In Vaccines We Trust? The Effects of the CIA's Vaccine Ruse on Immunization in Pakistan

Monica Martinez-Bravo
CEMFI, BREAD, CEPR

Andreas Stegmann
University of Warwick

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Vaccine Skepticism & Misconceptions on the Rise

- Vaccines behind some of the largest improvements in human wellbeing
- Vaccine skepticism is on the rise
  - 42% of Americans said they won't take the covid-19 vaccine in Oct 2020
- Fuelled by anti-vaccine movement and religious extremism (Afghanistan, Pakistan, Nigeria)
- Trust in health providers and vaccines is key for acceptance.

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Vaccines: Low trust in vaccination 'a global crisis'

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Measles outbreak across Europe

28 March 2017 | Health Share

SPL

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Vaccine Skepticism & Misconceptions on the Rise

- Vaccines behind some of the largest improvements in human wellbeing
- Vaccine skepticism is on the rise
  - 42% of Americans said they won't take the covid-19 vaccine in Oct 2020
- Fuelled by anti-vaccine movement and religious extremism (Afghanistan, Pakistan, Nigeria)
- Trust in health providers and vaccines is key for acceptance.
- How does **information discrediting health services** affect the **vaccination rates**?

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We Exploit the 2011 CIA Vaccine Ruse

- The CIA got intelligence suggesting Bin Laden was hiding in Pakistan
- The CIA organized a fake vaccination campaign to get DNA from kids in the compound
- They recruited a Pakistani physician, who conducted vaccinations in the area.
- Public disclosure: Jul 2011.
- The Pakistani Taliban used this information to discredit vaccines
  $\rightarrow$ Anti-Vaccine Propaganda

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S americas asia australia africa middle east cities development

CIA organised fake vaccination drive to get Osama bin Laden's family DNA

Senior Pakistani doctor who organised vaccine programme in Abbottabad arrested by ISI for working with US agents

CIA organised fake vaccination programme in Abbottabad to try and find Osama bin Laden. Photograph: Md Nadeem/EPA

The CIA organised a fake vaccination programme in the town where it believed Osama bin Laden was hiding in an elaborate attempt to obtain DNA from the fugitive al-Qaida leader's family, a Guardian investigation has found.

This Paper

- Objective: assess the impact of the disclosure of the vaccine ruse on immunization rates.
- We implement a **DiD strategy**:
  - We compare children born **before & after** the disclosure.
  - Across regions with different levels of **Islamist support**.
- Hypothesis:
  In regions with higher support for the Islamist groups, more individuals update their beliefs about vaccines according to the messages spread by the Taliban.

Overview of Results

- Disclosure of the vaccine ruse has a **large negative effect** on vaccination take-up.
  - A move from the 10th to the 90th percentile in Islamist support associated with **20% decline** in vaccination rates, 9pp
  - Robust to host of controls, and lack of pre-trends
- Consistent with **lower demand** & **trust** in formal medicine
  - Lower demand for formal medicine
  - No effects on the supply of vaccines
  - Larger effects in regions with higher (proxy of) exposure to Taliban propaganda

Related Literature

Demand for Health in Developing Countries

- Banerjee & Duflo (2012), Dupas & Miguel (2017)

Effects of Medical Malpractice

- Alsan & Wanamaker (2017), Lowes & Montero (2020)

Persuasion and Misinformation

- DellaVigna and Gentzkow (2010), Alcott and Gentzkow (2017), Cantoni et al. (2017), Bursztyn et al. (2017)

Outline

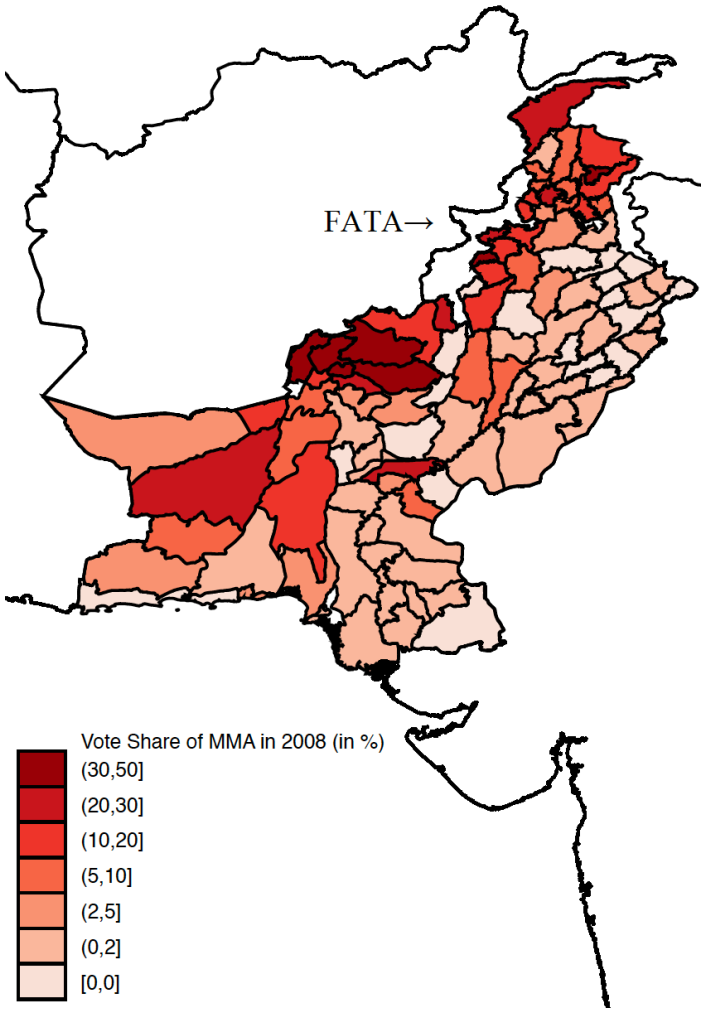
Background

Pakistan's Political & Administrative Background

- Federal parliamentary democracy.
- Regular elections since 2008
- Territory divided in 4 provinces, 3 autonomous territories, and Islamabad
- We focus on Pakistan's 4 provinces: 97% of the population

Pakistan's Political & Administrative Background

- Measure of **ideological alignment to the Taliban**:
- Vote share of MMA in 2008 parliamentary election
- Alliance of ultra-conservative Islamist parties
- Strong connection with the Taliban (Norell, 2007)
- 3% of the votes and seats but substantial variation



Taliban's Reaction to the CIA Vaccine Ruse

- Occasionally, the Pakistani Taliban have tried to discredit vaccines and formal medicine:
  - Strategy to increase population's reliance on non-state actors
  - *"Western conspiracy to sterilize Muslim girls"*, *"vaccines made of pig-fat"*, *"un-Islamic to take medicines before disease"*
- Rumors spread through Islamist illegal radio shows, newspapers, and prayers in radicalized mosques (Roul 2014).
- The CIA's vaccine ruse **lent credibility** to Taliban's anti-vaccine propaganda
- **Anti-vaccine propaganda intensified** after 2011
  - *"Polio agents could be also spies as we have found in the case of Dr. Shakil Afridi has surfaced. Keeping these things in mind, we announce to stop the polio dosage."*
    (Published in a fatwa, cited in Roul 2014).

Consequences of Taliban's Propaganda

- Anecdotal evidence of **increased mistrust** in vaccines:
  - *"Hamid Aziz says he listened to the advice of a cleric in his village, who announced over loudspeakers of the madrasah, a local Islamic religious school, that the vaccine was "not good" for children's health, and prevented it from being administered to any of his sons."*
  - *"Nooran Afridi, a pediatrician at a private clinic in Pakistan's Khyber tribal region, says one of the biggest obstacles to eradicating polio in Pakistan has been 'refusals' stemming from 'antipolio propaganda' spread by conservative Islamic clerics in 'backward areas.' "*
- Since end of 2012, vaccination campaigns have tried to address misconceptions
- Also evidence of **increased conflict**: since July 2012, a attacks against health workers

Vaccine Delivery in Pakistan

- Regular vaccines are administered by Lady Health Workers.
- Expanded Program in Immunization (EPI) coordinates the procurement of vaccines and organizes coordinated vaccination drives.
  - National & subnational vaccination days
  - Monthly polio vaccination drives
- Pakistan follows the official calendar recommended by WHO:

Vaccine	First Dose	Second Dose	Third Dose	Fourth Dose
Polio	At birth	6 Weeks	10 Weeks	14 Weeks
DPT	6 Weeks	10 Weeks	14 Weeks	
Measles	9 Months	15 Months		

Empirical Strategy and Basic Results

Empirical Strategy and Basic Results

- **Objective:** estimate the effect of the disclosure of information on vaccine ruse on immunization rates.

- **Measuring Vaccination Outcome:**
  - PSLM (Pakistan Social and Living Standards Measurement)
  - Rounds 2010 and 2012
  - Household surveys, contain child-level immunization
  - $\sim$ 18,000 children in the sample $<$ 2 years old
  - Outcome:
    indicator for a child having received the first dose of vaccine X
  - We do not rely on self-reporting:
    $= 1$ if vaccine noted in the vaccine card
    $= 0$ otherwise

▸ details

Difference-in-Differences Empirical Strategy

- **Difference-in-Differences** empirical strategy

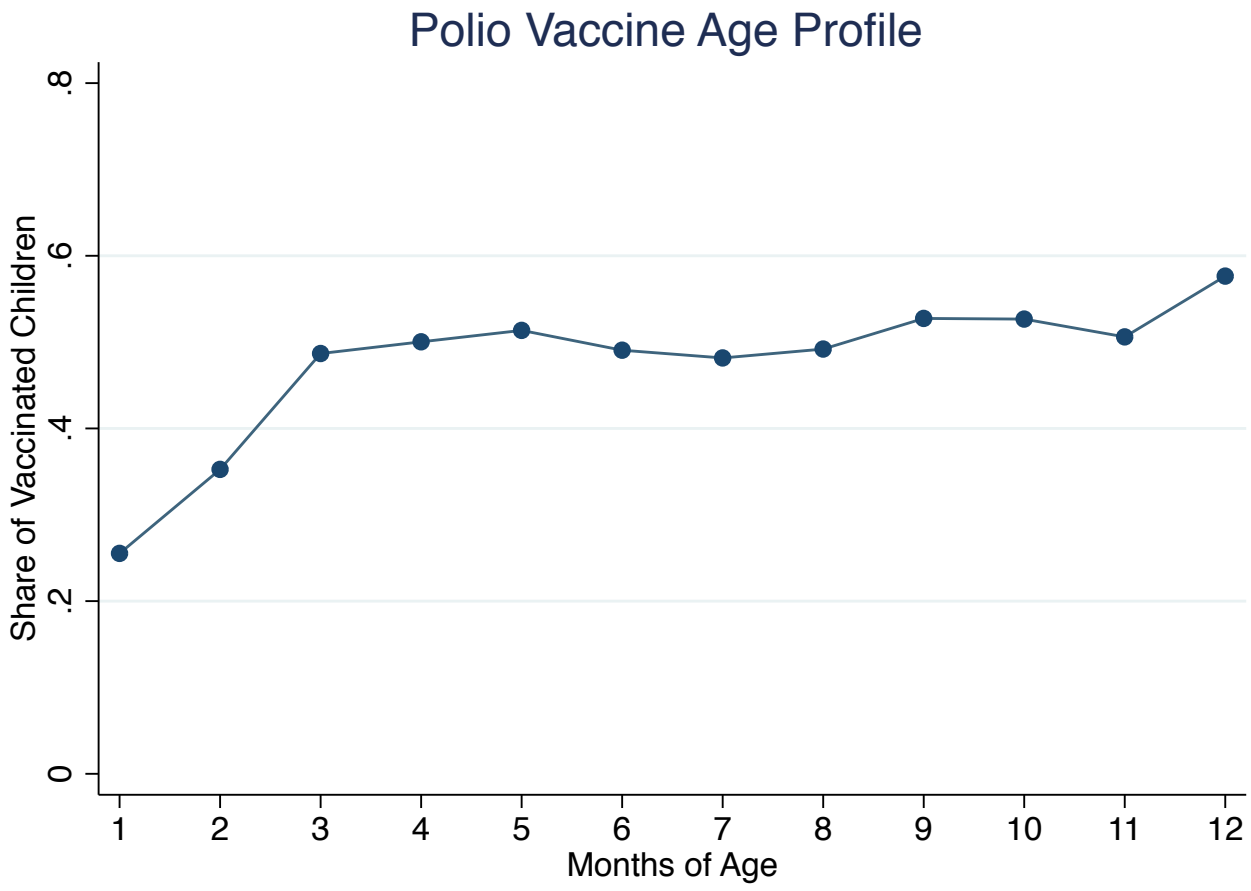
1. **Regional variation:**
   - Districts with high support for the Taliban $\rightarrow$ parents more exposed and persuaded by the anti-vaccine propaganda

