's population resides in rural areas, and is directly or indirectly linked with agriculture for their livelihood...Agriculture sector's strong linkages with the rest of the economy are not fully captured in the statistics. While on the one hand, the sector is a primary supplier of raw materials to downstream industry... on the other, it is a large market for industrial products[5]".

In addition, "Use of casual labour had been on the increase, 45% of farms reported use of casual labour in 1980 as compared to 30% during 1972. The percentage had further increased to 50% in 1990....The percentage of farms reporting permanent hired labour decreased from 7% in 1972..to 2% in 1990[6]". The trend has continued into the next two decades. Thus, the rural-agrarian employment effects of a negative rainfall shock will be felt almost immediately by the casual labour for whom the rainfall elasticity of labour demand is potentially higher. This lends support to basing this study on rural employment in Pakistan.

3.3. **Significance of Rainfall in the Rural-Agricultural Sector of Pakistan.** In the presence of a well-planned irrigation system and a well thought out water management policy the link from rainfall to rural-agriculture employment might have been minimal. However, in Pakistan, at present, the state of the existing irrigation system is very poor. According to the Indus River System Authority actual surface water availability and area weighted recorded rainfall has been less than the average[7]. Critical investments in water infrastructure have not being made and inadequate water storage further exacerbates the problem; Pakistan has just 9 percent storage capacity of the world's average [8].This is worsened by an inefficient water management system. Efficiency of water utilization is less than 0.1 kg/m^3 as compared to 0.39 kg/m^3 in India[9].The canal irrigation system, concentrated mainly in Punjab and Sindh has been inadequate to meet the water requirements of even the traditional cropping patterns[10] (see appendix A4 for irrigated areas in Pakistan). During the 'Green Revolution' era of the 1960s, tube wells were widely encouraged as a means of irrigation, however, these private tube wells remained limited to Punjab and were mainly installed by large landholders owning more than 25 acres[11].Owing to public officials' involvement in water supply regulation, there is a lack of equal access to water. The marginal farmers, usually the tail-enders on a water course, are always at a disadvantage in getting water in adequate quantity and at the time most needed[12].

In these circumstances, erratic and highly variable rainfall, both in spatial and temporal terms, has a significant negative effect on agricultural productivity. Rainfall remains one of the main reasons for the high volatility in the agricultural sector growth rate ranging from 6.5 per cent in 2004-05 to 1.0 per cent in 2007-08[13]. Rainfall shortage not only has direct effects but also works its way through its contributions to Upper Indus Basin Flow and an

[5]Economic survey of Pakistan 2009-2010, p.13
[6]Pakistan Bureau of Statistics,(2012)
[7]Economic survey of Pakistan 2009-2010, p.35.
[8]ibid.
[9]ibid.
[10]Khan, M. H. 1998 'Public Policy and the Rural Economy of Pakistan', Vanguard Books, Lahore, pp.68-71
[11]ibid.
[12]ibid.
[13]Economic survey of Pakistan 2009-2010, p.35.

adverse shock can lead to a reduction in overall availability of irrigation water. Therefore, given the political economy of irrigation policy in irrigated areas like Punjab and Sindh and the dependence on rain and uncertainty about water in rain-fed areas, rainfall remains a significant determinant of agricultural and hence rural productivity.

4. Theoretical Framework

4.1. **The Model.** Consider a static environment. There is a measure one of workers of different types. Workers are risk neutral and Von Neumann Morgenstern expected utility maximizers. They differ in the respective (psychological and other) utility from following a religious charitable norm which I denote by $\theta \in \{\theta_L, \theta_H\}$, $\theta_H > \theta_L$, where θ_L suggests that the agent enjoys a low benefit of following religious rituals (the non-religious types) and θ_H denotes a high benefit of conforming to the religious rituals (the religious types). Both types are equally likely. There are two stages to the agents' decision. At the first stage, the agent allocates one unit of labour across the agriculture and terror sector. At this stage the agent's type is unknown and I assume that the agent's religiosity has no real productivity effect in either sector. At the second stage the type of the agent is revealed. Those agents that participate in the agriculture sector compare the benefit of conforming to the ritual with the fraction of income that they are ordained to donate. Agents are imperfectly informed about the type of the charity when they make their donations. Let M be the total income of the consumer in agriculture. Agents with $\theta \geq \tau M$ follow the religious ritual and donate whereas others dont. For this to be a non trivial equilibrium assumption A1 has to hold.

Assumption A1: $\theta_H \geq \tau M$

This condition ensures that in equilibrium there will be some proportion of agents that donate to the charity sector. If this condition did not hold then there will be no flow of donations to the charity sector and no production of public goods by charities. It also ensures incentive compatibility.

For the set of agents that choose to follow the religious ritual they also have to decide the allocation of their religious donation across different types of charities. Agents have warm glow preferences for the public goods produced by charities. For simplicity let us assume that agents meet a militant and benign charities randomly. The probability of meeting a militant charity and it ending up with τM donations is thus,ζ.

The agriculture sector has a measure one of risk neutral producers who maximize expected profits. The agriculture production function is the standard neoclassical production function with constant returns to scale i.e. $Y = g((1+\varphi)L)$ where L is the amount of labour used and φ is a stochastic productivity parameter $\sim iidU[0,1]$.

The terror sector has a measure one of violence producers who maximize attacks[14]. The production of violence is additively separable in labour L, funds from religious donations D and a vector of other inputs $\overrightarrow{W}$. The terror production function is $A = h(L, \beta D, \overrightarrow{W})$. There is a probability γ that the terror producer will be caught by the state and production will close.

Assumption A2: $\beta > 0$

Assumption A2 simply states that a high flow of funds through religious donations increase attacks while a reduction in donations leads to a decrease in attacks.

[14]The main argument made in this paper remains unchanged by using other objective functions.

There is a monopolistically competitive charity sector run by entrepreneurs. The charity sector can earn profit but it is constrained by a non-distribution constraint i.e. entrepreneurs cannot appropriate profits and have to redistribute it back to the charity. The type of the charity is $t \in \{t_b, t_m\}$ where t_b denotes a benign charity which produces a differentiated public good and $t_m$denotes a militant charity. Militant charities differ from benign charities in their linkage with the terror sector. Militant charities get a fixed benefit ϖ of giving a fraction μ of their profits to the terror sector. The probability of a militant charity in the charity market is $Pr(t = t_m) = \lambda$.

Assumption A3: $\varpi \geq \mu\pi_m$ where $\mu > 0$

If A3 did not hold then there will not be any flow of funds to the terror sector and thus no interaction of the terror and charity sector. There A3 is a necessary condition to have a non-trivial equilibrium where funds flow to the terror sector.

Proposition 1: Let υ be the pecuniary benefit that the worker gets from the terror sector and φ stand for rainfall as a productivity shock. Let α be the probability that the agent allocates his one unit of labour time to the agricultural sector then:

$$\alpha = \begin{cases} 1 & if w = (1+\varphi)g_L((1+\varphi)L) > (1-\gamma)\upsilon \\ 0 & if w = (1+\varphi)g_L((1+\varphi)L) < (1-\gamma)\upsilon \\ \in [0,1] & w = (1+\varphi)g_L((1+\varphi)L) = (1-\gamma)\upsilon \end{cases}$$

If the net benefit to the agent from participating in the agriculture sector is greater than the expected benefit from the terror sector he will supply his unit of labour to the agriculture sector. Note that if $lim\gamma \to 1$ i.e. there is a very high probability of the state capturing and shutting down production then workers will allocate their unit of labour to the agriculture sector. In the simple version of the model γ is exogenous. The aggregate effect in the agricultural labour market can be seen in Figure 1. The figure shows that when positive rainfall shocks lead to an outward shift of the labour demand curve, it traces movements along the labour supply curve.

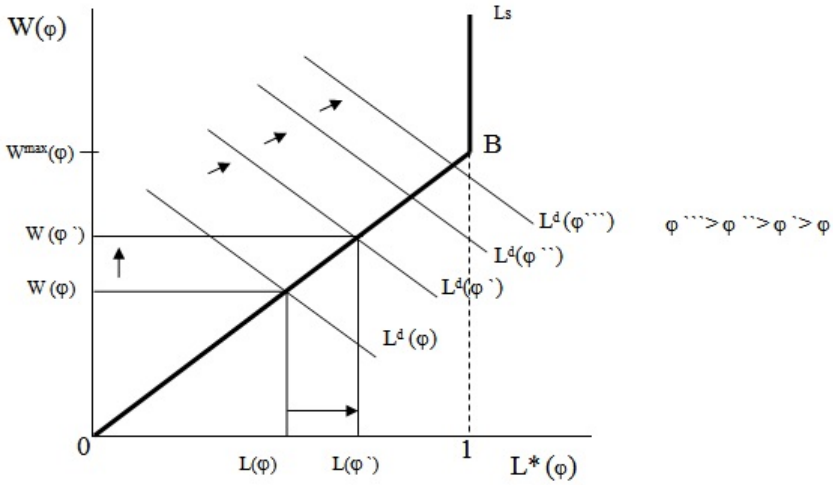


Figure 1. Aggregate Agrarian Labour Market Participation Decision. Rainfall Shocks (φ) to Aggregate Labour Demand ($L^d(\varphi)$) capture movements along the Aggregate Labour Supply Curve (L^s) i.e. the proportion of people participating in the agrarian market

Proposition 2: The overall effect of an exogenous employment shock on religious charitable donations is heterogeneous. It will vary with the religiosity of the agents.

