The Dynamics of Investment Projects: Evidence from Peru

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Disclaimer: Opinions herein are those of the authors and do not necessarily reflect those of the Central Reserve Bank of Peru.

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Empirical strategy

What is the paper about?

- Use investment projects announcements gathered by the BCRP
- 1109 projects from 2009 to 2015-10
- Studies the dynamics of projects states: confirmed, unconfirmed, cancelations, revisions
- Studies the dynamics of projects states: delays in time to completion
- What are the main drivers of these states? What is the role of commodity prices?

Main findings

Commodity prices and volatility affect project decisions in all sectors

- Mining: $\downarrow$ prices or $\uparrow$ price volatility $\Rightarrow$ $\uparrow$ probability project is unconfirmed
- Other sectors: $\uparrow$ price volatility $\Rightarrow$ $\uparrow$ probability project is unconfirmed or revised.
- $\downarrow$ prices or $\uparrow$ price volatility $\Rightarrow$ $\uparrow$ probability of delays
- $\downarrow$ prices $\Rightarrow$ $\downarrow$ probability of completion

Results in line with expert survey

Mining expert panel survey

- Central bank survey on mining experts
- Key Question: Three most important causes of delays in new mining projects

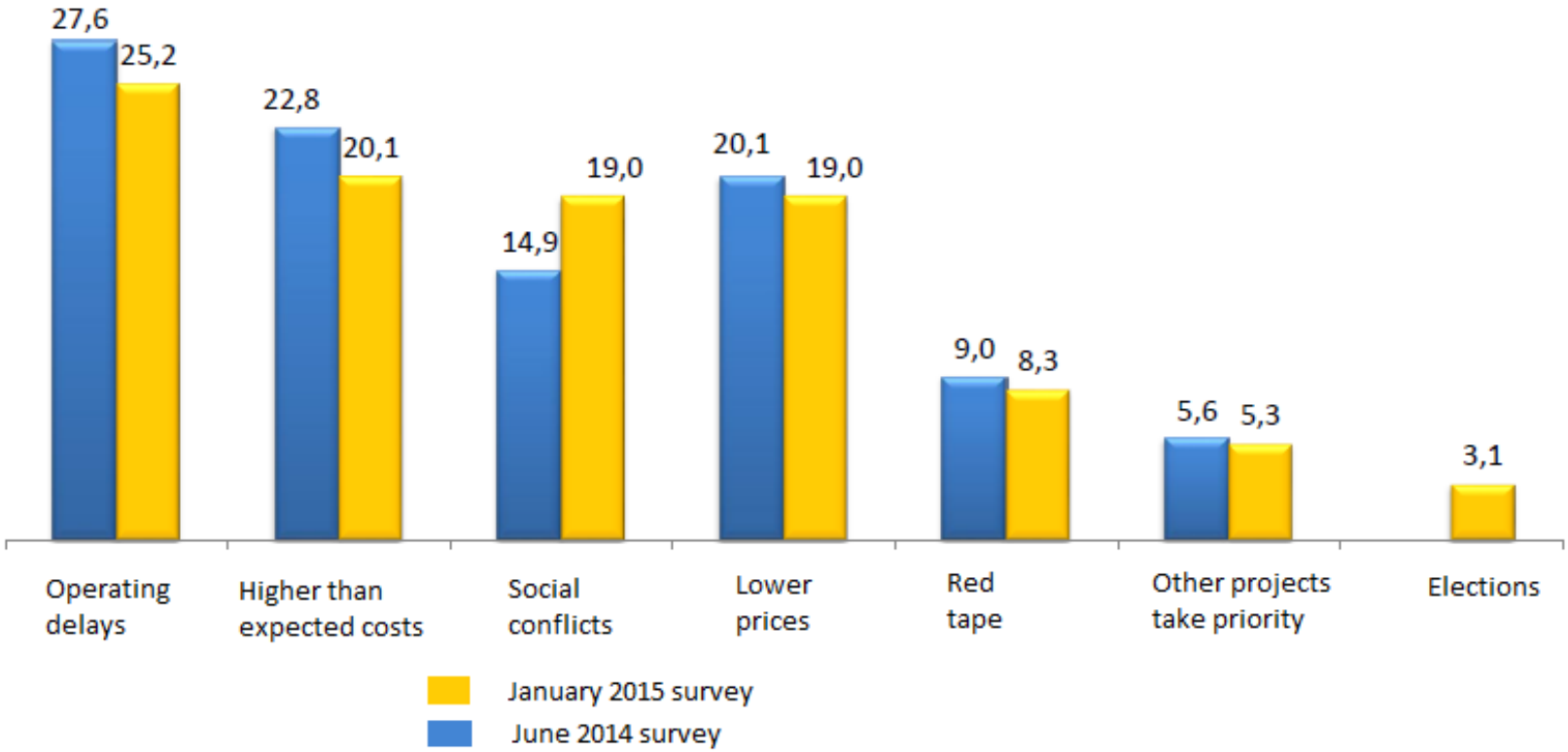

Figure: Causes of new mining project delays (in percent)