   ▸ Discussion

2. **Cohort variation:**
   - Fully exposed cohorts $\rightarrow$ born after July 2011 (disclosure)
   - Not exposed cohorts $\rightarrow$ born "much earlier" than July 2011
   - Partially exposed cohorts $\rightarrow$ born shortly before July 2011
     - Early months in their life under the new information scenario

$\rightarrow$ Next, we examine the **age profiles** to distinguish partially from not-exposed cohorts.

Age Profile of Vaccines (Pre-Treatment)



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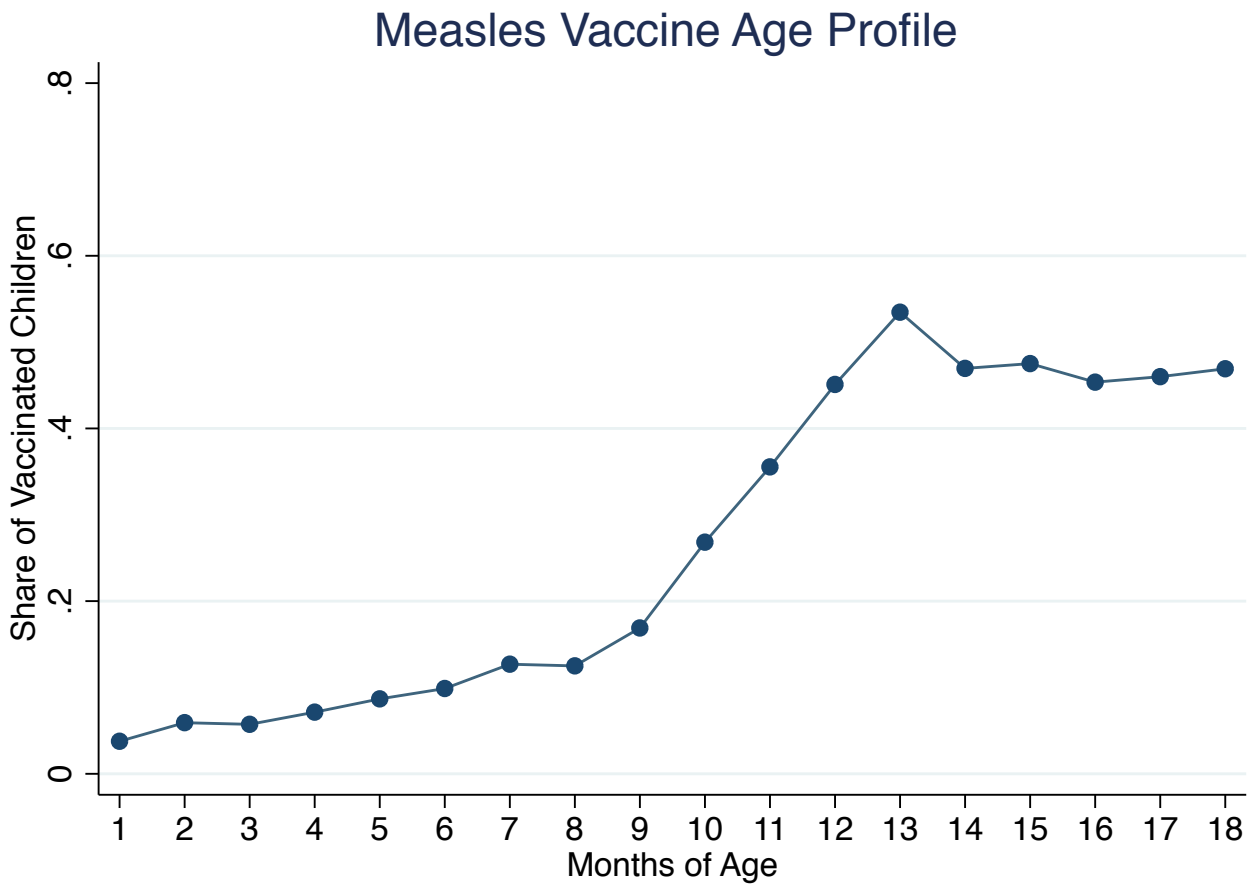


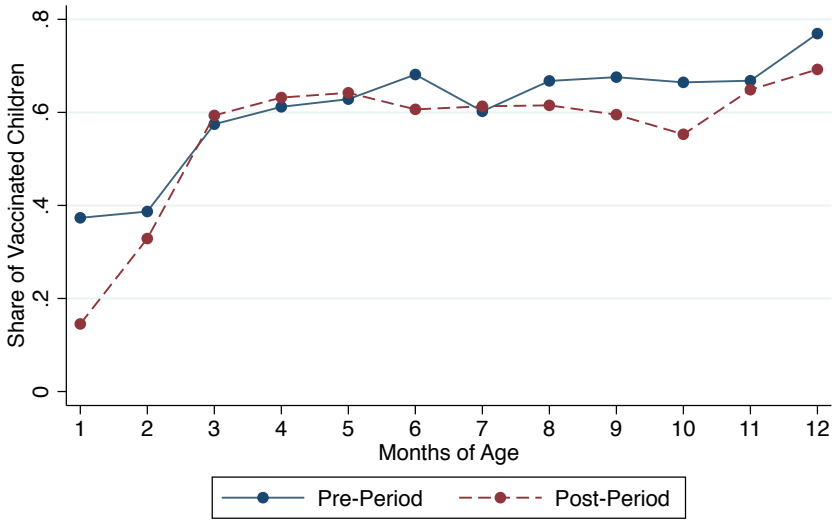
Empirical Strategy and Basic Results

- Identifying **partially treated** children:
  - The probability of getting polio and DPT vaccine increases in the first 3 months of life, 1st year for measles vaccine.
  - Children born 3 months before July 2011 $\rightarrow$ partially treated for polio, DPT
  - Children born 1 year before July 2011 $\rightarrow$ partially treated for measles
- Before showing regression estimates, we visually represent the main variation we exploit in the DID strategy.

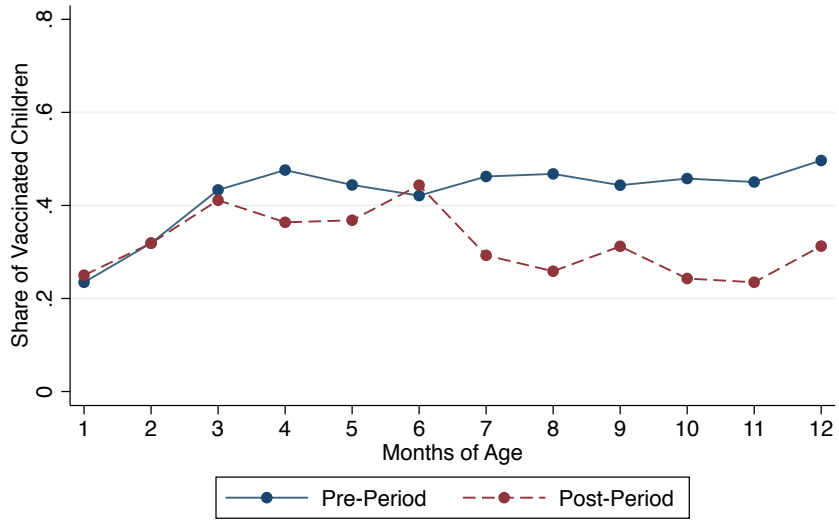
Age Profiles. Before & After. By Islamist Support

Polio Vaccine

Low Islamist Support



High Islamist Support



Age Profiles. Before & After. By Islamist Support

Measles Vaccine

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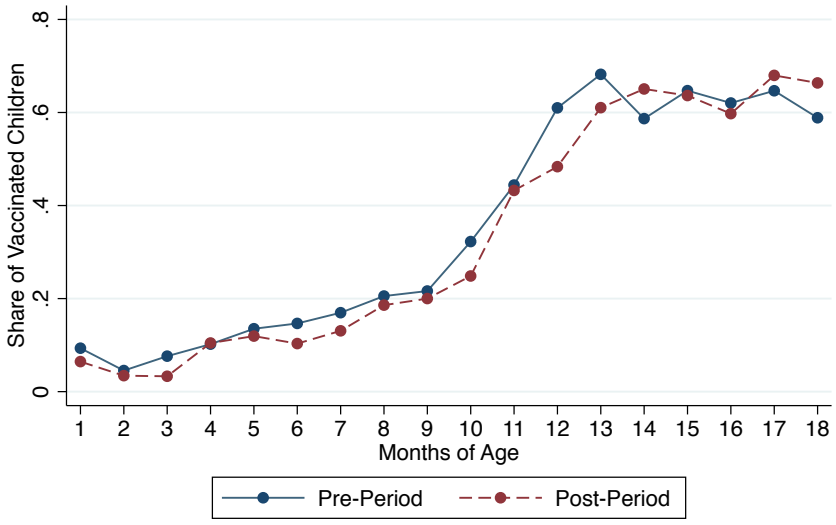

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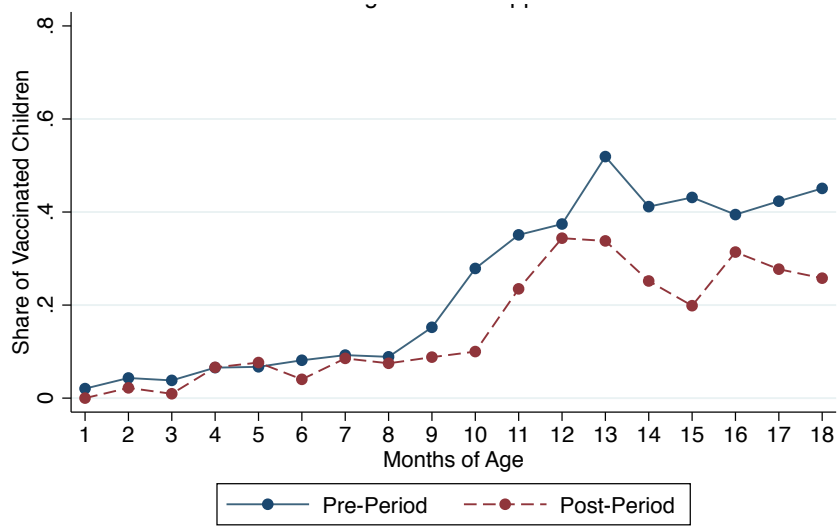