If the population is not religious then the religious donations constraint is not binding. An increased employment in the population should not lead to an increase in religious charitable donation. The effect reverses with a highly religious population. Thus, the effect of employment on religious charitable donations should be heterogeneous varying with the level of religiosity of the population.

Proposition 3: The effect of an exogenous rainfall shock on wage in the agriculture sector is unambiguously positive $\frac{\partial w^*}{\partial \varphi} > 0$***. As this is an extensive margin decision (there is no income effect) the effect of a rainfall shock on agricultural labour market participation is also unambiguously positive*** $\frac{\partial \alpha^*}{\partial \varphi} > 0$***. This implies that with a positive productivity or rainfall shock to the agricultural sector, the probability of labour being supplied to the terror sector reduces.***

As $h_L > 0$, the reduced supply of labour leads to a reduction in attacks. This is the opportunity cost effect of a rainfall shock on attacks.

Proposition 4: The overall effect of an exogenous rainfall shock on terrorist attacks is ambiguous i.e. $\frac{\partial A}{\partial \varphi} \gtreqless 0$. ***The marginal productivity of both donations and terrorist labour is positive. However, a positive rainfall shock in the agrarian market leads to opposite effects on equilibrium donations and labour employed. A positive rainfall shock translates into an increase in total income and equilibrium donations, while at the same time it leads to an increase in opportunity cost of terrorism, agrarian sector labour and a fall in the equilibrium terrorist labour employed. The relative strength of either channel depends on the size of the different parameters.***

$\frac{\partial A(L^*(\varphi),D^*(\varphi))}{\partial \varphi} = \frac{\partial A(L^*(\varphi),D^*(\varphi))}{\partial L^*(\varphi)}\frac{\partial L^*(\varphi)}{\partial \varphi} + \frac{\partial A(L^*(\varphi),D^*(\varphi))}{\partial D^*(\varphi)}\frac{\partial D^*(\varphi)}{\partial \varphi}$
$\frac{\partial A(L^*(\varphi),D^*(\varphi))}{\partial L^*(\varphi)}\frac{\partial L^*(\varphi)}{\partial \varphi}$ is what has been studied in the literature as the opportunity cost effect of a economic shock. The ambiguity that I highlight, stems from the additional religious donations channels i.e. $\frac{\partial A(L^*(\varphi),D^*(\varphi))}{\partial D^*(\varphi)}\frac{\partial D^*(\varphi)}{\partial \varphi}$. If this channel was absent we would have the regular expected sign of attacks with respect to a productivity or rainfall shock i.e. $\frac{\partial A}{\partial \varphi} < 0$. However, in many contexts the religious donations channel is not absent. Therefore, the overall effect depends on the relative strength of the labour supply and charitable donation channels of rainfall shocks on terrorism.

Proposition 5: The effect of an exogenous rainfall shock on terrorist attacks varies with religiosity of the populace i.e. $\frac{\partial A}{\partial \varphi} = q(\theta)$.

The more religious the population the greater the proportion donating to the charity market. With militant charities in the charity market this implies that a greater proportion of funds with be leaked to the terror sector. As the marginal product of donations is positive this implies that the probability of attacks will rise. Depending on parameters, this can result in a dominant donations channel effect $\frac{\partial A}{\partial \varphi} > 0$. In the absence of religious types, the economy will be the standard opportunity cost economy with $\frac{\partial A}{\partial \varphi} < 0$.

5. Empirical Strategy

5.1. **Instrumental Variables Estimation & Key Identifying Assumptions.** An OLS estimation strategy will not capture a causal effect of employment shocks on terrorism. One concern can be simultaneity. There is ample evidence within Pakistan that terrorist attacks have had a devastating impact on the economic conditions of the country.

> "Pakistan's economy is under pressure of the War on Terror. (It) has...cost the country..erosions of investment climate, nose diving of production and growing unemployment and above all brought economic activity to a virtual standstill in many part of the country[15]".

In addition, there can be a host of unobserved factors causing endogeneity. One example can be that of proximity to terrorist organizations. It is a potential determining factor of terrorist recruitment. Having a terrorist organization nearby means that it offers a viable substitute for agrarian employment, in case relative wages between agriculture and terrorist

[15]Special Section 1, Economic Survey of Pakistan, 2010-11.

sector fall. It increases the ease of labour supply shift to terror. It also affects the rural labour market as increased presence of terrorists potentially implies security concerns and fear of expropriation. This implies a lower investment in legal sectors like agriculture and a lower rural-agrarian employment. Another case can be where militant charities choose to relocate themselves in areas with a tight labour market so that they could maximize both donations and terrorist attacks. In the presence of such unobserved factors, a simple OLS of rural-agrarian employment and terrorist attacks will result in inconsistent estimation.

In order to circumvent endogeneity concerns and to identify a causal effect of rural household employment shocks on terrorist attacks, I use district level rainfall shocks as a source of exogenous variation to rural household employment. One can potentially justify the use of rainfall shocks as an instrument for rural employment in predominantly agricultural economies with little irrigation, like Pakistan. Referring back to Figure 1 in Section 4, another motivation for using rainfall deviations as an instrument for rural-agrarian employment is that it helps to disentangle agrarian labour supply from labour demand shocks. Rain induced shifts in labour demand, allows the use of variation in rural employment along the aggregate labour supply curve. This is important if it is to be argued that the empirical strategy rests on the structural relationship as outlined in the theoretical framework section.

One significant estimation concern needs to be highlighted. I use terrorist attacks dummy as an outcome variable with dummy endogenous rural household employment. There are natural non-lin**e**arities here. However binary outcome regressions with a dummy endogenous variable and the presence of fixed effects using non linear models is not straight forward. Angrist (2001) argues that in such a case conventional 2SLS estimates using LPM are consistent. In future work I aim to use non linear estimation as well. However, for ease of interpretation and computation I use the linear probability model here.

The structural equation is:

$A_{dt} = a_d + a_t + a_1 Emp_{idt} + \upsilon_{dt}$

The two stage least squares estimation is as follows:

$Emp_{idt} = \vartheta_d + \vartheta_t + \vartheta_1 R_{dt} + \Omega_{idt}$: (First Stage)

$A_{dt} = \alpha_d + \alpha_t + \alpha_1 \widehat{Emp_{idt}} + \phi_{dt}$: (Second Stage)

Where:

$\widehat{Emp_{idt}} = \hat{\vartheta}_d + \hat{\vartheta}_t + \hat{\vartheta}_1 R_{dt}$ & under consistent estimation:

$\phi_{dt} = [\upsilon_{dt} + \alpha_1(Emp_{idt} - \widehat{Emp_{idt}})] = \upsilon_{dt} + \alpha_1 \Omega_{idt}$

Where υ_{dt} consists of three main factors:

(i) unobserved factors that affect terrorist labour T_{dt};

(ii) unobserved factors that affect religious donations to terrorist organizations D_{dt};

(iii) unobserved factors that directly affect terrorist attacks A_{dt}.

In the data for $t \in \{1998, 2001, 2005, 2007, 2010\}$:

A_{dt}**:** are terrorist attacks both as a dummy variable which takes on the value of one if there has been a terrorist attack in a district d year t and zero otherwise and a continuous variable, number of attacks in a district d and year t

Emp_{idt}**:** is a dummy that turns on one if a rural household i is employed in district d and year t and zero otherwise

R_{dt}**:** is the single instrument used to instrument for rural household employment and captures rainfall deviation from the 20-30 year average rainfall in district d year t

ϑ_d, α_d**:** are district fixed effects in the first and second stage. They capture time-invariant district level unobserved heterogeneity, for example, geography, religious or ethno-linguistic fractionalization, culture, quality of institutions etc.

ϑ_t, α_t**:** captures year fixed effects in the first and second stage respectively. These control for any macroeconomic trends, for example, national policy or country level business cycles that are same for all districts but vary over years

Ω_{dt}, ϕ_{dt}**:** are error terms in the first and the second stage

ϑ_1**:** in the first stage captures how a $1mm$ above average rainfall shock (R_{dt}) in district d and time t will lead to a change in the probability of a rural household being employment (Emp_{idt}).

α_1**:** in the second stage is the main coefficient of interest and captures what effect a one percentage point, rainfall-induced, change in rural household employment has on terrorist attacks.

Within the context of Pakistan, using the aforementioned instrumental variables estimation, I find $\alpha_1 < 0$. This suggests that opportunity cost is the more dominant channel of of terrorism. However, for those districts that are religious the overall effect is in fact positive. This suggests that the donations is also a significant channel through which employment shocks effect violence.