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Overview of investment data

Monthly

- 1109 announced investment projects in all sectors of the economy from 2009 to 2015-10
- Collected by Central Bank of Peru - Economics and Information Department
- Investment projects announcements: Old and new projects and their status
- Status: Confirmed, not confirmed, under revision, canceled
- Sources: Media and press releases, surveys
- Covers all sectors: Mining, hydrocarbons, electricity, industrial, agro-industry, telecom, fishing, others

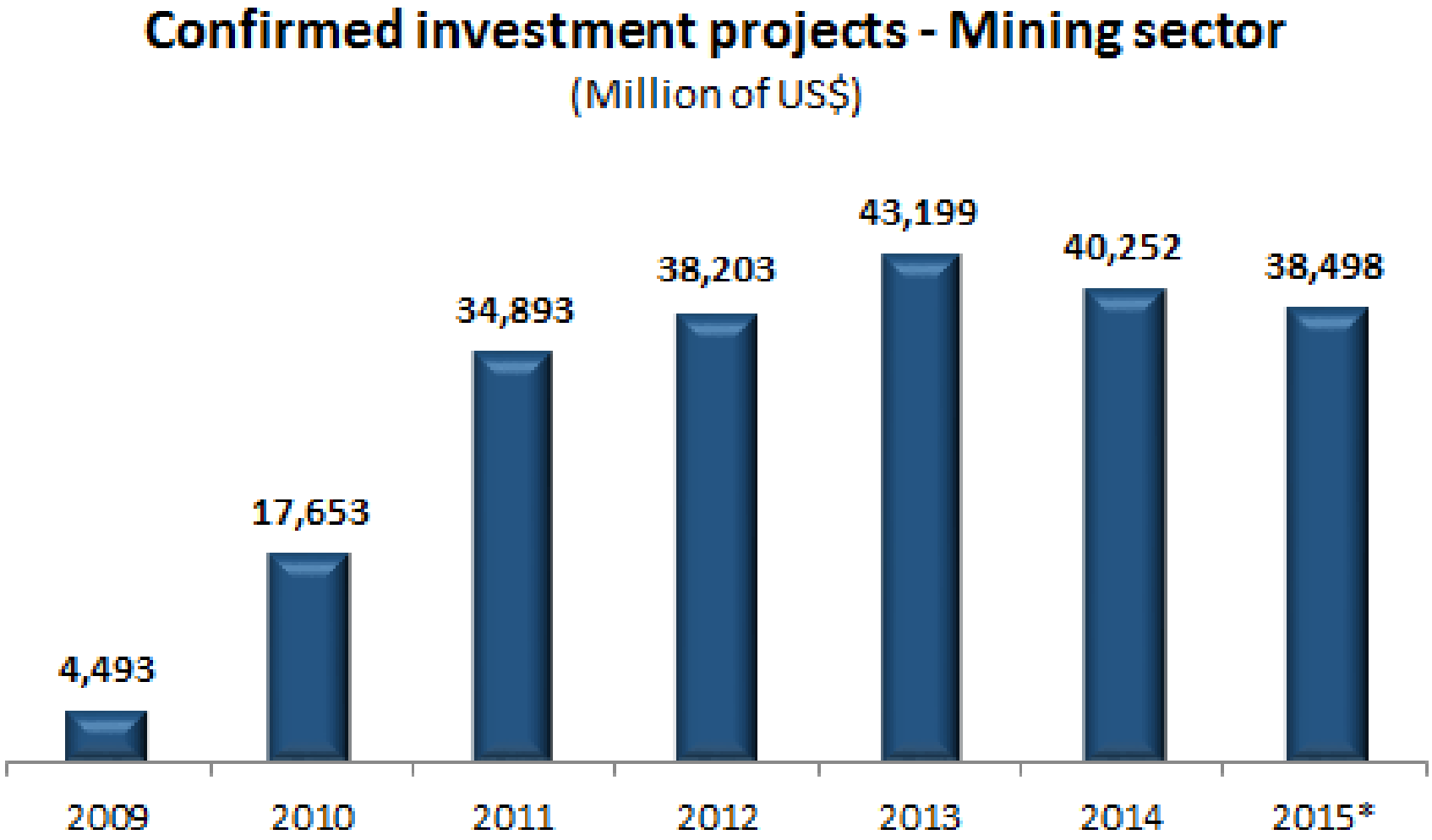
Overview of macro data

Monthly

- Terms of trade, commodity prices (big four metals: copper, gold, silver, zinc), return volatility.
- Social conflicts.
- Copper cash costs.

