Enforcing Public-Private Partnership Contract: Role of Incentive Contract and Fiscal Institution

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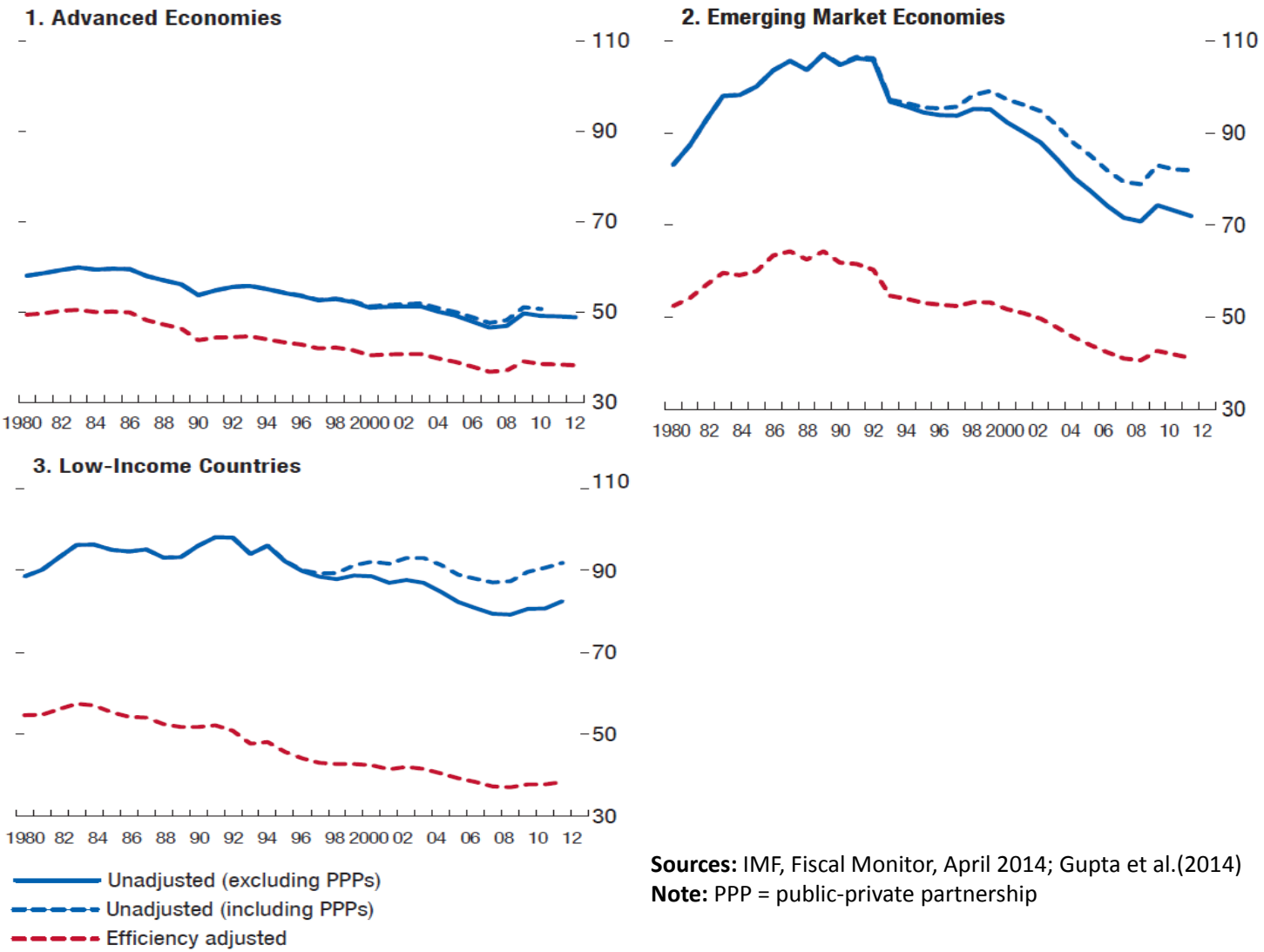
Declining trend in public capital stock ratio (in percent of GDP), partly reflecting inefficiencies



Sources: IMF, Fiscal Monitor, April 2014; Gupta et al.(2014)
Note: PPP = public-private partnership

Motivation - How can we successfully develop PPPs?