5.1.1. *Key Identifying Assumptions.* The identifying assumption for α_1 to capture the causal effect are:

***A1*:** *Instrumental Relevance or Rank Condition*: $E(Emp_{idt}, R_{dt}) \neq 0$ or $\vartheta_1 \neq 0$

***A2*:** *Order Condition:* As the model is exactly identified the order condition is trivially satisfied.

***A3a)*:** *Independence:* Conditional on fixed effects, the rainfall instrument R_{dt} is as good as randomly assigned $[\{A_{dt}(Emp_{idt}, R_{dt}); \forall Emp_{idt}, R_{dt}\}, Emp_{idt}] \perp R_{dt} \mid \alpha_d$

A3b): *Exclusion Restriction*: While the independence assumption claims random assignment of rainfall, the exclusion restriction assumes that the unique channel for the causal effect of rainfall on terrorist attacks is rural household employment changes. In the context, it requires strict exogeneity i.e.$E(\phi_{dt} \mid R_{dt}, \alpha_d) = 0$. This implies that the exclusion restriction holds if, conditional on fixed effects, within district-year rainfall shocks are mean independent of: unobserved factors that directly affect rural household employment (Emp_{idt}) and terrorist attacks (A_{dt}); unobserved factors that affect both terrorist labour employed (T_{idt}) and terrorist attacks (A_{dt}); unobserved factors that affect both religious charitable donations (D_{idt}) and terrorist attacks (A_{dt});unobserved factors that directly affect terrorist attacks (A_{dt}).

***A4*:** *Monotonicity:* Monotonicity in this context requires that with a rainfall deviation of $1mm$ above its 20-30 year average, rural household employment should be at least as big as that without this increase **(**Imbens & Angrist (1994)).

5.2. **Data.** Pakistan is administratively divided into four main provinces i.e. Punjab, Sindh, Khyber Pakhtunkhawa (KPK), and Balochistan comprising of 98 percent of the population. Provinces are administratively sub-divided into divisions which are further sub-divided into districts (see appendix A1 for a detailed map of districts of Pakistan).

5.2.1. *Data on Rainfall Shocks.* Data on annual district level rainfall in Pakistan is compiled from the Pakistan Meteorological Department's (PMD) gauge station data [16]. The merits of using gauge data over satellite based estimates are discussed in detail in Cheema et al. (2012) and are not repeated here. The main advantage is precision. Satellite rainfall data deviate from actual rainfall to the scale of approximately 10 percent for annual periods (ibid.).

There are at present 98 PMD gauge stations in Pakistan (See appendix A7). Daily rainfall data on 89 of these stations, from the date of each station's establishment, was collected from PMD. The daily rain estimates were then aggregated to months and annual averages. These stations were established in different years over the country's history and do not follow district boundaries. In addition, these rainfall estimates will pertain to a single geographical point where that station is located. They might not capture rainfall variation across an entire land mass of a district. In order to arrive at representative district level rainfall estimates, isohyetal method is used (estimation details and graphs at appendix A6 (i) and (ii)). Rainfall shocks are compiled as deviation of rainfall from 30 year average rainfall from 1970-2000, called 'Normals'.'Normals' data is on 55 PMD Stations. For the rest of the stations I use deviation from 20 year average rainfall generated using the same isohyetal method.

Table 1. Rainfall Deviation from Normals - Correlations

	Rain (t)	Rain (t-1)	Rain (t-2)	Rain (t-3)	Rain (t-4)
Rain (t)	1.00				
Rain (t-1)	0.0779***	1.00			
	(0.0070)				
Rain (t-2)	-0.0649**	0.0268	1.00		
	(0.0402)	(0.3980)			
Rain (t-3)	0.0271	-0.1191***	-0.0271	1.00	
	(0.4446)	(0.0007)	(0.4443)		
Rain (t-4)	-0.0047	0.1048**	-0.1964***	-0.0667	1.00
	(0.9086)	(0.0102)	(0.0000)	(0.1025)	

p-value in parenthesis
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Note: Data on annual district level rainfall in Pakistan is compiled from the Pakistan Meteorological Department's (PMD) gauge station data from 1997-2010. In order to arrive at representative district level rainfall estimates from 1997-2010, isohyetal method is used. The dataset includes 100 districts from four provinces of Pakistan i.e. Punjab, Balochistan, Khyber-Pakhtunkhawa (KPK), Sindh from 1997-2010.

Table-1 suggests that on average district rainfall is not predictably correlated over years. In this case, expectations about future rainfall might not be a significant determinant of behaviour.

5.2.2. *Data on Terrorist Attacks.* District level panel dataset is compiled from BFRS Political Violence in Pakistan dataset. Other datasets like the Global Terrorism Database (GTD) either under-report violence (De Mesquita et al. (2013)) or like the Southeast Asia Terrorism Portal (SATP), do not explicitly state their methodology.

[16] I would like to thank Mr. Asif Khan, PhD Candidate, Department of Engineering, University of Cambridge for using the isohyetal method and compiling rainfall estimates.

Transparency in data collection methodology is a huge advantage of the BFRS dataset. It codes a broad range of information on 28,731 incidents of political violence in Pakistan from January 1, 1988 through May 2011. For each incident the dataset records the location (including district), consequences, cause, type of violence, and party responsible as specifically as possible (De Mesquita et al. (2013)). These data are derived from press reports in The Dawn, the major English language newspaper in Pakistan. The dataset highlights some measurement error concerns in coding attacks across province. As the study is based on household and district level data this is less of a concern.
BFRS defines terrorism as:

> "Premeditated, politically motivated violence perpetrated against noncombatant targets by sub national groups or clandestine agents (22 U.S.C. 2656f (d) (2)). For example, the attack on the Data Ganj Baksh shrine is such an example as the victims were primarily intended to be non-combatants. In contrast, an attack on a police check point is not considered to be terrorism even if civilians are harmed in the conduct of the attack provided that the primary target was the check point. This is coded as an attack on police, paramilitary or military target. The intended targets of the attacks is key[17]".

I aggregated the number of terrorist attacks upto a month and a year for each of the district-year, which gives the continuous variable of number of terrorist attacks. The dummy variable of terrorist attack takes a value of one for each district-year if there is even a single terrorist attacks within the geographical bounds of a district in a particular year, and zero otherwise.

5.2.3. *Data on Rural Labour Market Measure.* I use original rural household level employment data of the Household Integrated Economic Survey of Pakistan. The main reason for using rural rather than agricultural employment is that while agricultural employment only includes skilled agriculture workers or self cultivating subsistence farmers, rural employment also accounts for unskilled agricultural labour like cleaners and helpers etc. Therefore, agricultural employment data under-reports actual agricultural employment. Using rural rather than agricultural employment accounts for all the backward and forward linkage between agriculture and other related sectors in a rural economy. For instance, a small workshop designed to repair tube well or tractors for farmers will be indirectly effected by the productivity of the agricultural farm land. Excluding these workers under reports agrarian employment. [18]**.** Apart from rural household employment, data on household income was also compiled. Owing to non-availability of disaggregated inflation data, rural income is not treated as the main variable of interest.

HIES is a repeated cross section for five waves i.e. 1998, 2001, 2005, 2007 and 2010. The universe of Household Integrated Economic Survey consists of 98 percent of total population of Pakistan and includes all urban and rural areas of the four provinces as defined in the 1998 Population Census. FATA and military restricted areas are excluded. A stratified two-stage sample design is adopted for the survey. Villages/mouzas/dehs the lowest denomination or a block in the 1998 Population Census are considered as Primary Sampling Units (PSUs) for rural areas. The listed households of sample PSUs are taken as Secondary Sampling Units (SSUs). A random sample of 16 households from each rural PSU is selected and surveyed.

[17]Data Collection Methodology, BFRS Political Violence Data set (De Mesquita et al. (2013)).

[18]While compiling rural household employment data I drop those households that had the following occupations: armed forces, legislators and senior officials, physical mathematical, life sciences, teaching professionals, life science and health associate and teaching associate and professional.

There are 50,588 mouzas/villages/dehs in the rural sub-universe of the survey. In the rural areas, the population of each district in Punjab, Sindh and N.W.F.P Provinces has been grouped together to constitute a stratum. For Balochistan province each of administrative Division has been taken as a stratum.

The 1998 HIES had a sample size of 2268 households as secondary sampling units (SSU) . In 2001 the sample size was increased to 16,400 rural households. The 2004-05 HIES was conducted as part of first round of PSLM Survey covering 14708 households. The 2005, 2007 and 2010 HIES were carried out covering 15453, 15512 and 16341 households respectively. HIES is only nationally and provincially representative at the 95% level of confidence with 5% to 7% margin of error[19] (see appendix A8 for pseudo panel graphs of district rural employment).

The rural population, 10 years of age and over, that responded in the affirmative to the following question was used to compile household rural employment rate data for the years 1998, 2001,2005,2007 and 2010:

> "Did you do any work for pay, profit, or family gain during last month, at least for one hour on any day?"

The employment definition under the HIES survey is as follows:

> "A person is considered employed if he/she worked for at least one hour during the month preceding the interview or, even if did not work in the last month, he/she had a job or ran an enterprise such as shop, business, farm or service establishment during the last year." (Pakistan HIES 2005, p.13. Similar to the US Labour Department, reference period there is a week before the survey and the age of entry into currently active population begins at 16 in the US statistics.

Certain data related concerns need to be highlighted. Rural employment can simply capture seasonality if HIES is carried out in the harvesting and sowing season when there is a higher demand for labour. However, seasonality does not pose a challenge in this context. First, the survey is carried out in all districts simultaneously in four distinct quarters. Second, using annual data smoothes the peaks and troughs of employment that are induced by seasonality. There are two cropping seasons. "Kharif" and "Rabi". The sowing season of "Kharif" begins in April-June and harvesting during October-December; sowing of "Rabi" begins in October-December and ends in April-May[20]. Therefore, high labour demand in one quarter is followed by a lower one in the next quarter with the cycle repeating itself after 6 months.