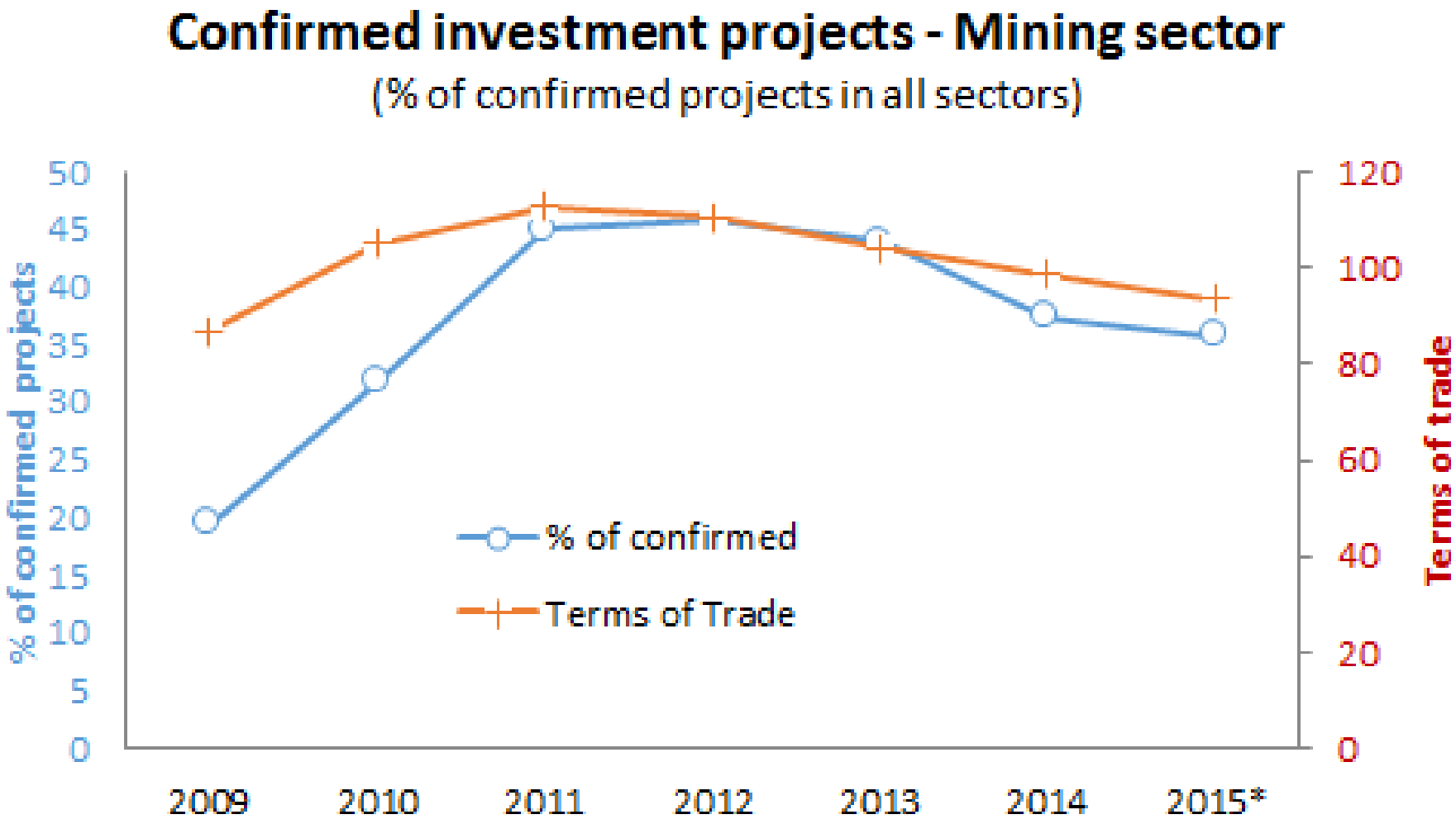
Confirmed investment projects: mining sector

Millions of USD



Confirmed projects and terms of trade

Confirmed projects as percentage of confirmed projects in all sectors



Project transitions: 2012

Initial state	Transition			
	Confirmed	Unconfirmed	Canceled	Completed
Confirmed	88.1	1.4	2.0	8.5
Unconfirmed	2.0	93.9	2.0	2.0
Canceled	0.0	0.0	100.0	0.0
Completed	0.0	0.0	0.0	100.0