▸ DPT

Empirical Strategy

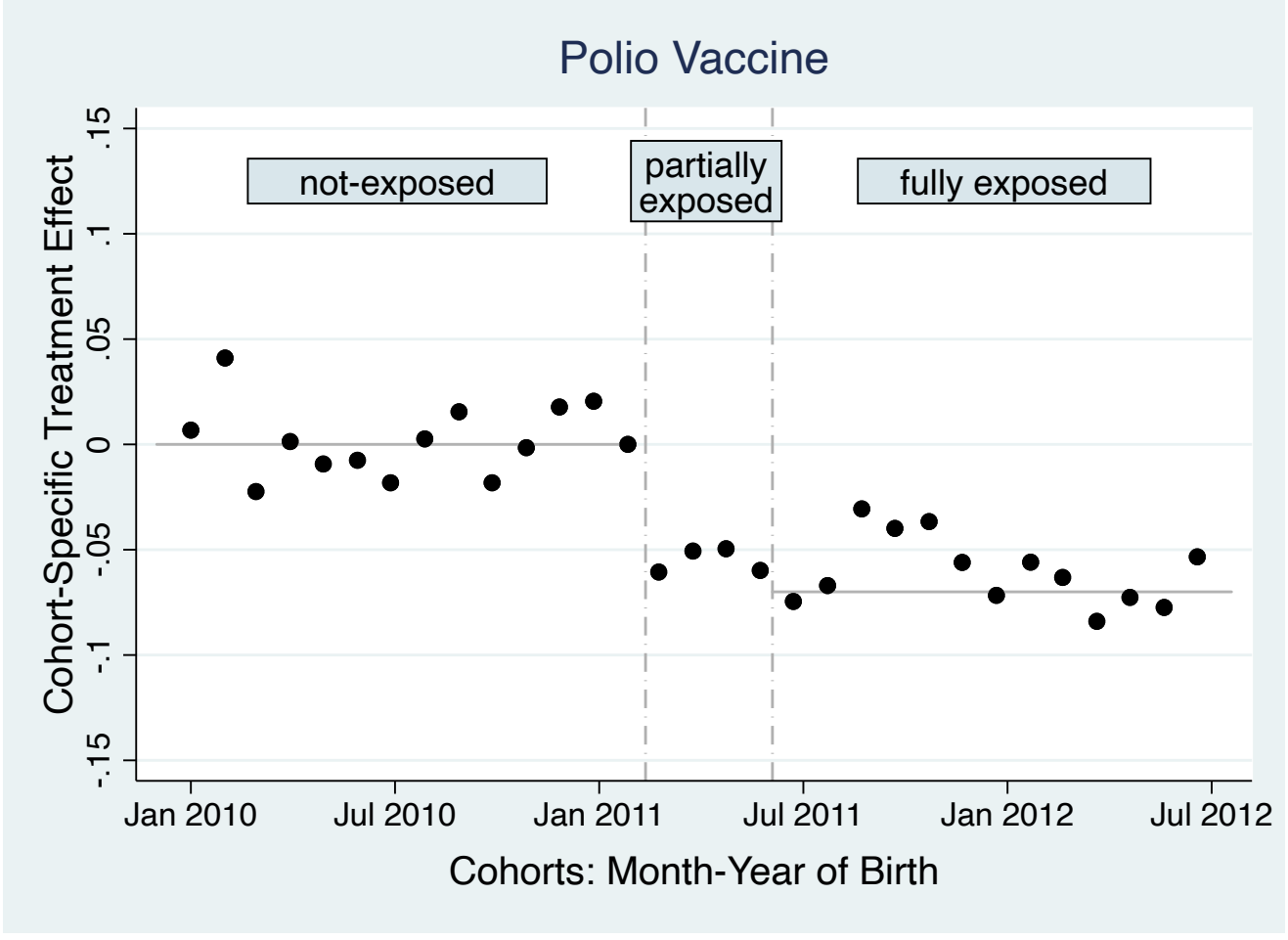
- Flexible Regression Framework

$$Y_{ikaj} = \sum_k \beta_k D_k I_j + \gamma_k + \gamma_j + \gamma_a + \delta c_i + \epsilon_{ikaj}$$

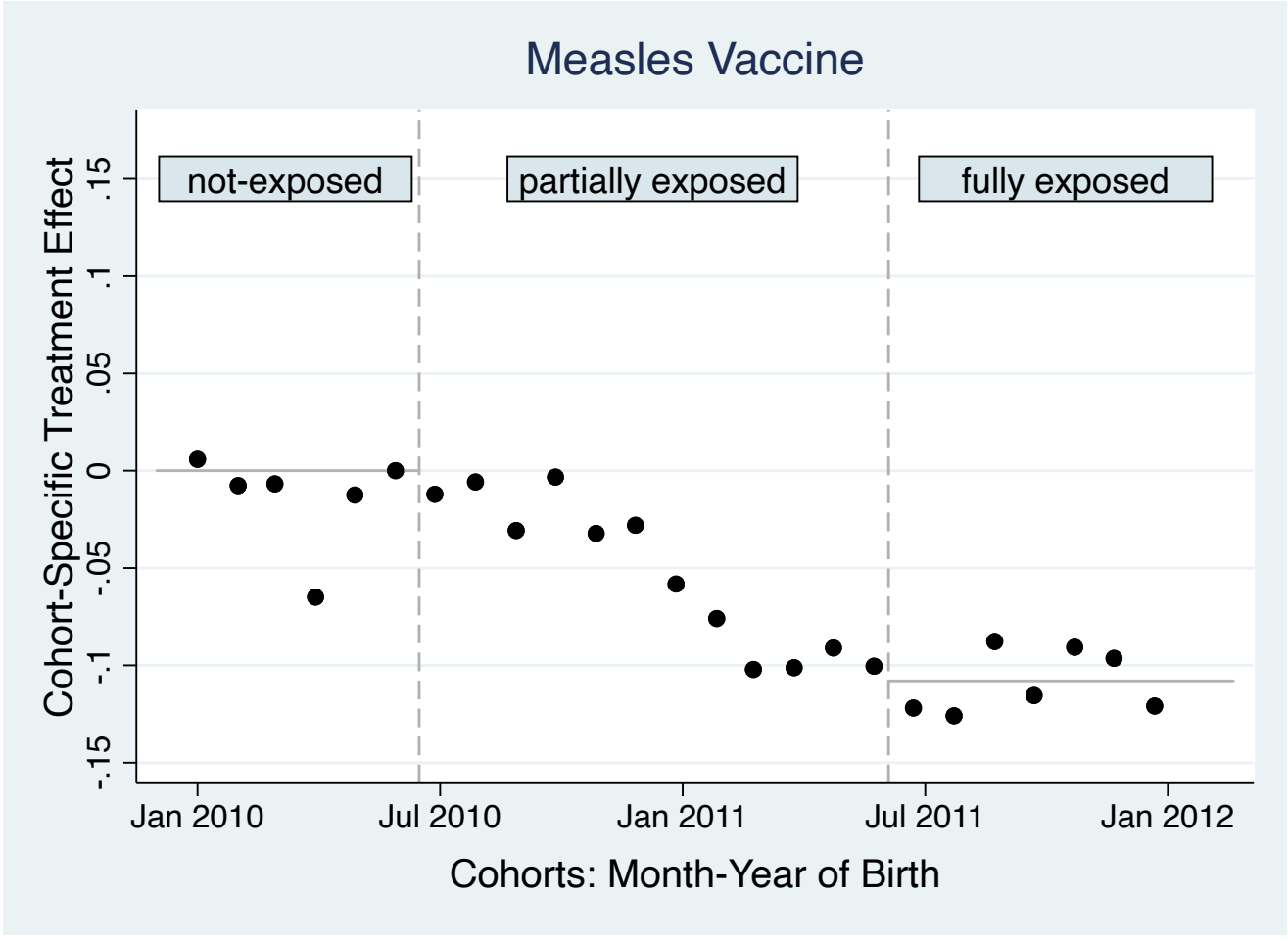
- $Y_{ikaj} = 1$ if child i got the 1st dose of the vaccine
- D_k dummy for month of birth k
- I_j Islamist Parties (MMA) 2008 vote share in district j (in standard deviations) ▸ details
- γ_k, γ_j, γ_a: monthly cohort FE, district FE, monthly age FE
- c_i covariates (month-of-interview & rural indicator)

We plot $\hat{\beta}_k$ coefficient: treatment effect for each cohort

Cohort-Specific Treatment Effects



Cohort-Specific Treatment Effects



▸ With CI ▸ Longer Pre-Trend ▸ Full Immunization ▸ Medium-Run ▸ Back Rob

Main Regression Estimates

Main Regression Estimates

- To assess the magnitude and significance of the effects we estimate:

$$Y_{ikaj} = \beta Post_k I_j + \delta c_i + \gamma_k + \gamma_j + \gamma_a + \epsilon_{ikaj}$$

  - $Y_{ikaj} = 1$ if child i got the 1st dose of the vaccine
  - $Post_k = 1$ for fully-exposed cohorts (born after July 2011)
  - $Post_k = 0$ for not-exposed cohorts
  - We exclude partially-exposed cohorts
  - Standard errors clustered at the district-level

Effects of Disclosure of Vaccination Ruse

	Dependent Variables:			
	Polio	DPT	Measles	All Vaccines
	(1)	(2)	(3)	(4)
	Panel A. 1st Dose of Each Vaccine			
Mean Dep. Var.	*0.420*	*0.453*	*0.279*	*0.250*
Post × Islamist Support	-0.060***	-0.056***	-0.055***	-0.058***
	(0.020)	(0.018)	(0.016)	(0.016)
Observations	16,654	16,654	12,479	12,479
R-squared	0.262	0.241	0.253	0.259
Number of Clusters	109	109	109	109
	Panel B. All Doses of Each Vaccine			
Mean Dep. Var.	*0.381*	*0.419*	*0.279*	*0.264*
Post × Islamist Support	-0.064***	-0.061***	-0.055***	-0.050***
	(0.019)	(0.018)	(0.016)	(0.015)
Observations	11,205	11,205	12,479	11,205
R-squared	0.277	0.247	0.253	0.272
Number of Clusters	109	109	109	109

▸ Non-linearities

Identifying Assumption & Robustness Checks

- **Identifying Assumption:** in the absence of the disclosure of information, the evolution of immunization rates would be similar in districts with different support for Islamist groups.

- **Evidence:**
  - Lack of pre-trends: no effects for not exposed cohorts

▸ cohort effects

  - We control for initial district conditions $\times$ cohort FE
    - Health, education, conflict, etc.

▸ Rob Checks

- **Additional Robustness Checks:**
  - No evidence of selective migration

▸ Migration

  - No evidence of differential under-reporting of vaccinations

▸ under-reporting

Additional Results: Cases of Poliomyelitis

Effects on Number of Cases of Polio

- We collected data on **number of polio cases** at the district level
- Data from the Global Polio Eradication Initiative.
- Available years: 2009, 2010, 2011, 2014
- DID strategy at the district-year level

	Dependent Variable: Number of Cases of Poliomyelitis	
	(1)	(2)
Mean Dep. Var.	*0.890*	*0.890*
Post × Islamist Support	0.831**	
	(0.330)	
2010 × Islamist Support		-0.032
		(0.340)
2011 × Islamist Support		1.004*
		(0.519)
2014 × Islamist Support		0.626*
		(0.372)
Observations	456	456
	0.475	0.478

Mechanisms

Our Proposed Mechanism

- The evidence is consistent with a decline in trust in vaccines
  - The disclosure of information on the vaccine ruse lent credibility to conspiracy theories spread by the Taliban
  - Parents in regions with higher support for Islamist groups, more exposed to these messages, or more persuaded by them.