5.2.4. *Data on Religious Charitable Donations or Zakat.* It would have been most useful to have district wise granular household level data on religious charitable donations or 'Zakat' paid to particular religious private organizations, relatives, other NGOs or government. Analysing the relationship of particular types of donations paid out with rural employment, rainfall shocks and violence would have added richness to the analysis and could have been used to isolate the mechanism in a more direct way. However, in the absence of such a granular dataset, in order to shed some light on the claimed underlying relationship between rural employment, rainfall, terrorist attacks and religious donations, I compiled rural household religious charitable donations data from the Household Integrated Economic Survey (HIES).

[19]Pakistan Bureau of Statistics various HIES/PSLM/PIHS reports.

[20]Economic Survey of Pakistan 2010 , p.15

The response to the following HIES questions was used to compile household level data on rural religious charitable donations paid out for the years 1998, 2001, 2005, 2007 and 2010**:**

> "During the last one year, did any member of the HH pay out to others , in cash or in kind?"

Certain data related concerns need to be highlighted. First of all this is stated 'Zakat' or religious charitable donations and might in fact vary from actual 'Zakat'. For instance, some households sometimes don't reveal the amount of 'Zakat' actually given as they find it to be a mark of impiety. On the other hand, other households might actually overstate the amount of 'Zakat' paid out. Apart from a desire to over or understate the amount of 'Zakat' there is also a natural recall bias that needs to be kept in mind. It would have been most useful to have a measure that bifurcates donations in cash and kind. However, in the absence of such a data I use religious charitable donations as a dummy variable that turns on one if a household gave religiously motivated donations in a particular year. I do not use the amount donated data owing to recall bias and lack of price level data for each village or district-year.

5.2.5. *Data on Religiosity.* In order to get a sense of the cross sectional variation in religious beliefs across districts I compiled a measure of religiosity. As a first step I characterised parties as religious through a study of the agenda and manifesto of each political party in Pakistan. Those parties that specifically follow a religious agenda were characterised as religious political parties in Pakistan. For instance Jamaat-i-Islami specifically states in its manifesto that it wants to establish an Islamic State on the model of the Islamic State under the prophet of Islam. While other parties might indirectly refer to an Islamic State only those that aim to specifically set up a particular kind of religious state through their politics, were characterised as religious political parties. I used election results 2013 to compile data on the number of votes cast in each district for religious parties as a fraction of total votes cast in a district. Using 2013 elections results allows to overcome any endogeneity from endogenous classification of religiosity.

The average district in a year has a mean rainfall of 37.29 mm with a standard deviation of 29.24. This suggests that there is sufficient exploitable variation in rainfall. If we look at rainfall deviation from 'Normals' we can see that rainfall has been on average 2.94 mm above the 'Normals'. The standard deviation is 12.424 points. The probability of a terrorist attack on average is 0.529. This shows that an average district in a year in Pakistan experiences a terrorist attack 52.9 percent. The mean number of terrorist attacks in a district-year is approximately 3.5. The variation in terrorist attacks is potentially sufficient to base this study on Pakistan. An average rural household is employed 40.1 percent of time in a year. The variation around the mean is 0.490 percent which again suggest the existence of exploitable variation. Mean total donations received in a given year by rural households is less than mean total donations paid out suggesting potential inefficiency in the system or some 'Zakat' or donations leaking out of the system. In addition, mean household 'Zakat' received by households from public sector is greater than 'Zakat' received from private sector. This trend is reversed in 'Zakat' paid out. A mean household 'Zakat' of Rs. 19.5 is paid to public sector versus a mean household 'Zakat' of Rs. 401.75 to the private sector. The probability of a household paying out religious donations is 0.155, while probability of receiving donations is 0.017.

Table 2. Descriptive Statistics

	Mean	Min	Max	Std Dev	N
District Rainfall	37.29	1	135	29.2400	400 dist-yr
District Rainfall Deviations from PMD Normals	0.294	-107	39	12.424	400 dist-yr
District Terrorist Attacks Dummy	0.529	0	1	0.499	400 dist-yr
District No. of Attacks	3.506	0	86	10.407	400 dist-yr
Household Rural Employment Dummy	0.401	0	1	0.490	192789
Religiosity- Votes cast for religious parties as a percentage of total votes cast (2013)	5.47	0	26.782	7.176	400 dist
Household Religious Charitable Donation Received					
Donations Binary	0.017	0	1	0.129	192,960
Govt. Donations (Rs.)	56.276	0	60,000	1113.53	136,147
Pvt. Donations (Rs.)	80.401	0	160,000	1656.21	136,147
T. Donations Received (Rs.)	117.602	0	162,400	1762.156	192,960
Household Religious Charitable Donation Paid					
Donations Binary	0.1549	0	1	0.3618	192,960
Govt. Donations (Rs.)	19.583	0	80,000	779.93	136,147
Pvt. Donations (Rs.)	401.751	0	100,000	2566.66	136147
T. Donations Paid (Rs.)	464.87	0	100,000	2479.46	192960

Note: The dataset is for the years 1998, 2001, 2005, 2007 and 2010. Panel Data on annual district level rainfall in Pakistan is compiled from the Pakistan Meteorological Department (PMD) gauge station data using isohyetal method. Panel district level dataset on terrorist attacks is from BFRS Dataset on political violence. Employment and Religious Charitable Donations or Zakat is household level repeated cross section data compiled from Household Integrated Economic Survey of Pakistan.

6. Results

If the theoretical propositions are true then empirically the following should hold:

(1) The overall effect of an exogenous employment shock on religious charitable donations should be heterogeneous $\frac{\partial D}{\partial Emp} = f(religiosity)$

(2) Areas which are less religious should be paying out little or no religious charitable donations and hence the main channel of a rural household employment shock on terrorist violence should be that of the opportunity cost channel i.e. $\frac{\partial A}{\partial R}<0$ This effect (if the finance channel is strong enough) should reverse in areas with a more religious population i.e. $\frac{\partial A}{\partial R} > 0$. In short, $\frac{\partial A}{\partial R} = h(religiosity)$.

6.1. **Relationship between Household Employment and Religious Charitable Donations.** In the absence of granular data on charitable donations to militant and benign charities I characterise religious donations as a dummy that turns on one if there have been religious charitable donations by a household in a particular year and zero otherwise. I do not use amount of donations data as disaggregated price data in not available for Pakistan and there will be recall bias in the amount of religious charitable donation.

I would like to highlight that religiosity is characterised by percentage of votes cast for religious parties as a percentage of total votes cast in 2013 general elections. The idea is to use a classifier that is not endogenously determined. Unless expected religiosity effects

individual household decisions to donate, endogeneity stemming from religiosity is less of a concern.

Table 3. OLS Regression of Household Religious Charitable Donations and Rural Employment

	HH Religious Donations Paid Dummy (1) OLS	HH Religious Donations Paid Dummy (2) OLS	HH Religious Donations Paid Dummy (3) OLS
Rural HH Emp	-0.0149***	.0003	-0.0009
	(0.0016)	(0.0016)	0.0020
Religiosity		0.0095***	0.0094***
		(0.0001)	(0.0001)
Religiosity*HH Emp			0.0002
			(0.0002)
Observations	192789	185026	185026
Time FE	Yes	Yes	Yes

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Religious charitable donation is a dummy that turns on one if a household gave religious donation in a particular district-year. Rural household employment is a dummy that turns on one if a household was employed in a district-year. Religiosity stands for the percentage of votes cast for religious parties in a district-year as a fraction of total votes cast in 2013 general elections. All specifications include time fixed effects.

6.1.1. *OLS Estimation.* OLS estimation exploits across household variation in donations and employment. Results in table 3, specification (1) suggests that contrary to theoretical predictions, as the household becomes employed the probability of paying out religious charitable donations decreases by 0.015. This effect disappears when we allow the effect to depend on the religiosity of the population. The OLS results suggest that religiosity is a strong predictor of religious charitable donations. A one percentage point increase in votes to religious parties is correlated with an increase in religious charitable donations of approximately one percentage point.

The OLS results suffer from endogeneity concerns. For instance it is possible that the quality of state institutions is such that individuals feel it imperative to donate and help around. The quality of state institutions will also have natural ramifications for the labour market and the way that it functions. Following the theoretical section let θ_d be religiosity of a district.

6.1.2. *Instrumental Variables Estimation.* Owing to endogeneity concerns I estimate the following two stage least squares estimates using across household variation:

$Emp_{idt} = \gamma_t + \gamma_1\theta_d + \gamma_2 R_{dt} + \gamma_3\theta_d * R_{dt} + \varepsilon_{idt}$: (First Stage-I)
$\theta_d * Emp_{idt} = \eta_t + \eta_1\theta_d + \eta_2 R_{dt} + \eta_3\theta_d * R_{dt} + \varepsilon_{idt}$: (First Stage-II)
$D_{idt} = \delta_t + \delta_1\widehat{Emp_{idt}} + \delta_2\theta_d + \delta_3\theta_d * \widehat{Emp_{idt}} + \Phi_{idt}$: (Second Stage)

The identifying assumption is $E(\Phi_{idt}, R_{dt}, \theta_d, \theta_d * R_{dt}) = 0$.