- Rising interest in the introduction of PPPs to fill in infrastructure gap and revert downward trend of capital stock ratio.
- Elevated risk in contractual dispute due to the challenge in managing fiscal risk and contractual complexities of PPPs.

- This paper focuses on three issues:
  1. Contract design (risk allocation scheme)
  2. Fiscal institution (public financial management)
  3. Safety-net (sovereign guarantees)

- Questions:
  - How should contract be structured to reduce disputes?
  - What is the impact of sovereign guarantees on outcomes in PPPs?
  - What is the role of fiscal institution (PFM) in PPP projects?

Outline

- Background
- Bargaining model
  - User-pay contract
  - Availability-pay contract
- Data
- Hazard analysis
- Conclusion

Background - PPP contract type and risk allocation

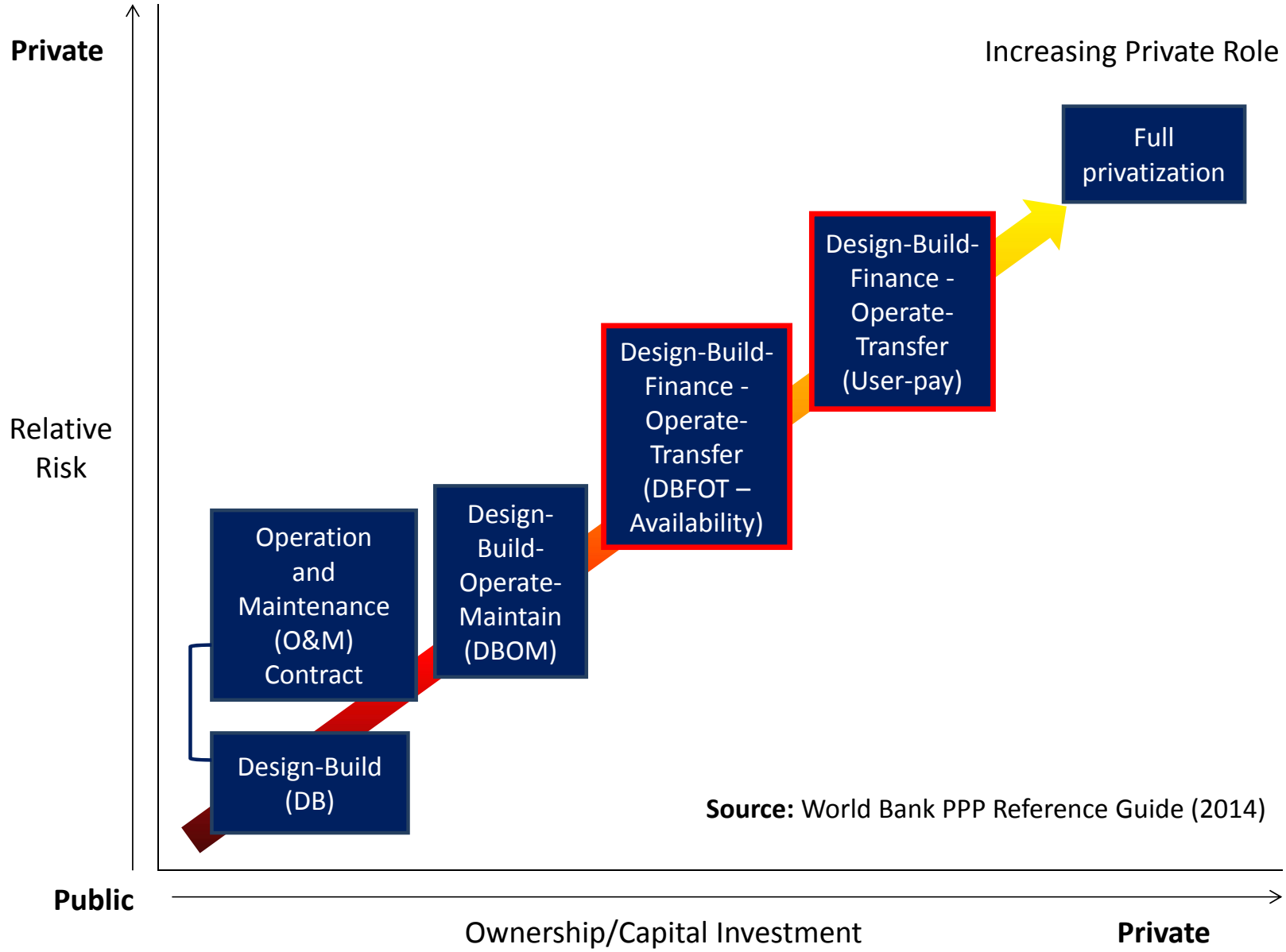
Degree of risk transfer to private sector alters by the combinations of three factors:

1. Involvement of private sector: (i) Design, (ii) Build, (iii) Finance, (iv) Operate, and (v) Maintenance

2. Compensation scheme:
   - **User-pay**: private sector collects toll from service users
   - **Government-pay**: government pays fixed (availability) payment to private sector for their service provision

3. Ownership of asset

Public-Private Partnership Spectrum



Bargaining Model of PPPs

- Assume Build-operate-transfer (BOT) contract
- Financial obligation can be either (i) user-pay ($\lambda = 1$) or (ii) availability-pay contract ($\lambda = 0$)
- Government offers contract $\phi = (I, \lambda, p, \bar{\alpha})$
- If $\lambda = 1$, government may provide the minimum revenue guarantee to cover market demand risk for shortfalls in revenues ($pq < \underline{pq}$ with probability $1 - \beta$)
- The firm finances investment I from (i) loan contract (C) and (ii) own equity investment (M)
- The firm decides whether or not to accept the contract based on the participation constraint (PC)
- The government decides whether or not to honor the contract based on (i) NPV of project's return, (ii) residual value of the asset, and (iii) the fiscal cost of providing sovereign guarantees

User-pay contract

- Demand risk exists (government may issue a revenue guarantee to promote private sector participation)

- Firm's PC (expected profit $\geq$ NPV of capital cost)

$$\beta(\chi)pq + (1-\beta(\chi))\underline{pq} - c_1(z,\chi)q - d \geq \frac{rM}{1-e^{-rT}} \tag{1}$$

where $\beta(\chi)$: probability of guarantee not trigerred ($\beta'(\chi) > 0$), c_1: firm's operation cost ($c'_{1,\chi}(z,\chi) < 0$), z: input price, χ: quality of PFM, d: loan repayment, T: contract period

- Government's decision (renege contract if $W_{NH} \geq W_H$)

$$rI + (1-\beta(\chi))(\underline{pq} - pq) - \underbrace{[c_2 - c_1(z,\chi)]}_{\text{Value for money}} q + d \geq [\frac{e^{-r\tau} - e^{-rT}}{r}]^{-1} R(\sigma) \tag{2}$$

where c_2: government's operation cost, R: reputation cost, σ: political constraint ($R'(\sigma) > 0$), τ: year of disputes

Availability-pay contract

- No demand risk exists, no guarantee
- Firm's PC

$$\bar{\alpha} - c_1(z, \chi) - d \geq \frac{rM}{1 - e^{-rT}} \tag{3}$$

where $\bar{\alpha}$: availability payment

- Government's decision

$$rI - [c_2 - c_1(z, \chi)]q + d \geq [\frac{e^{-r\tau} - e^{-rT}}{r}]^{-1} R(\sigma) \tag{4}$$