▸ extra

Supportive Evidence on the Mechanisms

1. Effects Driven by Demand of Vaccines, not Supply
   - 1.1 Effects in health seeking behavior
   - 1.2 No effects on supply

2. Unbundling Demand: Exposure to Taliban Propaganda
   - 2.1 Larger effects in regions with low access to mainstream media and greater exposure to Taliban information sources
   - 2.2 Larger effects for girls: behavior consistent with Taliban messages
   - 2.3 Effects driven by ideological proximity, not by intimidation

1. Additional Supportive Evidence for a Demand Channel

1.1. **Health Seeking Behavior**

- *Did your kid got sick in the last 2 weeks?*
- *Did you consult a medical worker?*

- DID where Post refers to interviews after July 2011

$$Y_{itj} = \beta Post_t I_j + \delta c_i + \gamma_t + \gamma_j + \epsilon_{itj}$$

Effects on Health Seeking Behavior

	Dependent Variables:			
		Heckman Selection Model		
	Dummy for Illness in Last 2 Weeks	Dummy for Consulted Anyone	Dummy for Consulted Formal Medical Sector	Labor Assisted by Traditional Birth Attendant
	(1)	(2)	(3)	(4)
Mean Dep. Var.	*0.191*	*0.980*	*0.923*	*0.331*
Post July 2011 × Islamist Support	0.025*	-0.023*	-0.061**	
	(0.014)	(0.013)	(0.027)	
		[0.010]	[0.018]	
Inverse Mills Ratio		-0.054*	-0.112***	
		(0.032)	(0.042)	
		[0.022]	[0.040]	
Post × Islamist Support				0.038***
				(0.014)
Observations	18,650	3,551	3,551	18,222
R-squared	0.064	0.077	0.153	0.137
Number of Clusters	109	108	108	109

1. Additional Supportive Evidence for a Demand Channel

1.2. No effects on **Supply** of vaccines:

- We collected administrative data on vaccination drives.
- Monthly- & district-level data on polio vaccination drives 2008-2013.

Supply of vaccines does not differentially change after the vaccine ruse

	Dependent Variable:		
	Time travel to Health Facilities	Indicator: Any Immunzation Activity	Number of Targeted Children Per Capita
	(1)	(2)	(3)
Mean Dep. Var.	*1.526*	*0.601*	*0.136*
Post July 2011 × Islamist Support	-0.034	-0.010	-0.004
	(0.047)	(0.014)	(0.006)
Observations	16,647	8,208	8,136
R-squared	0.399	0.578	0.535
Number of Clusters	109	114	113

Notes: Standard errors clustered at the district-level in parentheses in columns. The unit of observation is the child-level in Columns 1. In Columns 2 and 3, the unit of observation is the district-month level. In Column 1, the sample consists of children born between January 2010 and July 2012 that are less than 24 months of age at the time of interview. We exclude children that were partially treated. See the notes of Table 1 for details on the excluded cohorts. In Columns 2 and 3, the sample consists of all districts, observed at monthly frequency for the time period 2008 to 2013. All regressions include district and monthly time of interview fixed effects. The post indicator is defined based on the timing of the interview. *** p<0.01, ** p<0.05, *p<0.1.

Results Robust to Controlling for Supply of Health Services

		Additional Controls:				
	Baseline	Travel Distance to Health Facilities	Number of Immunization Campaigns		Number of Targeted Children per Capita in Immunization Campaigns	
			First 3 months of life	First year of life	First 3 months of life	First year of life
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A. 1st Dose of Polio Vaccine					
Post × Islamist Support	-0.060***	-0.061***	-0.060***	-0.060***	-0.061***	-0.062***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Observations	16,654	16,647	16,654	16,654	16,612	16,612
R-squared	0.262	0.264	0.262	0.263	0.261	0.261
Number of Clusters	109	109	109	109	109	109

2. Unbundling Demand:

2.1. **Larger effects in regions with low access to mainstream media and greater exposure to Taliban information sources**

- Data on media consumption and political views from Fair, Kaltenthaler and Miller
  - 2013, 79 districts, 7,648 households
- Media consumption. Two main sources of information:
  - Mainstream media: TV channels, printed media
  - Informal sources: religious leaders, traditional gatherings, family members

Evidence on Media Consumption

The greater the share of people that do not consume mainstream media $\rightarrow$ the larger the decline in vaccination rates.

	Dependent Variable: 1st Dose of Polio Vaccine				
	(1)	(2)	(3)	(4)	(5)
Post × Islamist Support	-0.072**				
	(0.027)				
Post × Not Using Mainstream Media		-0.077***			
		(0.027)			
Post × Not Trusing Mainstream Media			-0.061***		
			(0.022)		
Post × Support Pak Taliban & Trust Religious Leaders				-0.045**	
				(0.020)	
Post × Know of Drone Strikes					-0.058***
					(0.017)
Observations	13,689	13,689	13,689	13,689	13,689
R-squared	0.260	0.260	0.260	0.258	0.261
Correlation coefficient of key regressor and Islamist Support	1.00	0.58	0.54	0.46	0.22
Number of Clusters	79	79	79	79	79

Evidence on Media Consumption

Proxies for exposure to Taliban Propaganda:

- Share of people who mostly trust religious leaders to get their news and support the Taliban.
- Share of people that have heard of drone strikes against the Taliban

	Dependent Variable: 1st Dose of Polio Vaccine				
	(1)	(2)	(3)	(4)	(5)
Post × Islamist Support	-0.072**				
	(0.027)				
Post × Not Using Mainstream Media		-0.077***			
		(0.027)			
Post × Not Trusing Mainstream Media			-0.061***		
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Correlation coefficient of key regressor and Islamist Support	1.00	0.58	0.54	0.46	0.22
Number of Clusters	79	79	79	79	79

2. Unbundling Demand

2.2 **Heterogeneous Effects by Gender of the Child**

- Some of the rumors spread by the Taliban argued that vaccination was a "conspiracy to sterilize the Muslim population," *girls* in particular (Scientific American, 2013)
- If parents lent credibility to these rumors, we expect larger declines in vaccination take-up for girls.

Heterogenous Effects by Gender of the Child

	Dependent Variables:			
	Polio	DPT	Measles	All Vaccines
	(1)	(2)	(3)	(4)
	Panel A. 1st Dose of Each Vaccine			
Mean Dep. Var.	*0.420*	*0.453*	*0.279*	*0.250*
Post × Islamist Support	-0.047**	-0.041**	-0.043**	-0.044***
	(0.020)	(0.019)	(0.017)	(0.017)
Post × Islamist Support x Female	-0.028**	-0.032**	-0.024	-0.029
	(0.013)	(0.016)	(0.018)	(0.018)
Observations	16,654	16,654	12,479	12,479
R-squared	0.263	0.242	0.253	0.259
Number of Clusters	109	109	109	109

2. Unbundling Demand

2.3. **Change in Beliefs or Intimidation?**

- Potential Demand Channels:
  1. Parents **update their beliefs** about vaccines according to the messages spread by the Taliban
  2. **Fear of the Taliban** makes parents refuse vaccines

- Supportive evidence for [1.]:
  - Substantial anecdotal evidence more
  - Since end of 2012, vaccine drives have tried to address misconceptions

- **Empirical test:** horse-race between two channels
  - We collect data on district-level conflict involving the Taliban
  - ACLED data (631 instances during 2010-2013)
  - We include interactions *post x conflict of Taliban*

2. Unbundling Demand: Change in Beliefs or Intimidation?

	Dependent Variables: First Dose of			
	Polio	DPT	Measles	All Vaccines
	(1)	(2)	(3)	(4)
Mean Dep. Var.	*0.423*	*0.456*	*0.232*	*0.207*
	Panel A. Taliban Conflict Events in 2010			
Post × Islamist Support	-0.054***	-0.048***	-0.050***	-0.055***
	(0.020)	(0.018)	(0.017)	(0.016)
Post × Conflict Measure	-0.014	-0.018*	-0.009	-0.006
	(0.009)	(0.010)	(0.008)	(0.008)
Observations	16,624	16,624	12,459	12,459
R-squared	0.262	0.241	0.252	0.259
Number of Clusters	108	108	108	108

Taking Stock & Further Research (I)

- The disclosure of the CIA's vaccine ruse and the subsequent anti-vaccine propaganda lead to a substantial decline in immunization rates
- Additional evidence supportive of decline in demand & trust channel
- First quantification of the negative effects of using health services as covert for espionage

Taking Stock & Further Research (II)

- Can trust be regained? How?
  - Papers finding persistent effects of mistrust: Alsan and Wanamaker (2017), Lowes and Montero (2018)
  - Others find trust can be regained Andrabi and Das (2017), Acemoglu, Cheema, Khwaja, Robinson (2018)
  - ▸ Medium-Run Effects
- Broader implication of the CIA vaccine ruse: making vaccines vulnerable to future conspiracy theories.

Many thanks!

Consequences of Taliban's Propaganda

- Anecdotal evidence of **increased mistrust** in vaccines:

  "Many parents still resist the vaccine, as they believe in many conspiracies. Some think it's a Western conspiracy to sterilise the next generation, while others think that this campaign is a cover for some kind of spy programme. Many Urdu newspapers and magazines publish material to the effect that polio drops are not good for children, and then religious clerics use these articles to prove their conspiracy theories."

  (Dawn, 2014, quoting a health worker in Karachi)

- Since end of 2012, vaccination campaigns have tried to directly address misconceptions.