Table 4 reports results. The use of the variable religiosity that is constant over time for all districts does not permit the use of a district fixed effects specification. The assumption is

that all unobserved heterogeneity is captured by religiosity. Table 4, specifications (1) and (2) reports results using the entire sample of households. Results in the first stage suggest that a 1 mm above PMD 'Normals' rainfall leads to an increase in the probability of a household being employed of 0.001. With a rain dependent rural-agriculture sector that is fraught with drought and water shortage this does not seem very surprising. There have been droughts in Pakistan from 1998-2002, 2004-05 and middle of 2009 to 2010[21]. Thus, it appears logical that a positive rainfall deviation leads to an increase in rural household employment. The effect of rainfall on household employment is negative conditional for the more religious district. A district classified as religious also has a lower employment level than a less religious district.

The F-Stat is 34.16 with a p-value of 0. Staiger and Stocks (1997) recommend declaring instruments to be weak if the first stage F-Statistic is less than 10. The F-Stat suggests that there is evidence against a weak instrument problem. The F-Stat is lower for the first stage that instruments for the interaction term religiosity and employment. Only religiosity predicts this interaction term in the first stage.

Second stage results suggest that although the positive effect of employment on donations is mediated through religiosity, the effect is not strong enough for the entire sample. The overall probability of an employed religious household paying donations is -0.8653. As predicted the overall effect of religiosity on donations is positive. The overall negative effect implies that economic conditions for some households in the sample are such that a binding religiosity constraint is not enough to allow an overall positive relationship between employment and donations. As Zakat is due on income that is left over after paying for basic needs, if the earned income is low there should be no relationship between employment and donations despite being religious. The positive effect of employment on donations for the more religious should start to take effect only when income exceeds a threshold.

To see whether that holds, specifications (3)-(6) reports results after bifurcating the sample into top 20 percent of cash income households and subsistence farmers. The threshold income is Rs. 80,000. The definition of a subsistence farmer is standard. We see that the negative direct effect of household employment on religious donations does not hold for the top 20 percent of income households. For the religious household on becoming employed the probability of religious charitable donations increases by 0.2727. The overall effect of religiosity on donations is positive mediated through employment.

Specifications (5) and (6) presents results for subsistence farmers. These households have no extra income to pay religious donations. This is irrespective of religiosity. As expected there is no relationship of rainfall, religiosity or employment with religious charitable donations. These results are in line with the predictions.

6.2. **Rural Household Employment Shocks and Terrorist Attacks.**

6.2.1. *OLS Estimation.* The OLS estimation exploits across households-districts. Results in table 5, specifications (1) and (2) suggest that employment reduces the probability of a terrorist attack by 0.0098 and the number of terrorist attacks by 1. Results are suggestive of a dominant opportunity cost channel of terrorism. Specifications (3) and (4) suggests that conditional on religiosity of districts the effect is robust. A religious district is less likely to experience attacks.

[21]'History of drought in Pakistan', Pakistan Weather Portal, 2011

Table 4. IV Regression of Household Religious Charitable Donations and Rural Employment

	HH Religious Donations Paid (1) All HH	HH Religious Donations Paid (2) All HH	HH Religious Donations Paid (3) Top 20percent Income-wise	HH Religious Donations Paid (4) Top 20percent Income-wise	HH Religious Donations Paid (5) Subsistence Farmers	HH Religious Donations Paid (6) Subsistence Farmers
Rural HH Emp	-0.9824***	-0.9824***	-0.4348	-0.4348	-83.6142	-83.6142
	(0.2689)	(0.2689)	(0.7385)	(0.7385)	(219.53)	(219.53)
Religiosity	-0.033**	-0.033**	-0.0666**	-0.0666**	-38.143	-38.143
	(0.0186)	(0.0186)	(0.0356)	(0.0356)	(82.935)	(82.935)
Religiosity*HH Emp	0.1171**	0.1171**	0.2727**	0.2727**	38.185	38.185
	(0.0673)	(0.0673)	(0.1512)	(0.1512)	(82.973)	(82.973)
Anderson-Rubin Wald Test	141.12	141.12	145.89	145.89	90.81	90.81
(p-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
	Rural HH Emp	Religiosity* HH Emp	Rural HH Emp	Religiosity* HH Emp	Rural HH Emp	Religiosity* HH Emp
Panel A: First Stage	(1)	(2)	(3)	(4)	(5)	(6)
Rainfall Deviation	0.001***	-0.0018	0.0009***	-0.0029**	0.00003	-0.0001
	(0.0002)	(0.0013)	().0002)	(0.0013)	(0.00009)	(0.0006)
Religiosity	-0.0074***	0.3020***	-0.0071***	0.2670***	0.00009	0.9995***
	(0.0002)	(0.0014)	(0.0002)	(0.0014)	(0.00008)	(0.0005)
Religiosity*Rainfall Deviation	-0.00003**	-0.0001	-0.00003**	-0.00005	1.19e-06	0.00002
	(0.00001)	(0.0001)	(0.00001)	(0.0001)	(7.25e-06)	(0.00005)
F-Stat	34.16	7.41	23.95	7.97	0.36	0.06
(p-value)	(0.0000)	(0.0006)	(0.0000)	(0.0003)	(0.6967)	(0.9401)
Observations	185026	185026	169056	169056	6480	6480
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Religious charitable donation is a dummy that turns on one if a household gave religious donation in a particular district-year. Rural household employment is a dummy that turns on one if a household was employed in a district-year. Religiosity stands for the percentage of votes cast for religious parties in a district-year as a fraction of total votes cast in 2013 general elections. Income-wise top 20 percent of the sample was classified after tabulating data on cash income per household per year. The threshold income is Rs. 80,000. The definition of a subsistence farmer is standard. Panel A and B report first and second stage results respectively.

Specifications (5) and (6) aims to capture the channel described in the paper. If religious donations is really a channel of economic shocks on terrorism then, conditional on having income above basic needs, the more religious the population the more positive should be the effect of employment on terrorism. We see just the opposite in the case of probability of terror attack. The case of terrorist attacks intensity is more in line with what has been argued. Although the overall effect remains negative, the more religious districts tend to have a positive effect of employment on intensity of attacks. This is in line with the theoretical and empirical predictions.

Having said that the effect is still not causal due to endogeneity concerns stemming from omitted variables or reverse causality. I next discuss the instrumental variables estimation strategy that attempts to overcome these concerns.

6.2.2. *Instrumental Variables Estimation.* With the use of district fixed effects table 6, specifications (1) and (2) uses within district, across household variation in employment. Results

Table 5. OLS Regression of Rural Household Employment and Terrorist Attacks

	Terrorist Attack Dummy (1) OLS	Terrorist Attacks Intensity (2) OLS	Terrorist Attack Dummy (3) OLS	Terrorist Attacks Intensity (4) OLS	Terrorist Attack Dummy (5) OLS	Terrorist Attacks Intensity (6) OLS
Rural HH Emp	-0.0098***	-1.0146***	-0.009***	-0.7644***	-0.0033	-0.8640***
	(0.0023)	(0.0478)	(0.0024)	(0.0496)	(0.0029)	(0.0614)
Religiosity			-0.0017***	0.1770	-0.0013***	0.1703***
			(0.0002)	(0.0034)	(0.0002)	(0.0042)
Religiosity*HH Emp					-0.0011***	0.0197***
					(0.0003)	(0.0072)
Observations	192789	192789	185026	185026	185026	185026
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Terrorist Attacks is a dummy that turns on one if there has been a terrorist attack in a district-year. The number of terrorist attacks or the intensity of terrorist attacks counts the number of terrorist attacks in a district-year. Rural household employment is a dummy that turns on one if a household was employed in a district-year. Religiosity stands for the percentage of votes cast for religious parties in a district-year as a fraction of total votes cast in 2013 general elections. All specifications include time fixed effects.

in specifications (1) and (2) are consistent with the opportunity cost channel of terrorism. Employment reduces the probability of a terrorist attacks. With a coefficient outside the [0,1] boundary, till a non linear treatment of the effect, attention can be focused on the continuous variable terrorist attacks intensity. As the household switches into employment, the number of terrorist attacks reduce by approximately 42 attacks. This is economically a very large effect. This result is in sharp contrast to the literature that suggests that economic conditions are not directly correlated with the onslaught of terrorism (Krueger and Malecˇkova (2003); Abadie (2006); Piazza (2006); Krueger (2007); Krueger and Laitin (2008); Berrebi (2007)). Using rainfall induced exogenous variation the effect is also much larger as compared to OLS. The first stage F stat is 24.54 which suggests against a weak instrument problem. Rainfall in the first stage also leads to an increase in the probability of employment of the household.
The variation exploited, in specifications (3)- (6), is across households. As before, the assumption is that all unobserved heterogeneity is captured by religiosity. The model is exactly identified. Results in specification (3) - (6) suggests that the effect of employment on terrorist attacks depends on the religiosity of the populace. For those districts that are religious the overall effect is in fact positive and large for both terrorist attacks dummy and intensity. This is in line with the theoretical predictions. The first stage suggests that a 1 mm above PMD 'Normals' rainfall leads to a 0.1 percentage point increase in the probability of rural household employment. The overall effect of rainfall conditional on religiosity remains positive. The more religious district have a lower employment. The F-test of excluded instrument is 34.16 with a p-value of 0 which suggests against a weak instrument problem. The F-Stat is lower for the other first stage.