Theoretical predictions

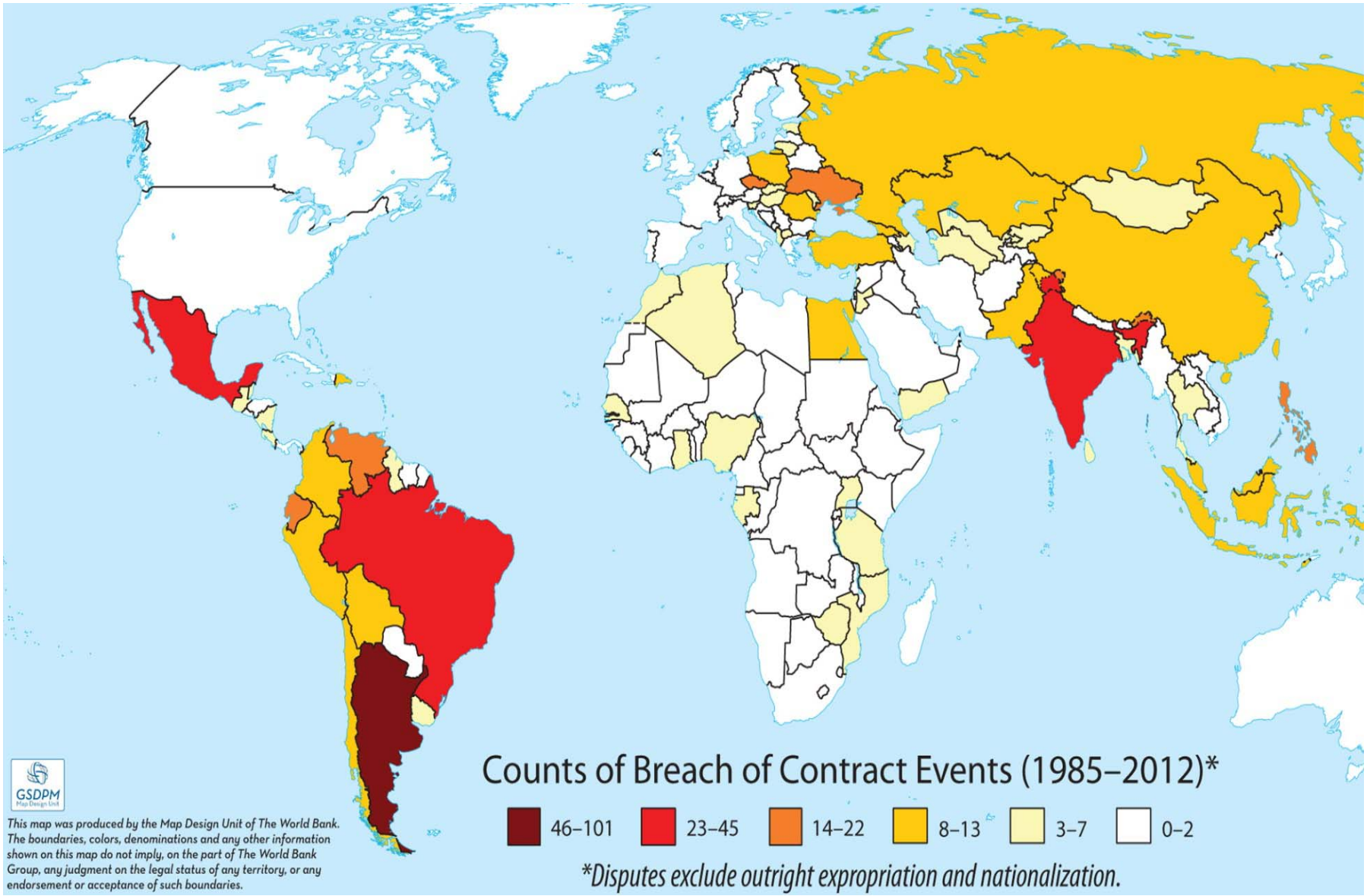
- Effect of fuel price shock: higher input prices (i) bind the firms PC and increase firm-led disputes and (ii) reduce the value for money (VfM) and increase government-led disputes
- Effect of sovereign guarantee: greater provision of guarantees relaxes the firm's PC but increases government-led disputes for an accumulation of contingent liability
- Effect of PFM: under the user-pay contract, better PFM reduces the government-led disputes by containing contingent fiscal risk
- Political constraint: higher reputation cost in face of stronger political constraint reduces government-led disputes (Tomz and Wright, 2010)
- Obsolescing bargain: longer duration of contract increases government-led disputes (Woodhouse, 2006)