Project transitions: 2015

Initial state	Transition			
	Confirmed	Unconfirmed	Canceled	Completed
Confirmed	96.7	0.0	1.3	2.0
Unconfirmed	0.0	100.0	0.0	0.0
Canceled	0.0	0.0	100.0	0.0
Completed	0.0	0.0	0.0	100.0

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Related literature

- Uncertainty and investment: Dixit and Pindyck (1994)
  - Bromander & Åtland (2012): An Empirical Study of Sequential Investments with Time-To-Build.
  - Kaldahl & Ingebrigtsen, (2014): Sequential investment in gas fired power plants: A real options analysis.
  - Marmer & Slade (2013): Investment and uncertainty with time to build: Evidence from US copper mining.
  - Bloom (2009): The impact of uncertainty shocks
  - Byun & Jo (2015): Heterogeneity in the dynamic effects of uncertainty on investment.
- Aggregate investment effects of commodity price shocks
  - Fornero et al (2015): Terms of Trade Shocks and Investment in Commodity-Exporting Economies
  - Dungey et al (2014). Chinese resource demand and the natural resource supplier
  - Carrière-Swallow & Céspedes (2013): The impact of uncertainty shocks in emerging economies.

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Empirical strategy and results

- Probability of unconfirmed projects
- Delayed projects
- Competing risks

First overview

Dependent variable: Proportion of unconfirmed mining projects

	(1)	(2)	(3)	(4)	(5)	(6)
lag_y	0.894***	0.894***	0.886***	0.872***	0.884***	0.884***
	(0.054)	(0.067)	(0.059)	(0.058)	(0.069)	(0.069)
Conflicts	-0.032			-0.005		
	(0.042)			(0.041)		
Env. conflicts		0.009			-0.017	-0.017
		(0.066)			(0.054)	(0.054)
Conflict ratio			0.032			
			(0.061)			
Margin	0.012*	0.011	0.013*			
	(0.006)	(0.008)	(0.007)			
Log terms of trade				0.095*	0.087	0.087
				(0.051)	(0.058)	(0.058)
Constant	0.212	-0.002	0.024	-0.328	-0.243	-0.243
	(0.234)	(0.314)	(0.046)	(0.331)	(0.430)	(0.430)

Marginal effects on the probability of unconfirmed projects in all sectors of the economy

Prob (confirmed)	Marginal effects					
	Mining		Other sector		All sectors	
Comm price growth	-0.0169	*	-0.0019		-0.0109	*
Comm price volatility	0.0407	*	0.0112	*	0.0482	*
Foreign ownership	-6.69e-06	*	-1.87e-06	*	-8.53e-06	*
Total financing (size)	0.0009	*	0.0003		0.0010	*
Conflict	-0.0066	*	-0.0005		-0.0032	*

* denotes that the coefficient is statistically significant at the 5 percent level.

Delayed projects

Logit regression

$$delay_{it} = \alpha_{0i} + \alpha_1 growth_{it} + \alpha_2 volat_{it} + \alpha_3 X_{it} \qquad (1)$$

- $growth_{it}$: year on year percentage price change
- $volat_{it}$: standard deviation of the last 12 months.
- X_{it}: control variables
  - $conflict_{it}$: number of social conflicts.
  - $financ_{it}$: amount of financial funding for the investment project.
  - fdi_{it}: amount of funding that comes from foreign investors.
  - $volatn_{it}$: volatility of commodity prices in periods of a downward trend in these prices.

Marginal effects: Probability of delay in investment projects in all sectors of the economy

Variable	Marginal effects					
	Mining		Other sectors		All sectors	
Comm price growth	-0.0266	*	-0.0052		-0.0439	*
Comm price volatility	-0.0864	*	0.1362	*	0.0156	
Comm price volatility (downward)	0.0664	*	-0.0045		0.0154	
Foreign ownership	2.73e-06	*	7.70e-07		1.30e-06	*
Total financing (size)	-0.0003	*	0.0001		-0.0001	
Conflict	-0.0094	*	-0.0167	*	-0.0145	*

* denotes that the coefficient is statistically significant at the 5 percent level.

Marginal effects: Probability of delay in investment projects in the mining sector

Variable	Marginal effects Mining	
Comm price growth	-0.0138	**
Comm price volatility	-0.0469	**
Comm price volatility (downward)	0.0466	*
Foreign ownership	1.78e-06	**
Total financing (size)	-0.0002	**
Conflict	0.0032	*

* denotes that the coefficient is statistically significant at the 5 percent level,
** denotes that the coefficient is statistically significant at the 10 percent level.