I also report Anderson and Rubin (1949) Wald test which is robust to the presence of weak instruments and seem to have the correct size under a wide variety of violations of the standard assumptions of IV regression (Stock and Yogo (2005)). The Wald test rejects the hypothesis that the coefficient of interest does not enter the reduced form regression consistent with the theoretical predictions.

Table 6. IV Regression of Rural Household Employment and Terrorist Attacks

	Terrorist Attack Dummy (1)	Terrorist Attacks Intensity (2)	Terrorist Attack Dummy (3)	Terrorist Attacks Dummy (4)	Terrorist Attack Intensity (5)	Terrorist Attacks Intensity (6)
Rural HH Emp	-4.8359***	-42.2843***	0.2914	0.2914	11.549	11.549
	(0.9895)	(8.8767)	(2.3715)	(2.3715)	(61.43)	(61.43)
Religiosity			-0.3421**	-0.3421**	-8.5345**	-8.5345**
			(0.1639)	(0.1639)	(4.2458)	(4.2458)
Religiosity*HH Emp			1.1377**	1.1377**	29.2283**	29.2283**
			(0.5932)	(0.5932)	(15.3658)	(15.3658)
Anderson-Rubin						
Wald Test	923.99	291.38	618.66	618.66	867.21	867.21
(p-value)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
	Rural HH Emp	Rural HH Emp	Rural HH Emp	Religiosity* HH Emp	Rural HH Emp	Religiosity* HH Emp
Panel A: First Stage	(1)	(2)	(3)	(4)	(5)	(6)
Rainfall Deviation	0.0006***	0.0006***	0.001***	-0.0018	0.001***	-0.0018
	(0.0001)	(0.0001)	(0.0002)	(0.0013)	(0.0002)	(0.0013)
Religiosity			-0.00735***	0.3020***	-0.00735***	0.3020***
			(0.0002)	(0.0014)	(0.0002)	(0.0014)
Religiosity*Rainfall Deviation			-0.00003**	-0.0001	-0.00003**	-0.0001
			(0.00001)	(0.0001)	(0.00001)	(0.0001)
F-Stat	24.54	24.54	34.16	7.41	34.16	7.41
(p-value)	(0.0000)	(0.0000)	(0.0000)	(0.0006)	(0.0000)	(0.0006)
Observations	192789	192789	185026	185026	185026	185026
District FE	Yes	Yes	No	No	No	No
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Terrorist Attacks is a dummy that turns on one if there has been a terrorist attack in a district-year. The number of terrorist attacks or the intensity of terrorist attacks counts the number of terrorist attacks in a district-year. Rural household employment is a dummy that turns on one if a household was employed in a district-year. Religiosity stands for the percentage of votes cast for religious parties in a district-year as a fraction of total votes cast in 2013 general elections. All specifications include time fixed effects.

6.3. **Robustness Checks - Reduced Form Relationship of Rainfall Shocks and Terrorist Attacks.** Next I estimate a reduced form relationship using district level data on terrorist attacks and rainfall shocks. I estimate:

$$A_{dt} = \psi_d + \psi_t + \psi_1 Rainfall_{dt} + \psi_2 F_{dt} + \phi_{dt}$$

where A_{dt} stands for terrorist attacks and F_{dt} captures all control variables at a district d and year t level. With district level data the specification exploits within division-year variation in rainfall shocks. The identifying assumptions are as described in section 5.

Results in table 7, specifications (1) and (2) suggest that a 1 mm above 20-30 year average rainfall within a district-year potentially results in a decrease in the probability of a terrorist attack of 0.25 percentage points. The number of terrorist attacks also decreases by 0.0693. Results are consistent with the opportunity cost channel as the dominant channel of terrorist

violence. Specifications (3) and (4) include district fixed effects. Results remain robust with a slight reduction in magnitude of the coefficient on the terrorist attack intensity. Results are as in the IV estimation in table 6.

It can be argued that when on a negative rainfall shock farmers invest in substitute agricultural inputs like irrigation, fertilizers etc. to bolster production. In addition, it is also possible that to send a greater signal, terrorists choose to increase violence when investment increases. I therefore include district level fertilizer consumed, agricultural electricity consumers, irrigated and cropped area as proxies for greater rural investment.

It has also been argued in the literature that the income effect of a rainfall shock leads to a higher fertility level (Iyer and Weeks (2009)). A bigger family means a bigger burden. This affects employment probability of a household. A bigger population also means a soft target for terrorism. I therefore also include population estimates of districts as well as percentage of population married.

Another concern for identification can be that above average rainfall in fact makes it harder easier for terrorists to go undetected and therefore they can reach more areas of the district, leading to a direct effect on terrorist attacks (Fearon and Laitin (2003)). The effect of a rainfall shock here is negative. The argument here is more in line with the possibility that rain shocks reduce the probability of terrorists reaching greater geographical areas effecting both employment and attacks. I control for total kilometres of low quality roads to capture terrorists' geographical reach.

Migration can be another identification challenge. For instance, if a positive rainfall shock attracts a lot of migrants within the district this can result in a greater pressure on existing jobs and thus a lower probability of an individual finding a job. A greater number of in-migrants again present a soft target for the terrorists. Migration, however, appears to be less of a concern in the context of this study. First, inter-district migration rates of the rural population are low (see appendix A**5**). Second, rainfall patterns are positively correlated across districts at least within the four main provinces (see appendix A6 (i) Figure A1, for the isohyetal map of Pakistan). Despite that I include percentage of the rural population that has been living in the same district since birth.

Results remain robust to the inclusion of all the above control variables. Specifications (5) and (6) suggest that a 1 mm above 20-30 year average rainfall potentially results in a decrease in the probability of a terrorist attack of 0.31 percentage points. The number of terrorist attacks decreases by 0.032[22].

7. Identification Concerns

7.1. **The Structural Relationship between Rainfall, Rural Employment, Religiosity and Terrorist Attacks - Potential Concerns.** If there are other equally valid intervening structural relationships between rain-induced rural employment shocks and terrorist attacks then that can be a challenge for identification. One of these can be the use of other tactics by terrorist organisations to raise funds. Empirical evidence suggests that terrorists sometimes engage in criminal activity like extortion of property and goods to raise funds. For this to be a problem for identification this has be be correlated with rainfall shocks at

[22]Details of all additional controls with their data source, level of disaggregation is provided at appendix Table A1.

Table 7. Reduced Form- Rainfall Shocks and Terrorist Attacks

	Terrorist Attack Dummy	Terrorist Attacks Intensity	Terrorist Attack Dummy	Terrorist Attacks Intensity	Terrorist Attack Dummy	Terrorist Attacks Intensity
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	FE	FE	FE	FE
Rainfall Deviation	-0.0025***	-0.0693***	-0.0029***	-0.0254***	-0.0031***	-0.032***
	(0.00009)	(0.0022)	(.0001)	(0.0019)	(0.0001)	(0.0018)
Observations (dist-yr)	400	400	400	400	400	400
Other Controls	No	No	No	No	Yes	Yes
District FE	No	No	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Terrorist Attacks is a dummy that turns on one if there has been a terrorist attack in a district-year. The number of terrorist attacks or the intensity of terrorist attacks counts the number of terrorist attacks in a district-year. Rural household employment is a dummy that turns on one if a household was employed in a district-year. Religiosity stands for the percentage of votes cast for religious parties in a district-year as a fraction of total votes cast in 2013 general elections. Specification (5) and (6) includes rural inter-district migration rate, population estimates and population married estimates, district level fertilizer consumed, agricultural electricity consumers, irrigated and cropped area and total low quality roads. All specifications include time and district fixed effects.

a within district year level. To directly check for this relationship, I use BFRS data on organized gangs extortion of money, property and goods at a district-year level for 1997-2010. I directly check for its correlation with rainfall shocks in a fixed effect specification. Results (not reported) suggest that there is no relationship between rainfall shocks and criminal violence like extortion.

It might also be possible that as labour market tightens in a religious context, it is also more feasible to set up seminaries that espouse radical ideas thereby radicalising the populace and leading to increased terrorist attacks. I directly check for the relationship between rainfall shocks and religious seminaries. There is no direct effect of rainfall shocks on religious seminaries at a within district year level. However, data on religious seminaries only includes registered seminaries and is mostly missing for one province i.e. Sindh. This remains a concern if we consider unregistered seminaries.

Another concern can be that of cost of information for counter-terrorist forces. The cost of obtaining counter-terrorist information rises as the rural labour market becomes tight on a positive rainfall shock resulting in an increase in terrorist attacks (Kalyvas (2006); Berman, et al. (2008, 2011)). However, for this to be a problem the cost of information should also be systematically higher for more religious districts. There is no apriori reason to suggest that. In addition, the overall effect is negative.