Data

- **World Bank's PPI database**: 5,237 public-private infrastructure contracts signed in 146 emerging economies and low-income countries from 1984-2012
  - Focus on 4,277 greenfield or concession contracts (excluding cases of nationalization and outright expropriations)
  - Project status (completed, under construction, cancelled, in disputes)
  - Origin of disputes
  - Year of contract award and timing of disputes are recorded
  - Other (contract and procurement type, sector, supports from multilateral donors)

- **UNCTAD's Treaty-based investor-state dispute settlement database**: 394 cases from 1987-2010

Disputes were clustered in some regions



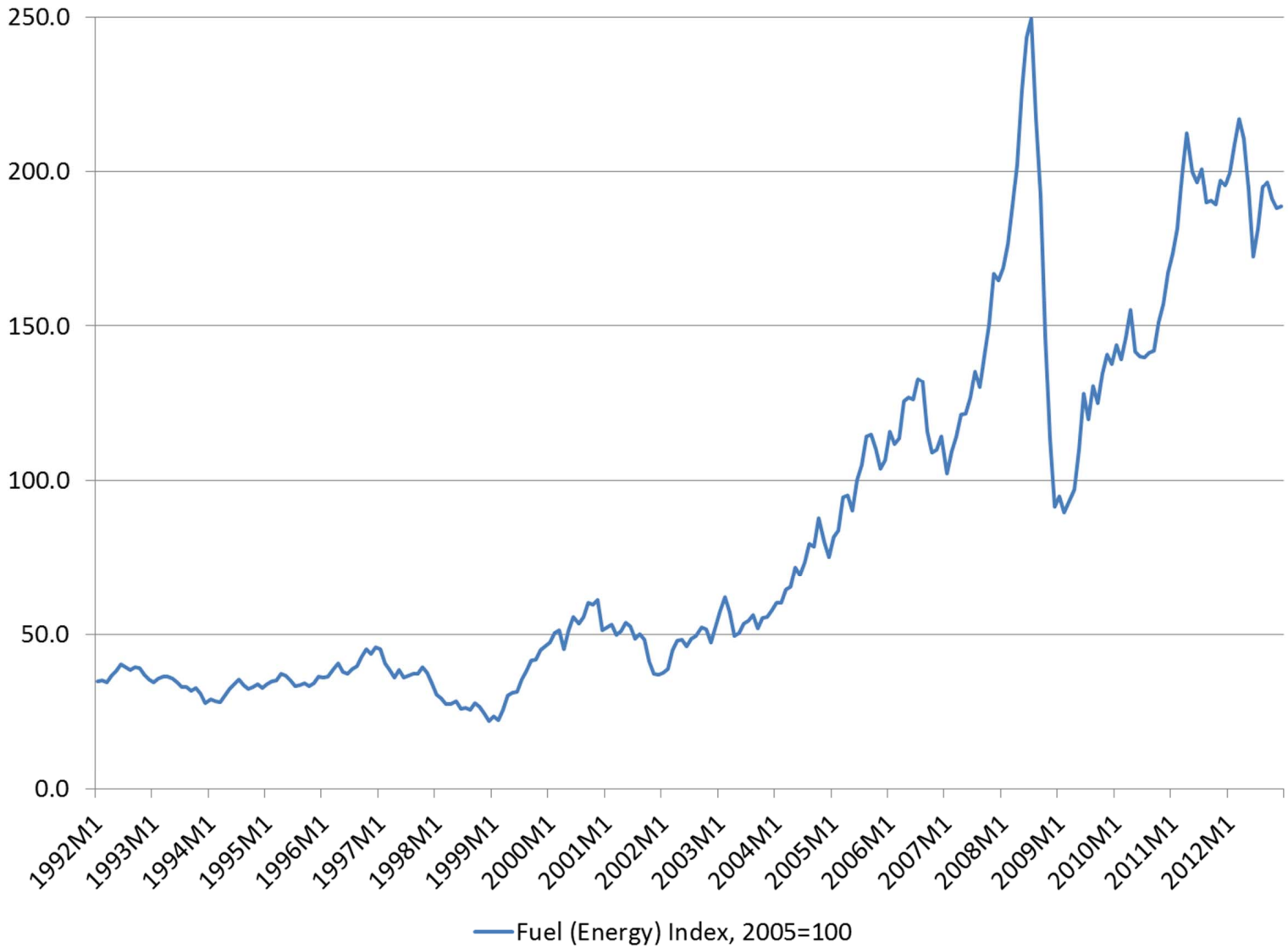
Variable construction

- Input price shock: based on (i) global prices of three major commodities (oil, natural gas, and coal) and (ii) share of energy sources ϕ_{ict}

$$E[\Delta \text{Input cost}_{i,t_1}] = \sum_{c=1}^{3} \phi_{ic,t_1}(\ln p_{ic,t_1} - \ln p_{ic,t_1-1}) \tag{5}$$

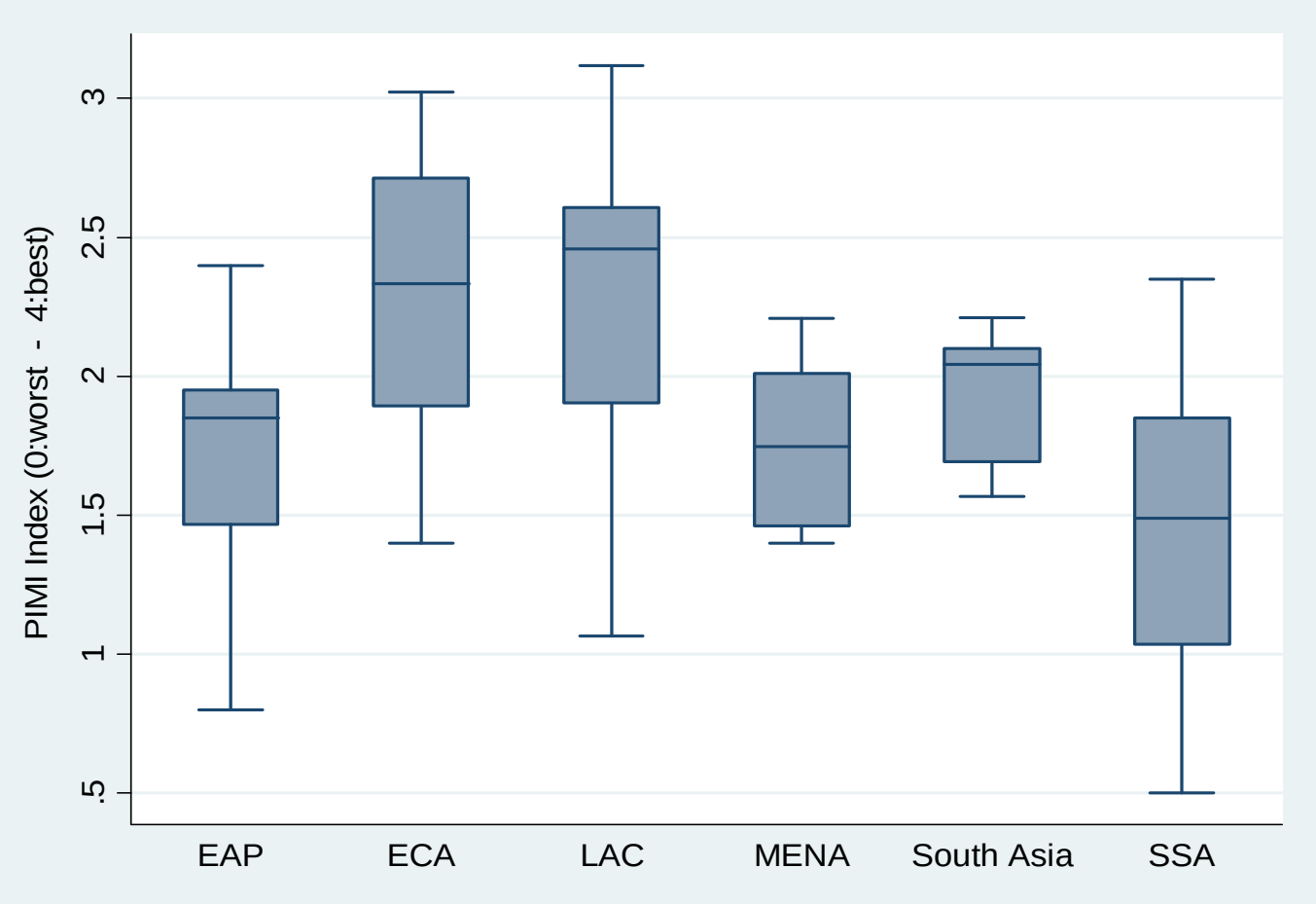
- A new PFM index:
  - Original PIMI index for 71 countries (Dabla-Norris et al, 2012)
  - Additional PFM index to extend the coverage to the Middle East and Central Asian countries and other emerging and low-income countries (IMF, 2014, 2015)
  - Imputed PIMI index based on the World Bank's governance indicators for missing countries