Marginal effects: Probability of delay in other sectors

Variable	Marginal effects					
	Hydrocarbons		Electricity		Infrastructure	
Comm price growth	-0.0127		-0.0097		-0.0043	
Comm price volatility	0.1807	*	-0.0886		0.0362	*
Comm price volatility (downward)	-0.0127		-0.0023		-0.0004	
Foreign ownership	-0.00001	*	9.02e-06	*	3.06e-07	
Total financing (size)	0.0010	*	-0.0001		0.0001	*
Conflict	-0.0351	*	-0.0218	*	0.0106	*

NOTE: * denotes that the coefficient is significant to 5 percent.

Determinants of announced delays in investment in the mining sector

Announced delay (in number of months)

	(1)		(2)		(3)		(4)	
Comm price growth	-0.4688	*	-0.1102	**	0.0163		-0.0008	
Comm price volatility	0.7692	*	0.0227		-1.0252		-1.0262	*
Comm price volatility (downward)	—		1.3147	*	1.2381	*	1.3020	*
Foreign ownership	0.0396	*	0.0385	*	0.0284	*	0.0294	*
Total financing (size)	0.0015	*	0.0014		0.0009	*	0.0011	*
Conflict (total)	-0.0477		-0.0335		—		—	
Mining conflicts	—		—		0.0444	*	—	
Environmental conflicts	—		—		—		0.0144	*

NOTE: * and ** denote that the coefficient is significant to 5 and 10 percent, respectively.

Marginal effects: Probability of delay. Differentiated effects between large and small projects

	All sectors		Mining		Other	
Comm price growth	-0.0787	*	-0.0911	*	-0.0091	
Comm price growth (big projects)	0.0461	*	0.0806	*	0.0029	
Comm price volatility	0.0502	*	-0.0661	*	0.1467	*
Comm price volatility (big projects)	-0.0636	*	-0.0291		-0.0206	
Comm price volatility (downward)	-0.034	*	-0.0364	**	0.0131	
Comm price volatility (downward, big projects)	0.0718	*	0.1326	*	-0.0325	
Foreign ownership	1.26e-06		2.90e-06	*	6.90e-07	
Total financing (size)	-0.0001		-0.0003	*	0.0001	
Conflict	-0.0144	*	-0.0090	*	-0.0174	*

NOTE: * and ** denote that the coefficient is significant to 5 and 10 percent, respectively.

Competing risks: Number of projects according to status

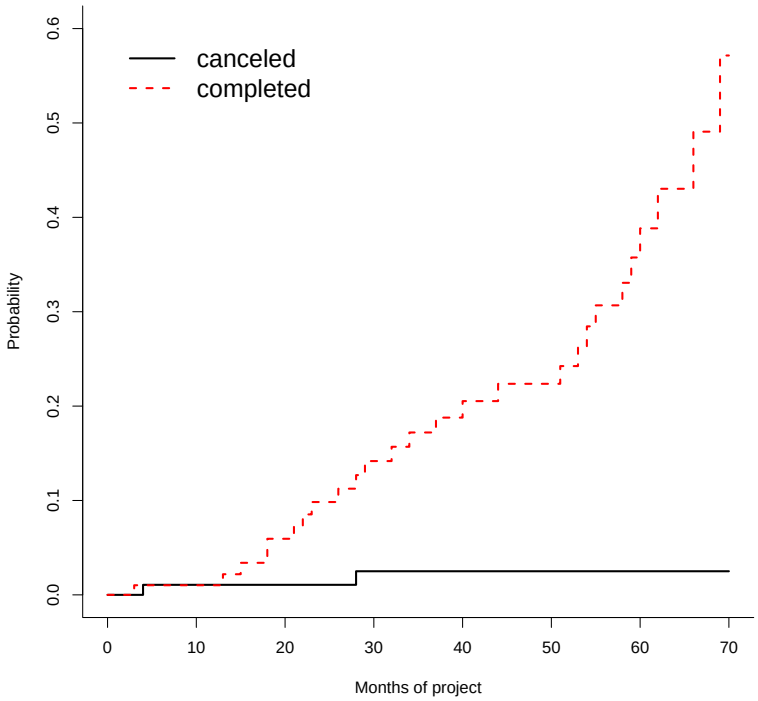
	Sector	Censored	Canceled	Completed
1	Agro-industry	40	0	3
2	Electricity	73	2	26
3	Hydrocarbon	54	1	15
4	Industry	88	2	18
5	Infrastructure	56	3	18
6	Mining	86	3	18
7	Other	483	2	75
8	Fishing	10	0	4
9	Telecom	27	0	2