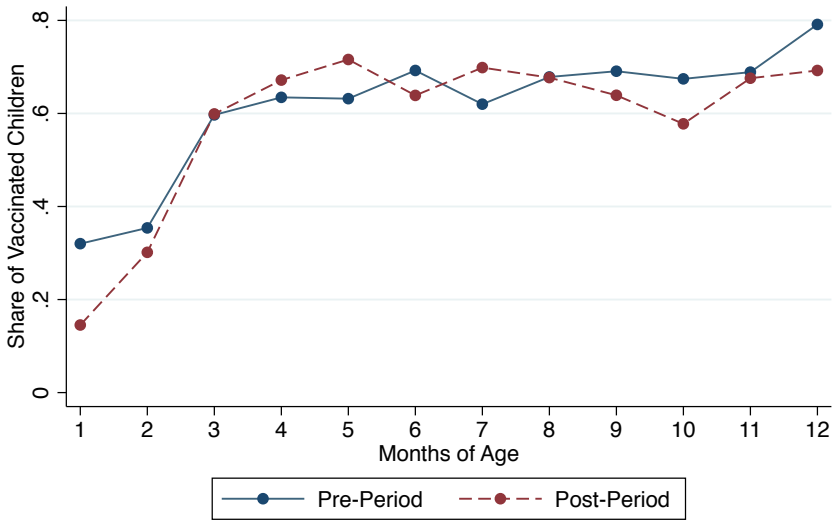
- Also evidence of **increased conflict**:
  - Since July 2012, the Taliban attacked health workers

Back

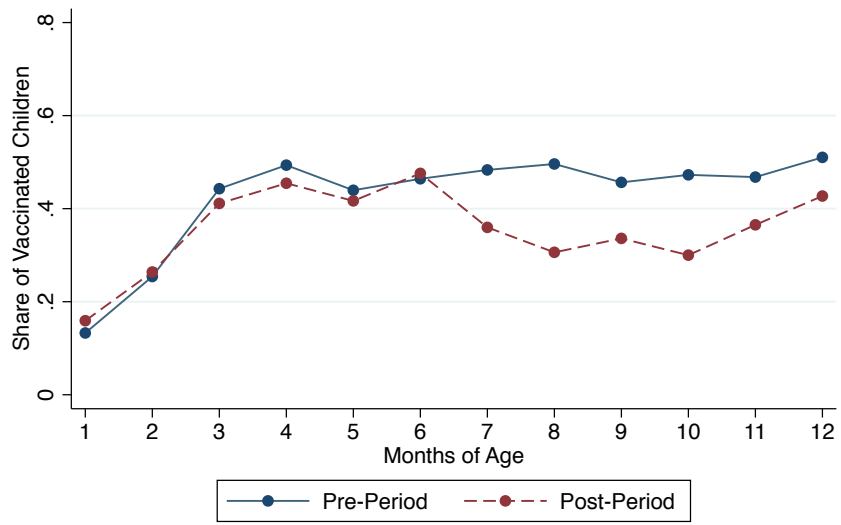
Age Profiles. Before & After. By Islamist Support

DPT Vaccine

Low Islamist Support



High Islamist Support



Back

Descriptive Statistics

	Observations (1)	Mean (2)	Std. Dev. (3)
	Panel A. Child Characteristics		
Received one dose of Polio vaccine	18,650	0.418	0.493
Received one dose of DPT vaccine	18,650	0.451	0.498
Received one dose of Measles vaccine	18,650	0.257	0.437
Received three doses of Polio vaccine	18,650	0.334	0.472
Received three doses of DPT vaccine	18,650	0.363	0.481
Received all vaccines	18,650	0.231	0.421
Illness or injury (two weeks prior to interview)	18,650	0.191	0.393
Age (in months)	18,650	11.051	6.298
Male	18,650	0.513	0.500
	Panel B. Mother Characteristics		
Mother's education level	18,650	3.504	4.359
Mother's age	18,650	27.981	6.038
	Panel C. Household Characteristics		
Rural region	18,650	0.657	0.475
Radio ownership	18,650	0.229	0.420
Television ownership	18,650	0.578	0.494
Number of rooms	18,650	2.632	1.555
Number of household members	18,650	8.237	3.885
	Panel D. District Characteristics		
Vote Share MMA	114	0.073	0.113
Vote Share PPP	114	0.261	0.204
Vote Share PML (N)	114	0.105	0.140

Measurement of Vaccination Status (I)

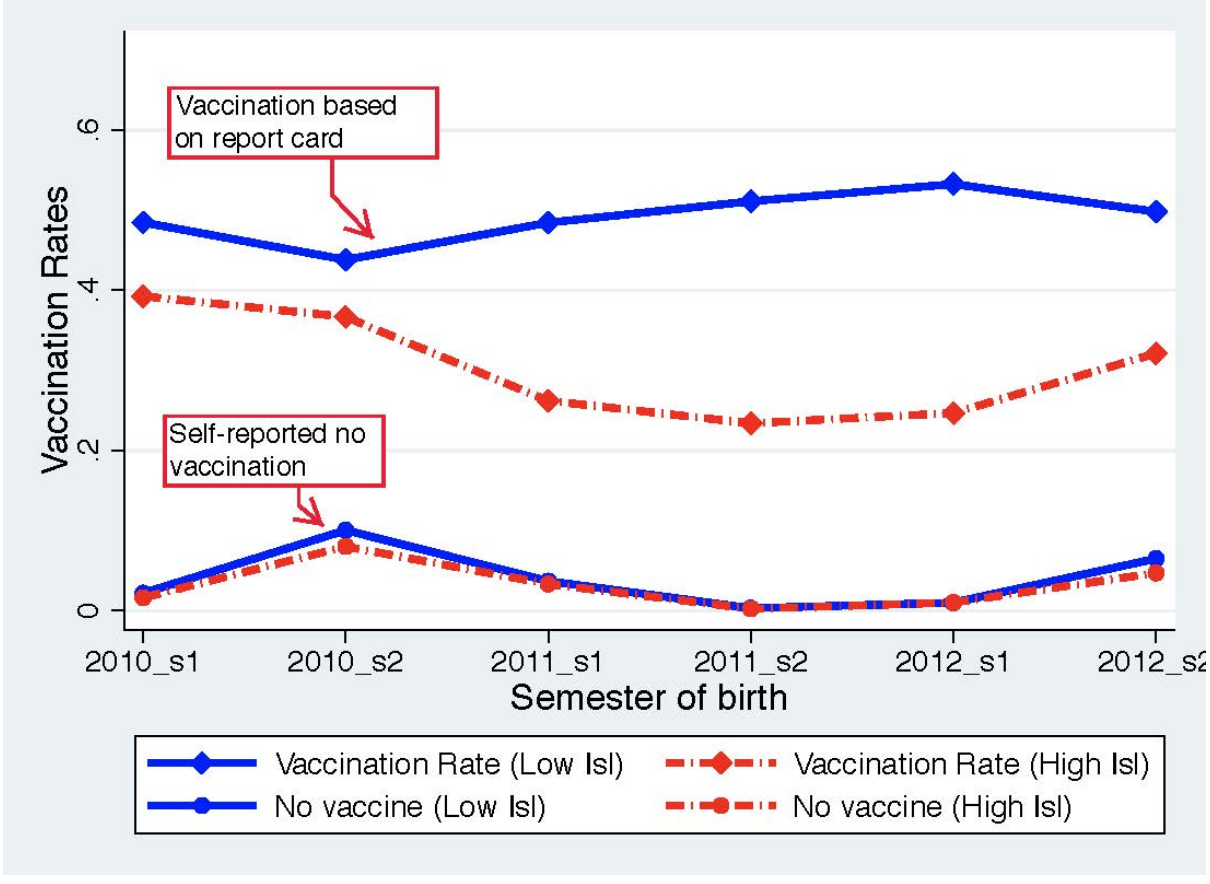
- Survey question regarding vaccination status:

- Did the child received the 1st dose of polio vaccine?
  1. Yes (based on vaccination card) $\rightarrow$ 42%
  2. Yes (based on recall) $\rightarrow$ 55%
  3. No $\rightarrow$ 3%

- Under-reporting does not seem quantitatively relevant.
- Furthermore, no differential change across regions after the disclosure of the CIA vaccine ruse

Back to Data

Measurement of Vaccination Status (II)



Measurement of Vaccination Status (III)

Propensity of having the vaccination card:

- It does not change over time (0.68 before and after)
- It does not change differentially by districts level of Islamist Support:

	Dependent Variable: Dummy for Having a Vaccination Card	
	(1)	(2)
Mean Dep. Var.	*0.685*	*0.685*
Post July 2011 × Islamist Support	-0.007	-0.008
	(0.020)	(0.016)
Post July 2011	-0.013	
	(0.014)	
Islamist Support	-0.064**	
	(0.027)	
Observations	18,650	18,650
R-squared	0.013	0.206

Back to Rob

Heterogeneous Effects By Level of Islamist Support

- Islamist support and persuasion effects of anti-vaccine propaganda:
  1. Higher **exposure** to Taliban propaganda network:
     - Network of radicalized mosques and organizations
     - Individuals consume media that shares similar ideology (Gentzkow and Shapiro 2010, Mullainathan and Shleifer 2005)
  2. **Confirmation bias.** Greater **persuasion** effect when information confirms priors:
     - Perceived credibility of the source higher when information confirms priors (Gentzkow and Shapiro 2006)
     - Parents that sympathize with the Taliban may assign a higher probability to them being trustworthy

back back mechanisms

Heterogeneous Effects By Level of Islamist Support

	Dependent Variables: Dummy for Receipt of 1 Vaccine Dose								
	Polio			DPT			Measles		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Mean Dep. Var.	*0.422*	*0.422*	*0.422*	*0.455*	*0.455*	*0.455*	*0.231*	*0.231*	*0.231*
Post × Islamist Support	-0.060***			-0.056***			-0.055***		
	(0.020)			(0.018)			(0.016)		
Post × 1(IslSup>P50)		-0.153***			-0.135***			-0.093***	
		(0.032)			(0.031)			(0.026)	
Post × Isl Support in 20th - 40th			0.023			0.044			-0.011
			(0.047)			(0.039)			(0.043)
Post × Isl Support in 40th - 60th			-0.013			-0.023			-0.080**
			(0.060)			(0.059)			(0.040)
Post × Isl Support in 60th - 80th			-0.162***			-0.135***			-0.121***
			(0.048)			(0.046)			(0.043)
Post × Isl Support in 80th - 100th			-0.134***			-0.118***			-0.127***
			(0.038)			(0.036)			(0.039)
Observations	16,654	16,654	16,654	16,654	16,654	16,654	12,479	12,479	12,479
R-squared	0.262	0.266	0.266	0.241	0.244	0.244	0.253	0.253	0.254

Notes: Standard errors clustered at the district-level in parentheses. The sample consists of children born between January 2010 and July 2012 that are less than 24 months of age at the time of interview. We exclude partially treated children. See the notes of Table 1 for details on the excluded cohorts. All regressions include district, monthly cohort, monthly age, and calendar month of interview fixed effects and a dummy for rural regions. The dependent variables in Panel A take value 1 if the first dose of each vaccine was received, 0 otherwise.

back

Robustness to Controlling for Supply of Health Services

		Additional Controls:				
	Baseline	Travel Distance to Health Facilities	Number of Immunization Campaigns		Number of Targeted Children per Capita in Immunization Campaigns	
			First 3 months of life	First year of life	First 3 months of life	First year of life
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A. 1st Dose of Polio Vaccine					
Post × Islamist Support	-0.060***	-0.061***	-0.060***	-0.060***	-0.061***	-0.062***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Observations	16,654	16,647	16,654	16,654	16,612	16,612
R-squared	0.262	0.264	0.262	0.263	0.261	0.261
Number of Clusters	109	109	109	109	109	109

Back

Evidence Consistent with Demand Channel

1. **Health Seeking Behavior**
   - *Did your kid got sick in the last 2 weeks?*
   - *Did you consult a medical worker?*

   - DID where Post refers to interviews after July 2011

$$Y_{itj} = \beta Post_t I_j + \delta c_i + \gamma_t + \gamma_j + \epsilon_{itj}$$

Effects on Health Seeking Behavior

	Dependent Variables:		
	Dummy for Illness in Last 2 Weeks	Dummy for Consulted Anyone	Dummy for Consulted Formal Medical Worker
	(1)	(2)	(3)
Mean Dep. Var.	*0.191*	*0.980*	*0.923*
Post July 2011 × Islamist Support	0.025*	-0.019	-0.052**
	(0.014)	(0.012)	(0.026)
Observations	18,650	3,558	3,558
R-squared	0.064	0.076	0.151

Back

Identifying Assumption & Robustness Checks

- **Identifying Assumption:** in the absence of the disclosure of information, the evolution of immunization rates would be similar in districts with different support for Islamist groups.

- **Evidence:**
  - Lack of pre-trends: no effects for not exposed cohorts

▸ cohort effects

  - We control for initial district conditions $\times$ cohort FE
    - Health, education, conflict, etc.