Rising fuel price and high volaility



Source: IMF: Primary Commodity Price Index

Distribution of the new PFM index



Sources: Dabla-Norris et al (2012), IMF (2014a, 2015), author's calculation
Note: Y-axis indicates the PIMI index which ranges from 0 (worst PFM system) to 4 (best PFM system). The box plot depicts the distribution of the PIMI index across regional groups, with the middle line indicating median, the lower and upper boundaries of the box 25th and 75th percentiles, respectively, and the lower and upper lines 10th and 90th percentiles, respectively.

Hazard model

- Duration of contract: $A_i = t_1 - t_0$
- If contract is on-going in 2012, the observations are right-censored. Observed duration is defined as $A_i = min(A_i^*, c)$
- The density for uncensored contracts $f(A_i|x_i;\theta)$. The probability of A_i is censored if $P(A_i^* \geq c|x_i)$
- Maximum-likelihood estimation:

$$L = \sum_{i=1}^{N} \left\{ d_i \log[f(A_i|x_i;\theta)] + (1 - d_i)\log[P(A_i^* \geq c|x_i)] \right\} \quad (6)$$

where $x_i = [X_{1,i}, X_{2,c}, \kappa, D_j]$. $X_{1,i}$ and $X_{2,c}$ are contract and country characteristics. κ and D_j are regional and sector dummies