Competing risks: Average time of projects according to status

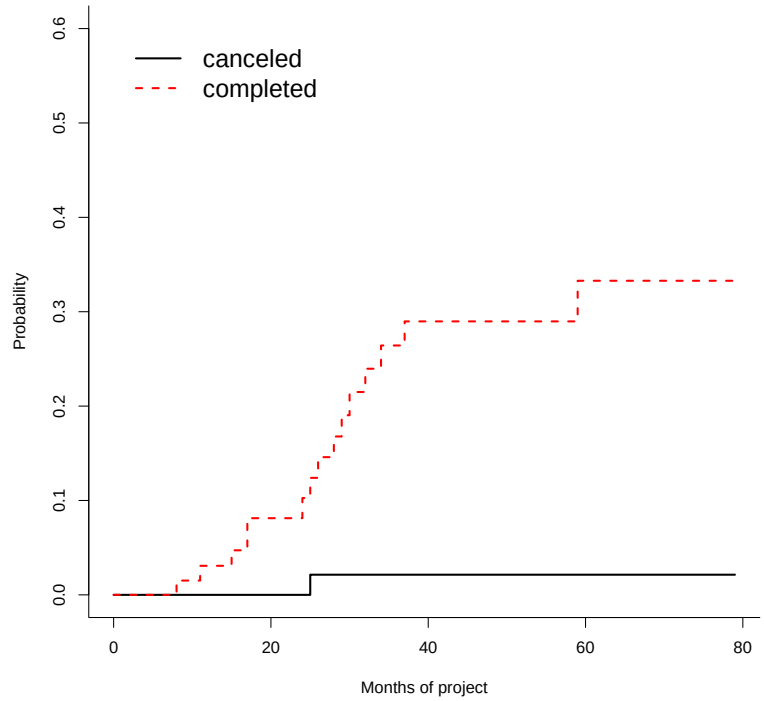
Sectors	Censored	Canceled	Completed
Agro-industry	34.3		15.3
Electricity	36.3	16.0	38.1
Hydrocarbon	39.6	25.0	26.1
Industry	34.8	20.0	25.7
Infrastructure	43.7	7.0	25.9
Mining	45.4	38.3	26.1
Other	32.5	25.0	16.2
Fishing	35.2		16.3
Telecom	36.0		37.0