▸ Rob Checks

- **Additional Robustness Checks:**
  - No evidence of selective migration

▸ Migration

  - No evidence of differential under-reporting of vaccinations

▸ under-reporting

▸ Back

Robustness (Minimum Controls)

	Dependent Variables:			
	Polio	DPT	Measles	All Vaccines
	(1)	(2)	(3)	(4)
	Panel A. 1st Dose of Each Vaccine			
Mean Dep. Var.	*0.422*	*0.455*	*0.231*	*0.207*
Post × Islamist Support	-0.057***	-0.054***	-0.065***	-0.067***
	(0.021)	(0.019)	(0.018)	(0.018)
Observations	16,654	16,654	12,479	12,479
R-squared	0.251	0.227	0.227	0.236
Number of Clusters	109	109	109	109
	Panel B. All Doses of Each Vaccine			
Mean Dep. Var.	*0.338*	*0.371*	*0.231*	*0.213*
Post × Islamist Support	-0.062***	-0.061***	-0.065***	-0.062***
	(0.020)	(0.019)	(0.018)	(0.018)
Observations	11,205	11,205	12,479	11,205
R-squared	0.267	0.237	0.227	0.250
Number of Clusters	109	109	109	109

Robustness Checks of Main Estimates (I)

	Baseline	Mean of Dep Var Pre-Treatment x Cohort FE	Initial Health x Cohort FE	Initial Education x Cohort FE	Nightlights at Birth	Conflict Events in the First Year of Life	Conflict Events in 2010 x Cohort FE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel A. First Dose of Polio Vaccine						
Post × Islamist Support	-0.060***	-0.061***	-0.052***	-0.044**	-0.055***	-0.060***	-0.060***
	(0.020)	(0.020)	(0.018)	(0.020)	(0.019)	(0.020)	(0.020)
Observations	16,654	16,654	16,654	16,654	16,654	16,624	16,624
R-squared	0.262	0.262	0.264	0.263	0.264	0.262	0.263
	Panel D. All Vaccines						
Post × Islamist Support	-0.058***	-0.056***	-0.046***	-0.040**	-0.048***	-0.058***	-0.058***
	(0.016)	(0.016)	(0.016)	(0.017)	(0.014)	(0.016)	(0.016)
Observations	12,479	12,341	12,479	12,479	12,479	12,459	12,459
R-squared	0.259	0.261	0.263	0.263	0.264	0.258	0.259

Robustness Checks of Main Estimates (II)

	Baseline	Mean of Dep Var Pre-Treatment x Cohort FE	Initial Health x Cohort FE	Initial Education x Cohort FE	Nightlights at Birth	Conflict Events in the First Year of Life	Conflict Events in 2010 x Cohort FE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Panel B. First Dose of DPT Vaccine						
Post × Islamist Support	-0.056***	-0.058***	-0.054***	-0.056***	-0.055***	-0.057***	-0.056***
	(0.018)	(0.019)	(0.016)	(0.019)	(0.018)	(0.017)	(0.018)
Observations	16,654	16,654	16,654	16,654	16,654	16,624	16,624
R-squared	0.241	0.242	0.244	0.241	0.241	0.242	0.243
	Panel C. First Dose of Measles Vaccine						
Post × Islamist Support	-0.055***	-0.053***	-0.046***	-0.049***	-0.048***	-0.055***	-0.054***
	(0.016)	(0.016)	(0.015)	(0.018)	(0.015)	(0.016)	(0.016)
Observations	12,479	12,341	12,479	12,479	12,479	12,459	12,459
R-squared	0.253	0.254	0.256	0.254	0.255	0.252	0.253

Back

Robustness to Selective Migration

- **Concern:**
  - Parents that plan to vaccinate their kids may out-migrate from high Islamist support districts after the disclosure of the vaccine ruse $\rightarrow$ donward biased estimates
- **Robustness Checks:**
  - We use 2012 wave of DHS to construct district-level measures of migration
  - Average in-migration 2.5%, average out-migration 3.9%
  - Panel A. We control by in- and out-migration rates x cohort fixed effects.
  - Panel B. We construct an upper bound assuming the most unfavorable selective migration.
    - e.g. we add observations with positive vaccination status to districts that experienced net-outmigration and have high Islamist support
  - Panel C. We estimate our specification in the DHS sample assigning households to the district of origin.

	Dependent Variables:			
	Polio	DPT	Measles	All Vaccines
	(1)	(2)	(3)	(4)
	Panel A. Controlling for In- and Out-migration Rates			
Mean Dep. Var.	*0.426*	*0.459*	*0.233*	*0.208*
Post × Islamist Support	-0.060***	-0.055***	-0.054***	-0.058***
	(0.021)	(0.020)	(0.017)	(0.017)
Observations	16,491	16,491	12,349	12,349
R-squared	0.262	0.240	0.254	0.261
Number of Clusters	104	104	104	104
	Panel B. Lower Bound (in Magnitude) if Most Unfavorable Selective Migration			
Mean Dep. Var.	*0.422*	*0.456*	*0.278*	*0.248*
Post × Islamist Support	-0.052**	-0.048**	-0.047***	-0.050***
	(0.021)	(0.019)	(0.017)	(0.017)
Observations	16,345	16,345	12,203	12,203
Number of Modified Obs	613	613	613	613
R-squared	0.261	0.238	0.252	0.259
Number of Clusters	104	104	104	104
	Panel C. Assigning Households to District of Origin (DHS sample)			
Mean Dep. Var.	*0.281*	*0.286*	*0.117*	*0.111*
Post × Islamist Support	-0.041**	-0.038**	-0.010	-0.016
	(0.018)	(0.018)	(0.015)	(0.017)
Observations	5,782	5,699	5,297	5,235
Number of Reassigned Obs	340	340	340	340
R-squared	0.187	0.184	0.164	0.156
Number of Clusters	112	112	112	112

Back

Additional Supportive Evidence for a Demand Channel

2. **Trust Measures**
   - Trust measures from South Asia Barometer: 2005 and 2013
   - Outcome $= 1$ if individuals trust organization X *"a great deal"* or *"some"*
   - Caveats:
     - Geo-referenced at the province level.
     - We compare provinces with $>$ average support to MMA
     - We complement with an individual proxy for ideological alignment: TV ownership.

Effects on Trust Measures

	Dependent variables. Trust in:										
	Civil Service	Police	The Courts	Parliament	Political Parties	Army	Central Gov.	Provincial Gov.	Local Gov.	z-score	z-score (ex. Army)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Mean Dep. Var.	*0.46*	*0.53*	*0.49*	*0.47*	*0.58*	*0.50*	*0.53*	*0.50*	*0.58*	*0.00*	*0.00*
	Panel A. Effects on Trust										
Post x (Islamist Support > Avg)	-0.076**	-0.135***	-0.065*	-0.093**	-0.187***	0.144***	-0.052	0.012	0.086**	-0.081*	-0.127**
	(0.039)	(0.036)	(0.039)	(0.039)	(0.036)	(0.035)	(0.039)	(0.039)	(0.039)	(0.049)	(0.051)
Observations	3,252	3,252	3,252	3,252	3,252	3,252	3,252	3,252	3,252	3,252	3,252
R-squared	0.054	0.208	0.029	0.054	0.215	0.204	0.050	0.041	0.055	0.069	0.100
	Panel B. Effects on Trust by Ownership of TV										
Post x (Islamist Support > Avg)	0.040	-0.101**	-0.034	-0.031	-0.098**	0.158***	0.000	0.108**	0.149***	0.045	0.011
	(0.050)	(0.045)	(0.051)	(0.050)	(0.047)	(0.042)	(0.050)	(0.050)	(0.050)	(0.063)	(0.065)
Post x (Isl. Support > Avg)	-0.275**	-0.217**	-0.121	-0.149	-0.293***	0.109	-0.243**	-0.268**	-0.083	-0.345***	-0.415***
x No TV	(0.107)	(0.097)	(0.103)	(0.106)	(0.096)	(0.096)	(0.105)	(0.106)	(0.103)	(0.136)	(0.139)
Observations	3,212	3,212	3,212	3,212	3,212	3,212	3,212	3,212	3,212	3,212	3,212
R-squared	0.054	0.209	0.034	0.056	0.222	0.215	0.052	0.045	0.058	0.071	0.102

Back

Effects on Trust Measures (Interaction Coefficients)

	Dependent variables. Trust in:								
	Civil Service	Police	The Courts	Parliament	Political Parties	Central Government	Provincial Government	Local Government	z-score
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Mean Dep. Var.	*0.46*	*0.53*	*0.49*	*0.47*	*0.58*	*0.53*	*0.50*	*0.58*	*0.00*
	Panel A. Effects on Trust								
Post	0.136***	0.447***	0.113***	0.152***	0.494***	0.065**	-0.048*	0.062**	0.358***
	(0.026)	(0.023)	(0.026)	(0.026)	(0.023)	(0.026)	(0.027)	(0.026)	(0.033)
Post x (Isl Support > Average)	-0.076**	-0.135***	-0.065*	-0.093**	-0.187***	-0.055	0.013	0.086**	-0.128**
	(0.039)	(0.036)	(0.039)	(0.039)	(0.036)	(0.039)	(0.039)	(0.039)	(0.051)
Observations	3,265	3,265	3,265	3,265	3,265	3,265	3,265	3,265	3,265
R-squared	0.054	0.207	0.028	0.054	0.213	0.050	0.041	0.055	0.099
	Panel B. Effects on Trust by Ownership of TV								
Post	0.038	0.439***	0.074*	0.088**	0.434***	0.006	-0.141***	0.003	0.237***
	(0.038)	(0.032)	(0.039)	(0.038)	(0.035)	(0.038)	(0.038)	(0.037)	(0.048)
No TV	-0.144***	-0.001	-0.029	-0.093**	-0.100**	-0.083**	-0.129***	-0.102**	-0.171***
	(0.042)	(0.035)	(0.043)	(0.042)	(0.039)	(0.042)	(0.042)	(0.042)	(0.055)
Post x No TV	0.186***	0.060	0.218***	0.115*	0.068	0.157**	0.231***	0.027	0.266***
	(0.066)	(0.059)	(0.065)	(0.067)	(0.061)	(0.066)	(0.068)	(0.067)	(0.082)
Post x (Isl Support > Average)	0.040	-0.101**	-0.034	-0.031	-0.098**	0.000	0.108**	0.149***	0.008
	(0.050)	(0.045)	(0.051)	(0.050)	(0.047)	(0.050)	(0.050)	(0.050)	(0.065)
Post x (Isl Support > Average) x NO TV	-0.275**	-0.217**	-0.121	-0.149	-0.293***	-0.243**	-0.268**	-0.083	-0.414***
	(0.107)	(0.097)	(0.103)	(0.106)	(0.096)	(0.105)	(0.106)	(0.103)	(0.138)
	3,225	3,225	3,225	3,225	3,225	3,225	3,225	3,225	3,225
	0.054	0.208	0.033	0.055	0.220	0.053	0.045	0.058	0.100