Another concern can be reduced presence of security establishment i.e. above average rainfall shocks can obstruct the establishment of checkpoints by the security establishments. This reduced security machinery on the one hand can potentially reduce disruption of the economy, and on the other cause an increase in the production of violence (Hendawi (2008)). For this to be a concern, the security establishment response to rainfall shock in religious districts should systematically be different from non religious districts. This appears less realistic. Fresh military movement into areas, say for example in Swat in KPK in May 2009, is the result of socio-political reasons and is potentially mean independent of religiosity classification of districts. In addition, the overall effect is negative.

Rationality dictates that they would increase the intensity of fund-raising activity if there is a positive rainfall shock in the more religious districts. In the context of this study, the

challenge from intensive fund-raising activity of State 'Zakat' institutions remains limited. In fact, the biggest chunk of State 'Zakat' is automatically collected through direct deduction from the income of the salaried class (Chodhry(2012)). Although the intensity of militant fund-raising remains unobserved their intensity of fund-raising is mostly dictated by the ease with which they can operate (Haider (2010)). The bigger concern is from the intensity of fund-raising activities of private benign charities. In the absence of district level fund-raising activity data identification rests on the assumption that the intensity of benign fund-raising is mean independent of rainfall shocks.

Other important concerns include 'Zakat' to militant charities from the Middle East, particularly Saudi Arabia. Preliminary evidence on financial channel of terrorism suggests that it is one of the main actors providing religious charitable donations to militants. It is also possible that these funds are systematically sent to the more religious districts in Pakistan. However, this is less of a concern as evidence suggests that the operation of international terror financing is potentially mean independent of rainfall shocks at a within district-year level in Pakistan.

If government tightens security and levies more checks and balances, the ability of the terrorist organizations to raise funds is diminished. For instance, the State Bank of Pakistan (SBP) Financing of Terrorism Regulations (2012). Such regulations, if differentially implemented with a rainfall shock in a more religious district, can potentially prove to be an identification concern for the study. However, these do not pose a challenge in this context as such regulations are implemented country-wide, irrespective of religiosity and rain shocks.

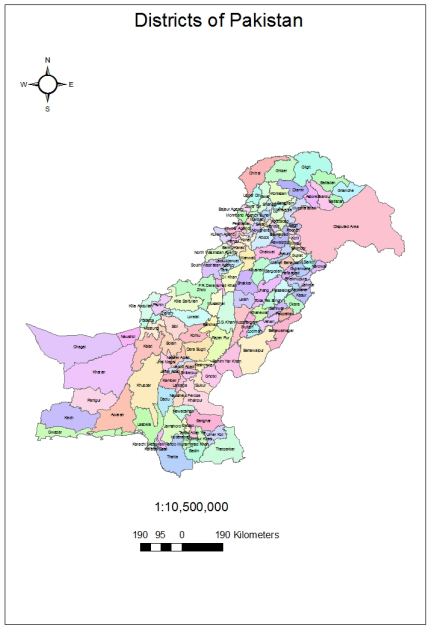
8. Conclusion

This paper proposed a new channel of employment shocks and violence i.e. charitable donations channel. The theoretical predictions of the model were tested using data from Pakistan. Basing this study on Pakistan with a 62 percent rural economy and a vibrant religious donations market with militant presence, has aided identification and the exploration of this channel. The theoretical effect of an exogenous rainfall shock on terrorist attacks is ambiguous depending on the relative strength of the religious donation or opportunity cost channel of violence. Results suggest that opportunity cost is the more dominant channel. In contrast to the literature, I find that as the household switches into employment, the number of terrorist attacks reduce by approximately 42 attacks. This is an economically large effect. In line with theoretical predictions, I also find that the effect of employment on terrorist attacks depends on the religiosity of the populace. For those districts that are religious the overall effect is in fact positive and large for both terrorist attacks dummy and intensity.

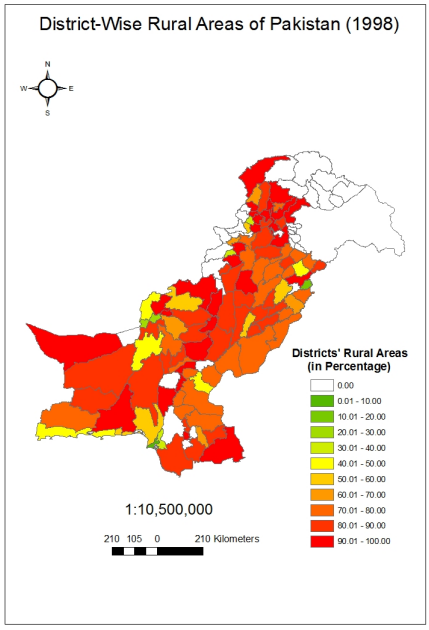
The donations channel of attack should hold equally in societies that have a charitable norm for secular charity or where there are not enough natural resources to be exploited by militants to raise funds. Future research can explore this heterogeneity further. The general equilibrium implications of having more productive militant charities or allowing for part-time terrorist activity can be another dimension to explore. Future research should design ingenious ways to collect data and estimate structural parameters.

This study suggests that counter-terrorism attention should be focused on isolating and drying out terrorist financing. Advocacy campaigns which promote a more informed charitable giving behaviour and which highlight the militant nature of charities can be a way forward. Another would be to create a licensing requirement for religious charities.

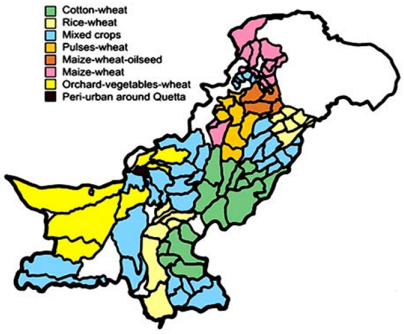
Appendix A1 Districts of Pakistan



Appendix A2 District Level Percentage of Rural Areas of Pakistan 1998 Census

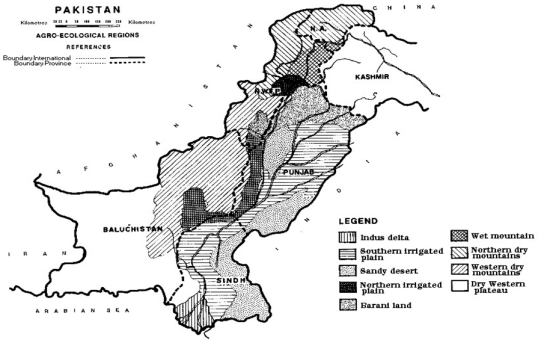


Appendix A3 Cropped Areas of Pakistan



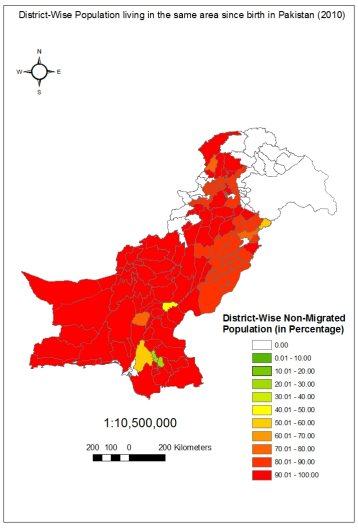
Crop Producing Regions (scale = 1:7 000 000)

Appendix A4 Irrigated Areas of Pakistan



Source: Food and Agricultural Organization

Appendix A5 Population Living in the same District since Birth (Percentage) 2010



Appendix A6 (i) Details of Rainfall Estimation Strategy

Rainfall data (1997-2010) has been obtained from PMD and average annual rainfall Isohyetal map is provided in Fig 1, which shows spatial distribution of rainfall throughout Pakistan. To devise a criterion for spatial interpolation of rainfall distribution for districts that do not have any gauge station or has some missing data, following procedure has been adopted. Gujrat has been selected as test case, where no gauge station is available. Its geographic location is provided in Fig 2. All periphery meteorological stations are shown in Fig 3, which shows all possible nearest stations from where one can spatially interpolate rainfall data for Gujrat. Isohyetal map for average annual rainfall over Gujrat is shown in Fig 4, which shows a number of Isohyets passing through the region, ranging from 95 to 120 mm. For simplification and quick selection of an appropriate average Isohyet for Gujrat, centroid of district area (shown by red asterisk) has been calculated using ArcGIS and provided in Fig-5. Centroid of region and Isohyets passing through Gujrat district area, are provided in Fig 6, which show nearest Isohyet with the centroid is 105mm (average annual rainfall over Gujrat). Hence in that year, the average annual rainfall over Gujrat is 105 mm.