Competing risks: Cumulative incidence function by sector

Electricity

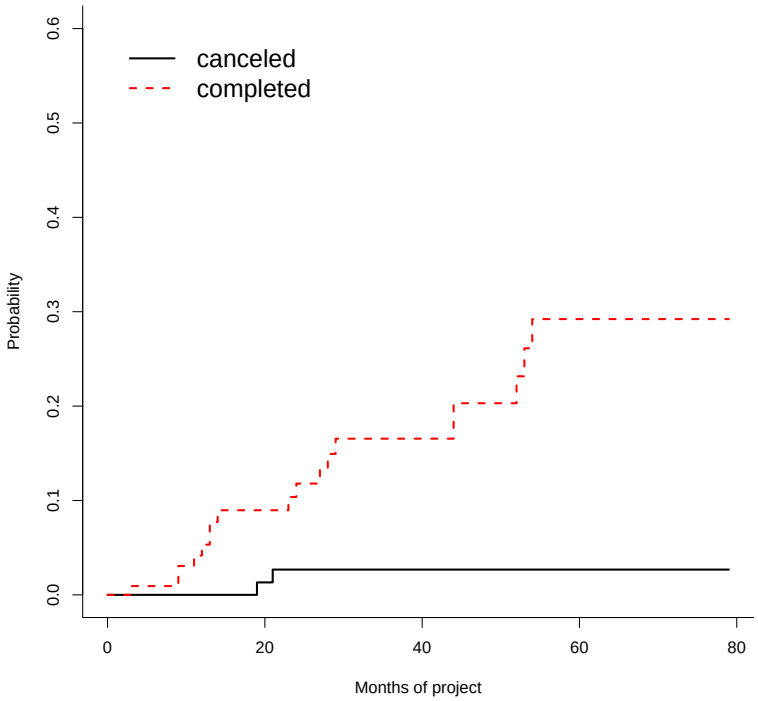


Hydrocarbons

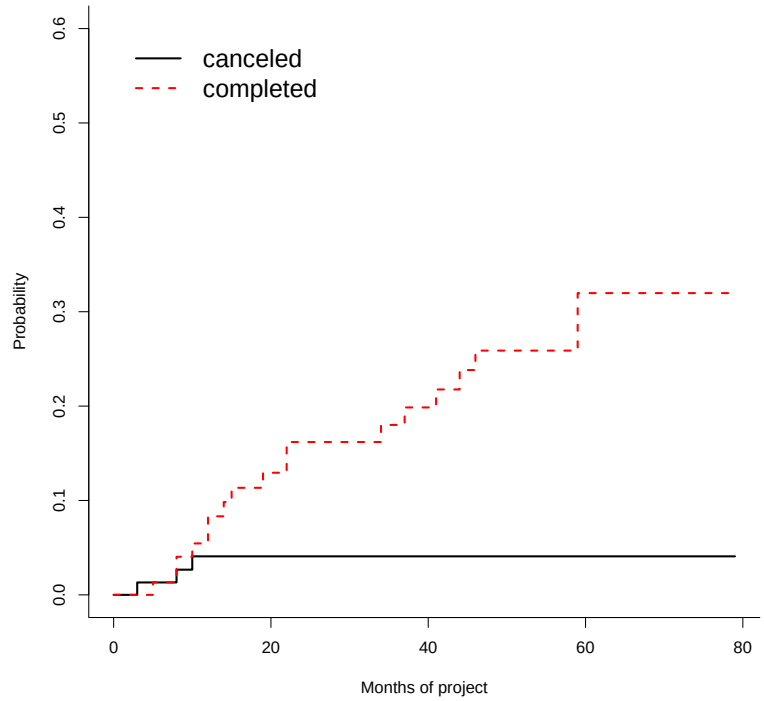


Competing risks: Cumulative incidence function by sector

Industry

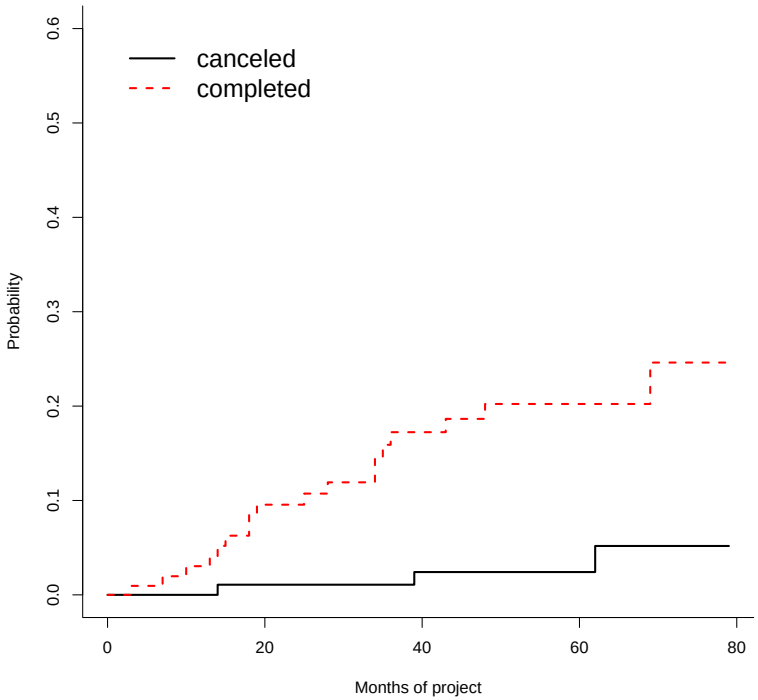


Infrastructure

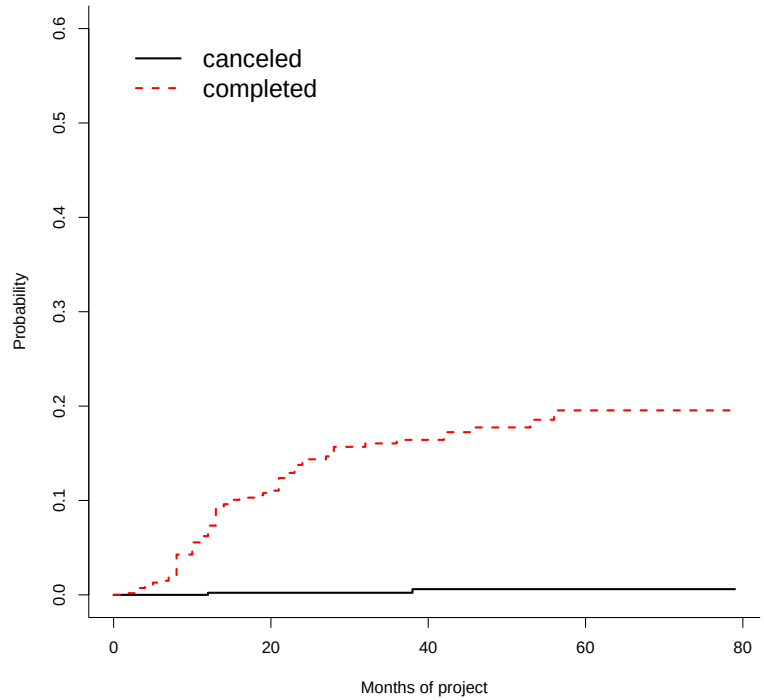


Competing risks: Cumulative incidence function by sector

Mining

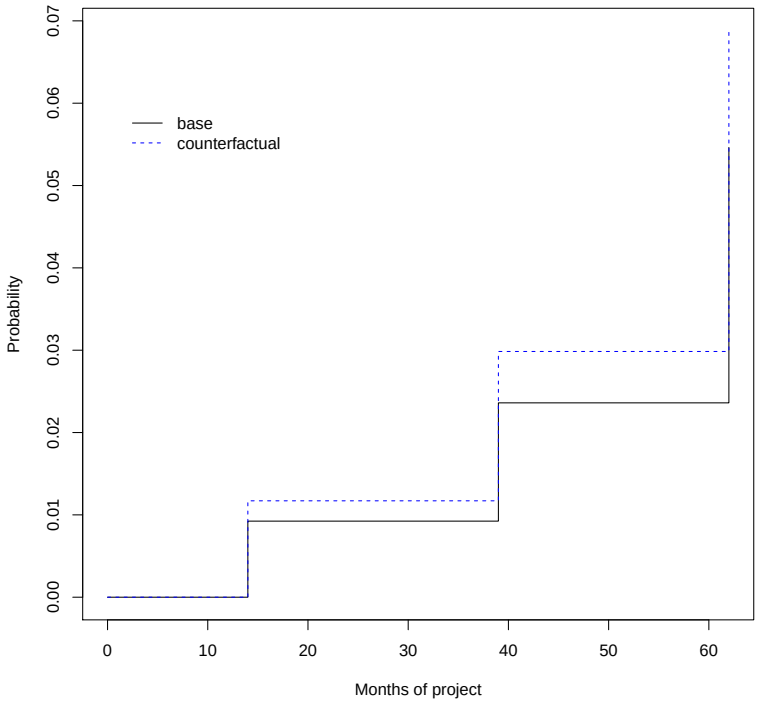


Other