Additional Supportive Evidence for a Demand Channel

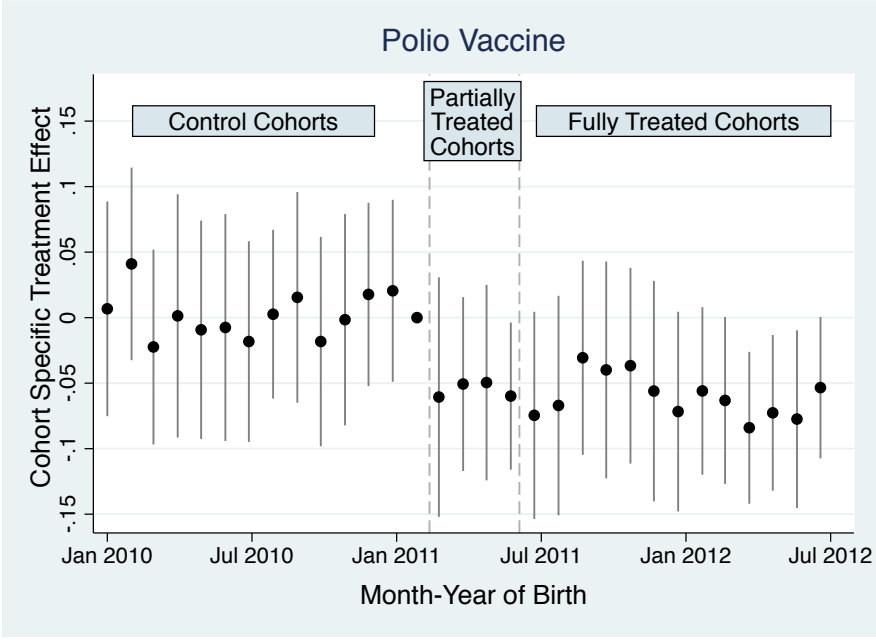
3. **Heterogeneous Effects by Gender of the Child**
   - Some of the rumors spread by the Taliban argued that vaccination was a "conspiracy to sterilize the Muslim population," *girls* in particular (Scientific American, 2013)
   - If parents lent credibility to these rumors, we expect larger declines in vaccination take-up for girls.

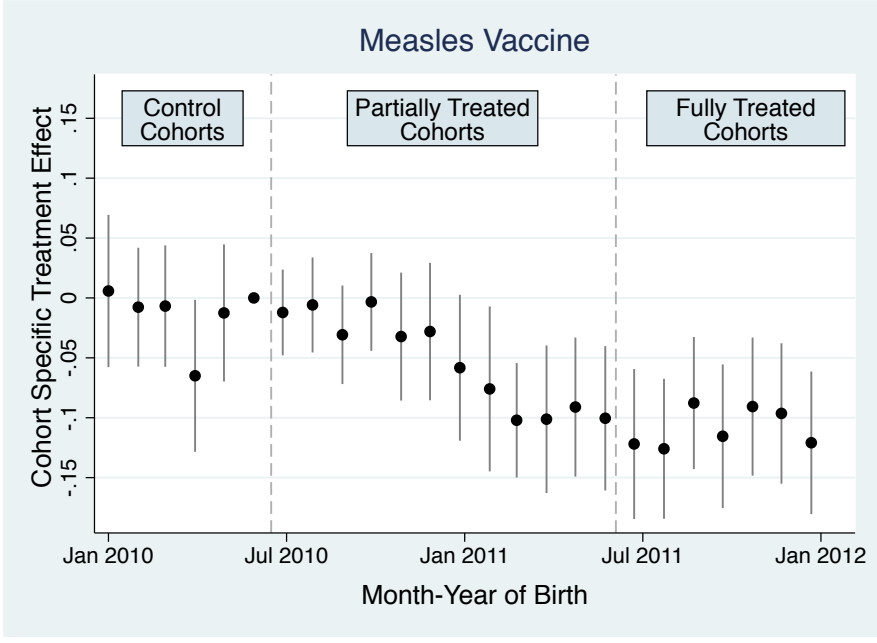
Heterogenous Effects by Gender of the Child

	Dependent Variables:			
	Polio	DPT	Measles	All Vaccines
	(1)	(2)	(3)	(4)
	Panel A. 1st Dose of Each Vaccine			
Mean Dep. Var.	*0.420*	*0.453*	*0.279*	*0.250*
Post × Islamist Support	-0.047**	-0.041**	-0.043**	-0.044***
	(0.020)	(0.019)	(0.017)	(0.017)
Post × Islamist Support x Female	-0.028**	-0.032**	-0.024	-0.029
	(0.013)	(0.016)	(0.018)	(0.018)
Observations	16,654	16,654	12,479	12,479
R-squared	0.263	0.242	0.253	0.259
Number of Clusters	109	109	109	109

Back

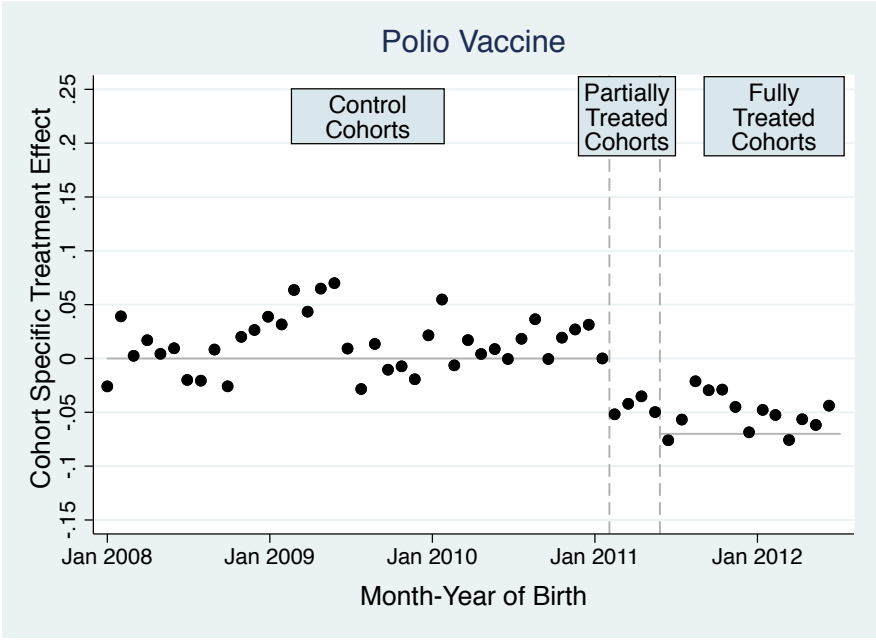
Cohort-Specific Treatment Effects (with Confidence Intervals)

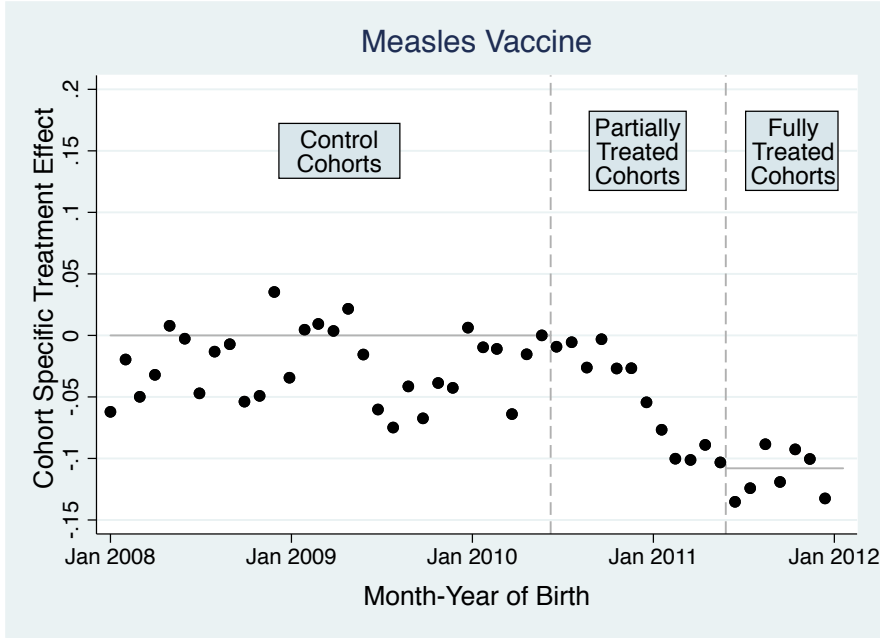




Back

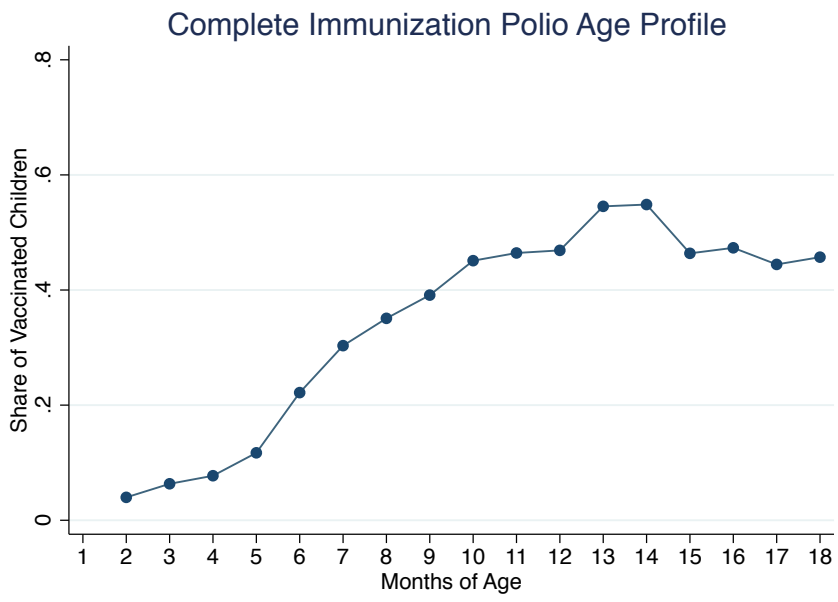
Cohort-Specific Treatment Effects (Longer Pre-Trend)