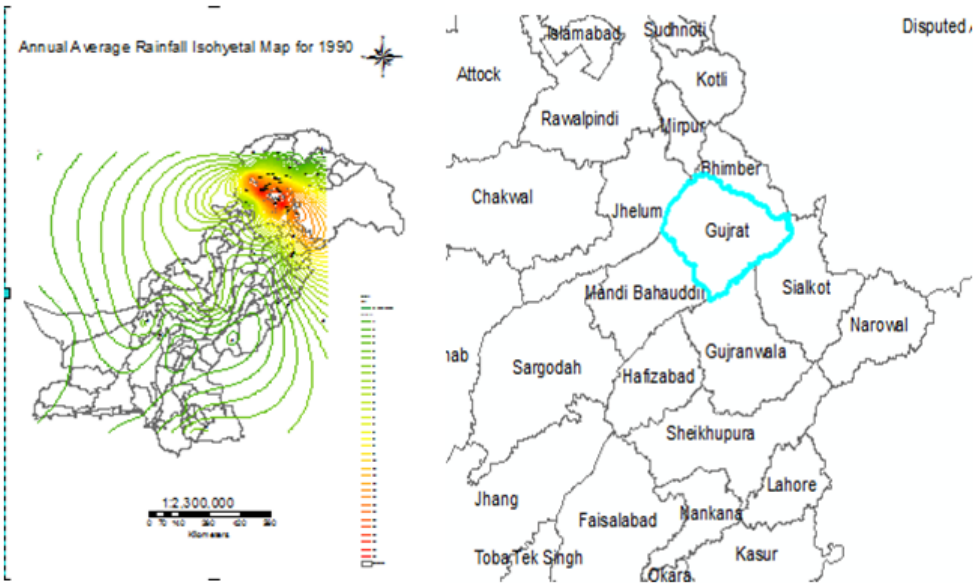


Figure A1. Average Rainfall Isohyetal Map; Figure A2. Geographic location of Gujrat

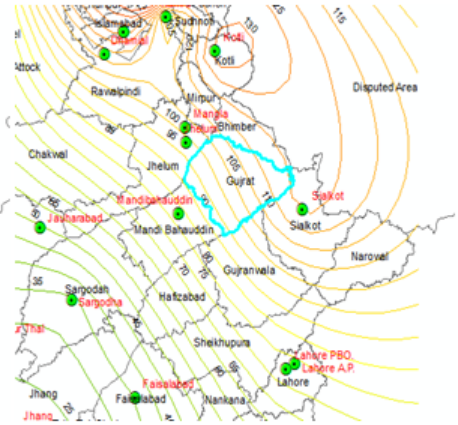


Figure A3: Peripheral Meteorological Stns; Figure A4: Isohyets passing through Gujrat

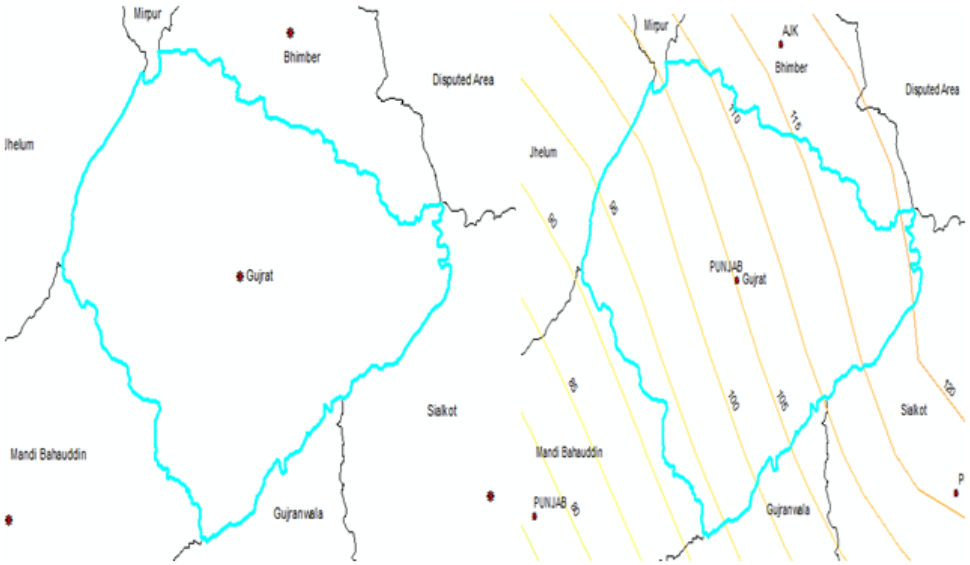
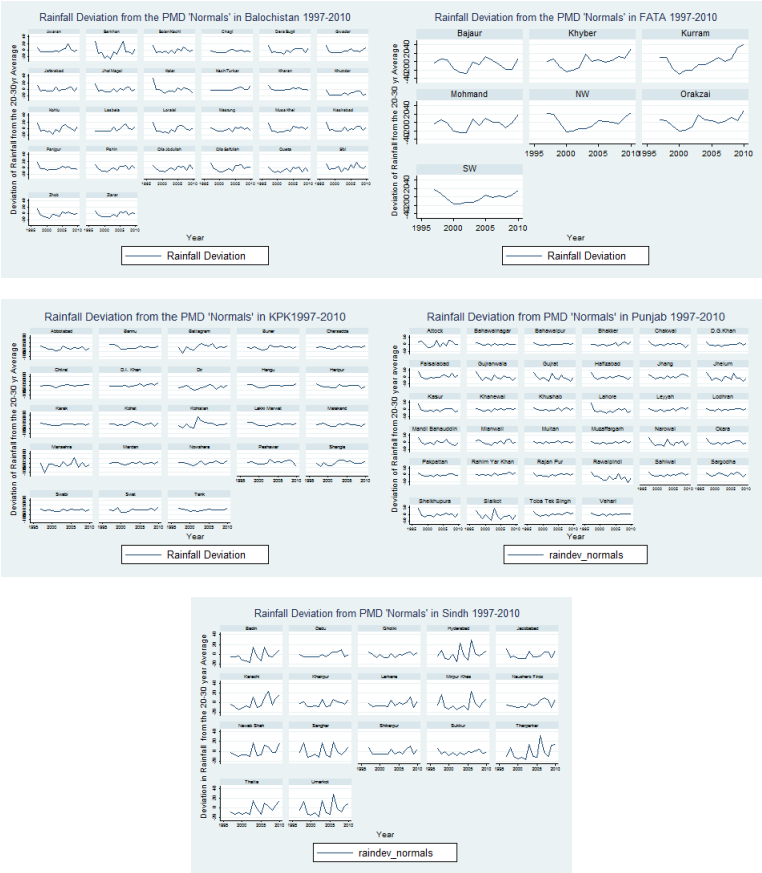
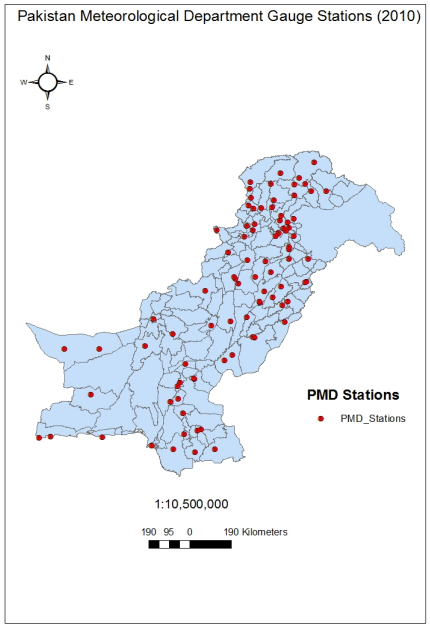


Figure A5: Centroid of Gujrat extracted; Figure A6: Isohyetal Map & Gujrat's Centroid

Appendix A6 (ii) Rainfall Deviation from PMD 'Normals'



Appendix A7 Pakistan Meteorological Department (PMD) Gauge Stations



Appendix A8 District Level Rural Employment in Pakistan 1997-2010

Appendix Table A1: Details of Control Variables

It may be pertinent to mention that for the years 1998, 2001, 2005, 2007 and 2010 many districts have been split to form new districts[23] . I merge districts back into their parent district to create a balanced panel. For continuous variables I use the ratio of each district's area as a percentage of total area as reported by Survey of Pakistan, to create adjusted values. Using the ratio of population across the parent and new district might have been a better way especially for continuous variables. However the last population census was held in 1998 and most of these districts were created post 2003.

[23]Nankana was created from Sheikhupura district in Punjab in 2005. Chiniot was created from Jhang in 2009. Jacobabad, Larkana and Dadu districts in Sindh were bifurcated to form Kashmore Kamber/Shahdat Kot and Jamshoro in 2004. From Hyderabad district were created Matiari, Tando Allah Yar, Tando Muhammad Khan and Hyderabad in 2005. Harnai in Balochistan was created from Sibi in 2007, Washuk from Kharan in 2007 and Sherani from Zhob in 2006. Nushki is treated as part of Chagi district. Lower and Upper Dir in KPK were created from Dir in 2001.

Control Variables	Punjab	Sindh	Balochistan	KPK	FATA
Level at which data available					
Other Agricultural Inputs					
Irrigated area*	District	District	District	District	Tribal Agency
Cropped area*	District	District	District	District	Tribal Agency
Fertilizer consumption*	District	District	District	District	Tribal Agency
Agri-electricity consumers*	Provincial***	Provincial***	Provincial***	District	Tribal Agency
Total low quality road km*	District	District	District	District	Tribal Agency
Population estimates^	District	District	District	District	Tribal Agency
Percentage of pop married**	Rural Area	Rural Area	Rural Area	Rural Area	NA
Percentage of population**					
living in the same district					
since birth	Rural Area	Rural Area	Rural Area	Rural Area	NA

* Source: Development Statistics of the four provinces and FATA

** Source: Survey data of Labour Force Survey 1997-2010

***NB: Provincial/divisional average is used for all districts, on the assumption that the value is not systematically different for districts within the province/division

^NB: District level projected estimates using 1981-1998 intercensal district level population growth rates. Source: 1998 Population Census of Pakistan

^^NB: A lot of missing values

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