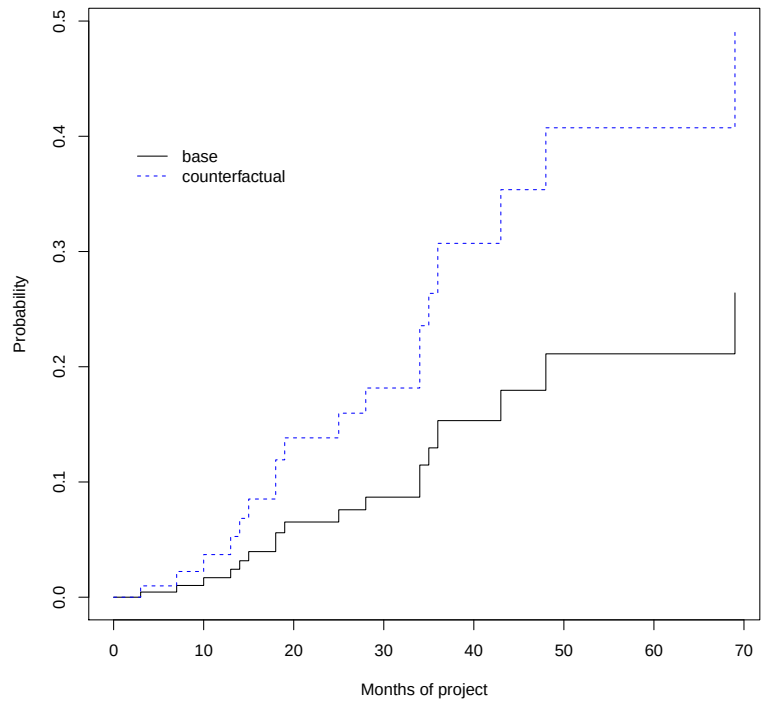


Competing risks: Predicted CIFs under base and counterfactual case

Cancelation



Completion



Next steps

- Use commodity futures for regressions on delays.
- Endogeneity of social conflicts to commodity price fluctutations.
- Robustness checks
  - Eliminate unconfirmed projects from the sample
  - Regroup good (confirmed, completed) vs bad outcomes (unconfirmed, under revision, canceled)
  - Multistate models and competing risks