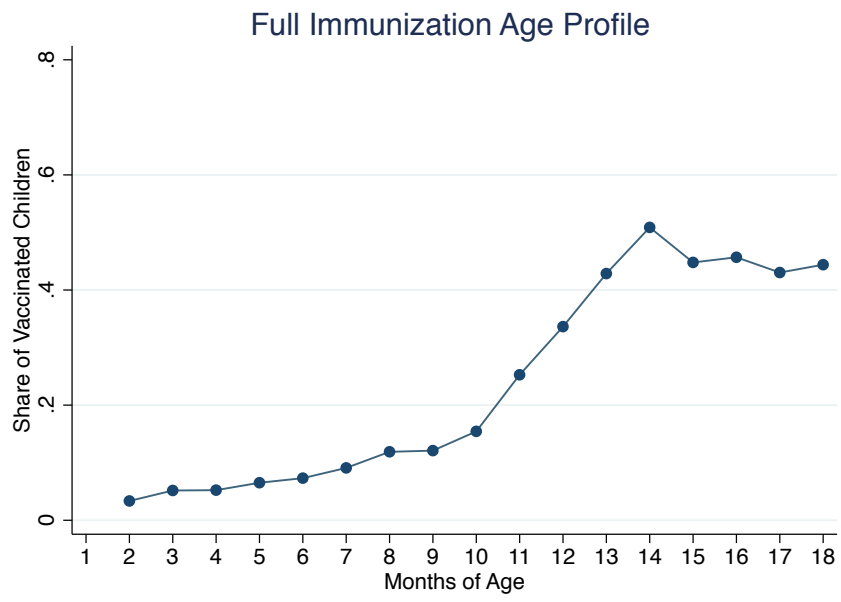




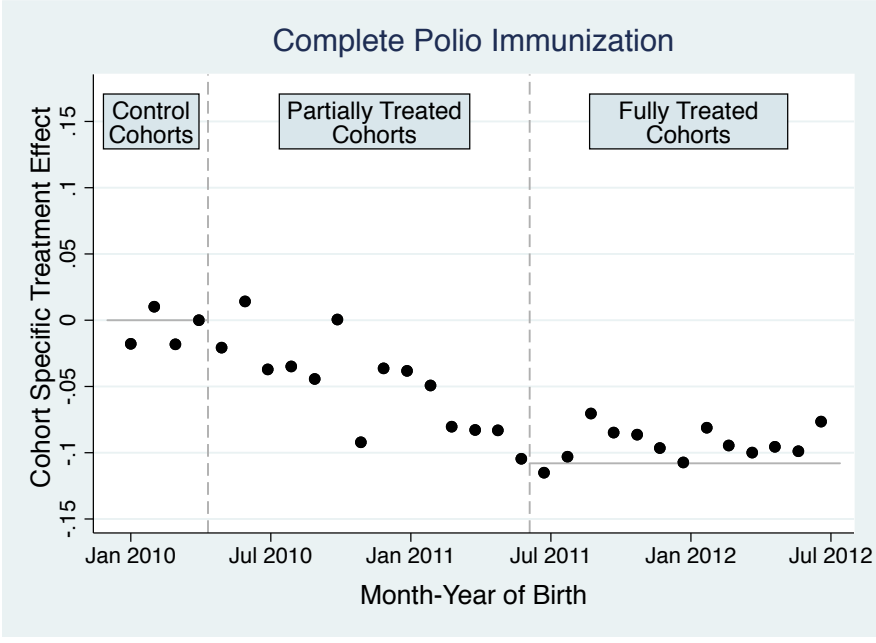
Back

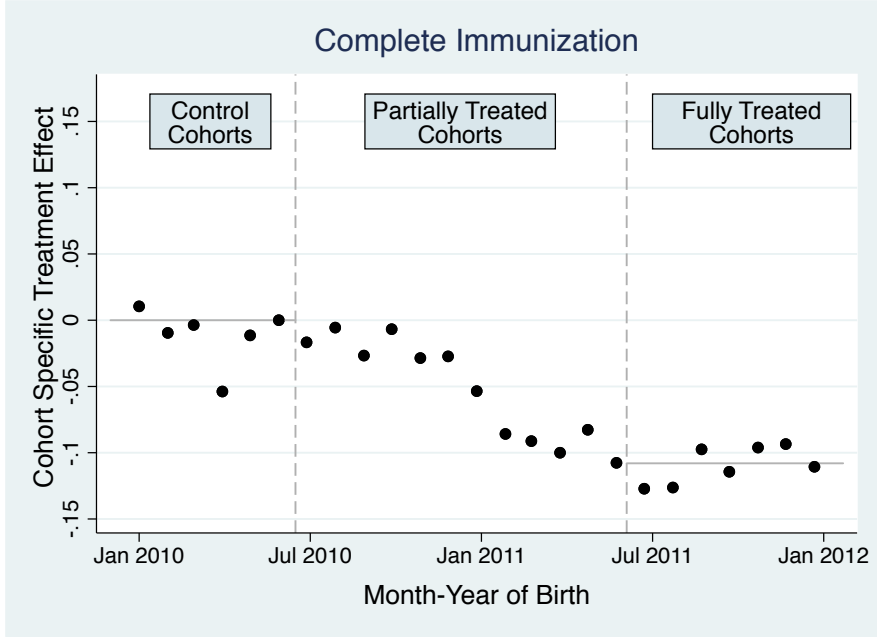
Full Immunization Age Profiles of Vaccines (Pre-Treatment)





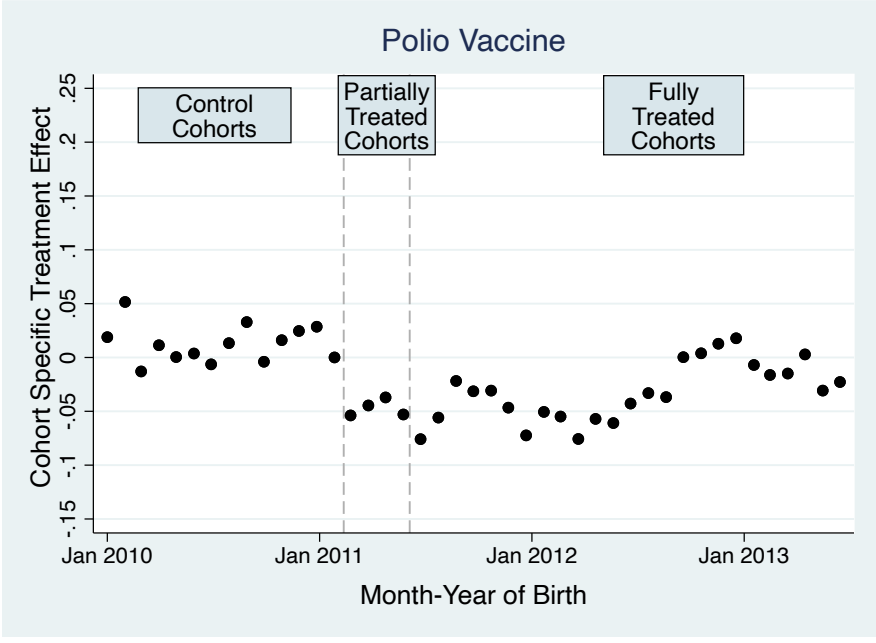
Treatment Effects by Monthly Cohort (Full Immunization)

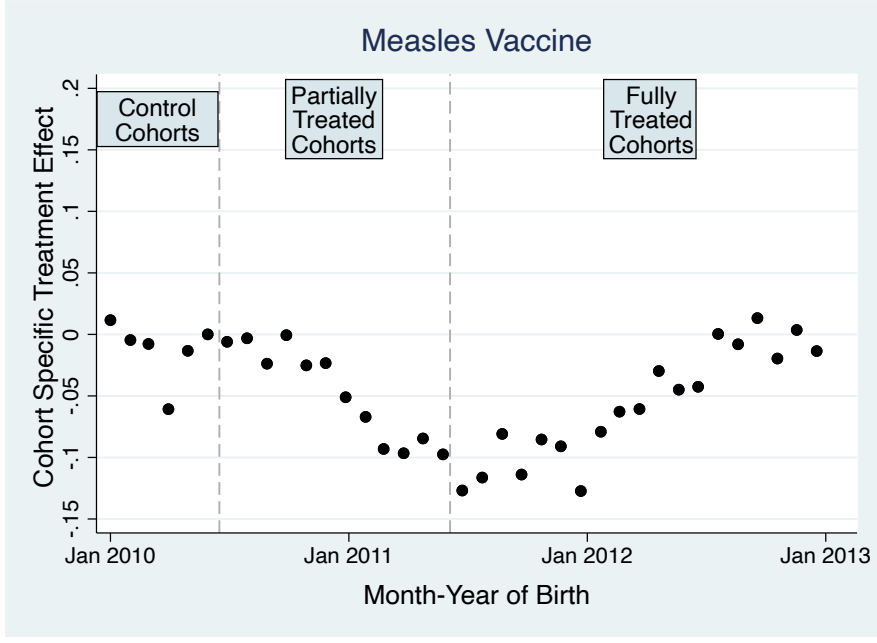




Back

Treatment Effects by Monthly Cohort (Medim-Run Effects)





▸ Back ▸ Back Conclusions

Treatment Intensity: Support for Islamist parties

- Our measure of support for Islamist groups, I_j obtained from provincial legislative elections in 2008.
- Electoral districts smaller than districts.
- We aggregate the vote shares for the Islamist coalition MMA at the district-level, weighting by population.
- To ease interpretation I_j is expressed in standard deviations
- One standard deviation, corresponds to 11.3% vote share

Back

Anecdotal Evidence of Changes in Beliefs (I)

From the article: **"'We Believed Our Cleric': Pakistani Polio Victim's Regretful Father Urges Others To Use Vaccine".**
Radio Free Europe Radio Liberty

> *"Hamid Aziz says he listened to the advice of a cleric in his village, who announced over loudspeakers of the madrasah, a local Islamic religious school, that the vaccine was "not good" for children's health, and prevented it from being administered to any of his sons."*
>
> *"Nooran Afridi, a pediatrician at a private clinic in Pakistan's Khyber tribal region, says one of the biggest obstacles to eradicating polio in Pakistan has been 'refusals' stemming from 'antipolio propaganda' spread by conservative Islamic clerics in 'backward areas.' "*

Anecdotal Evidence of Changes in Beliefs (II)

The article also describes the CIA vaccine ruse and anti-vaccine propaganda as a contributing factors to vaccine skepticism.

> *"Antipolio propaganda also has been fueled by distrust in Western governments who fund vaccine programs—particularly after the CIA staged a fake hepatitis vaccination campaign in 2011 to confirm the location of Al-Qaeda leader Osama bin Laden in Abbottabad, Pakistan."*

Back

Additional Supportive Evidence for a Demand Channel

2. **Trust Measures**
   - Trust measures from South Asia Barometer: 2005 and 2013
   - Outcome $= 1$ if individuals trust organization X *"a great deal"* or *"some"*
   - Caveats:
     - Geo-referenced at the province level.
     - We compare provinces with $>$ average support to MMA
     - We complement with an individual proxy for ideological alignment: TV ownership.

Effects on Trust Measures

	Dependent variables. Trust in:										
	Civil Service	Police	The Courts	Parliament	Political Parties	Army	Central Gov.	Provincial Gov.	Local Gov.	z-score	z-score (ex. Army)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Mean Dep. Var.	*0.46*	*0.53*	*0.49*	*0.47*	*0.58*	*0.50*	*0.53*	*0.50*	*0.58*	*0.00*	*0.00*
	Panel A. Effects on Trust										
Post x (Islamist Support > Avg)	-0.076**	-0.135***	-0.065*	-0.093**	-0.187***	0.144***	-0.052	0.012	0.086**	-0.081*	-0.127**
	(0.039)	(0.036)	(0.039)	(0.039)	(0.036)	(0.035)	(0.039)	(0.039)	(0.039)	(0.049)	(0.051)
Observations	3,252	3,252	3,252	3,252	3,252	3,252	3,252	3,252	3,252	3,252	3,252
R-squared	0.054	0.208	0.029	0.054	0.215	0.204	0.050	0.041	0.055	0.069	0.100
	Panel B. Effects on Trust by Ownership of TV										
Post x (Islamist Support > Avg)	0.040	-0.101**	-0.034	-0.031	-0.098**	0.158***	0.000	0.108**	0.149***	0.045	0.011
	(0.050)	(0.045)	(0.051)	(0.050)	(0.047)	(0.042)	(0.050)	(0.050)	(0.050)	(0.063)	(0.065)
Post x (Isl. Support > Avg)	-0.275**	-0.217**	-0.121	-0.149	-0.293***	0.109	-0.243**	-0.268**	-0.083	-0.345***	-0.415***
x No TV	(0.107)	(0.097)	(0.103)	(0.106)	(0.096)	(0.096)	(0.105)	(0.106)	(0.103)	(0.136)	(0.139)
Observations	3,212	3,212	3,212	3,212	3,212	3,212	3,212	3,212	3,212	3,212	3,212
R-squared	0.054	0.209	0.034	0.056	0.222	0.215	0.052	0.045	0.058	0.071	0.102