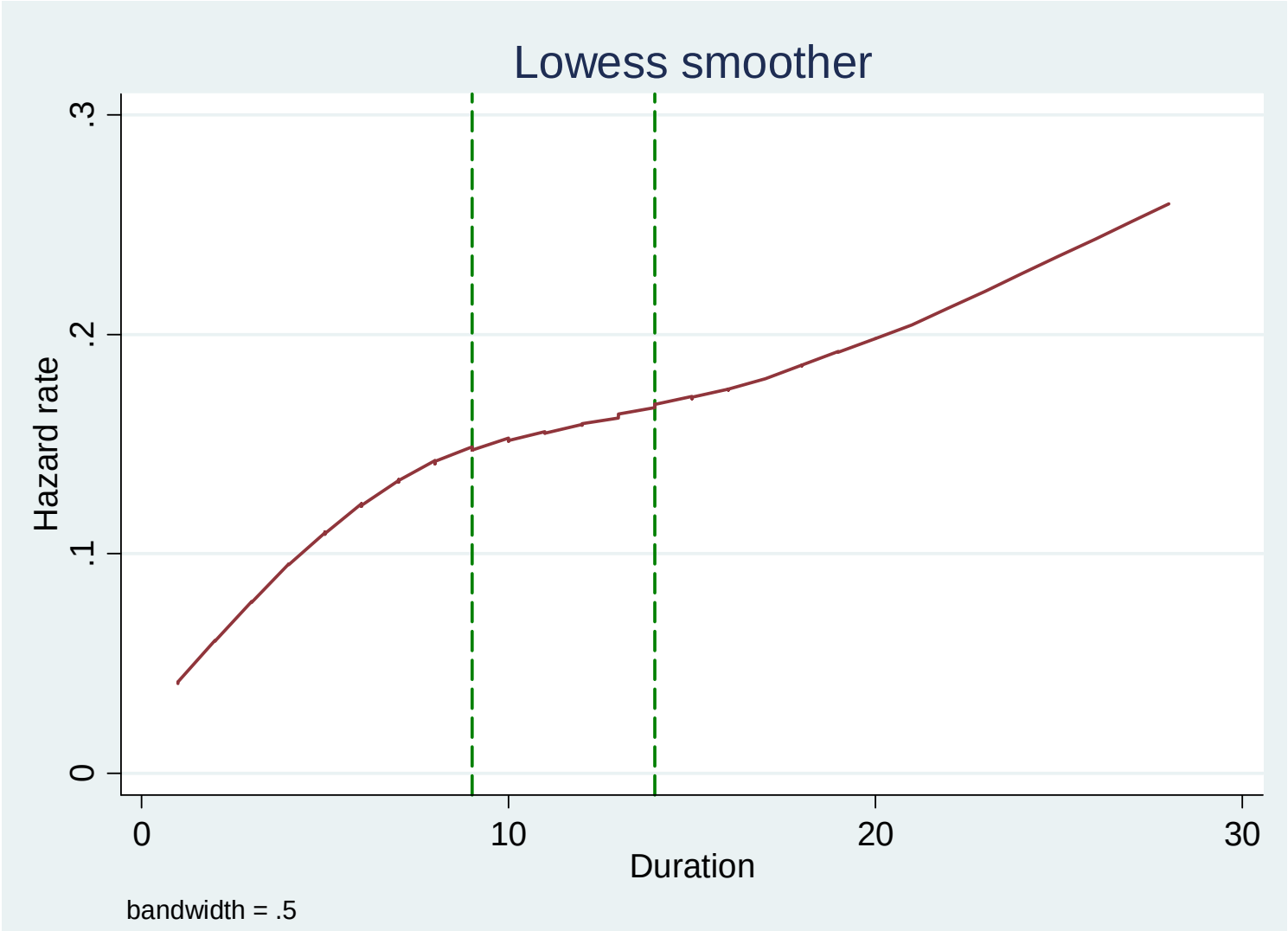
- With $\hat{\theta}$, hazard function is estimated assuming that the density function follows the Weibull distribution

Baseline result

	(1)	(2)	(3)	(4)	(5)	(6)
Partnership with IFI (IFI)[1]	0.167	0.070	0.045	0.094	0.067	0.040
	(0.103)	(0.104)	(0.122)	(0.149)	(0.150)	(0.123)
Private share above 80% $= x$	0.468***	0.507***	0.473***	0.407***	0.411***	0.482***
	(0.043)	(0.046)	(0.050)	(0.058)	(0.057)	(0.051)
$x \times$ IFI	-0.527***	-0.438***	-0.500***	-0.554***	-0.549***	-0.486***
	(0.113)	(0.114)	(0.131)	(0.157)	(0.160)	(0.133)
Democracy	-0.544***	-0.158***	-0.331***	-0.446***	-0.470***	-0.327***
	(0.049)	(0.060)	(0.062)	(0.070)	(0.069)	(0.063)
Duration of political leader		0.008***				
		(0.001)				
Change in input cost			1.938***	1.412***	1.404***	2.046***
			(0.293)	(0.347)	(0.352)	(0.298)
Sovereign guarantee					0.889***	
					(0.115)	
Concession contract						0.191***
						(0.042)
Constant	-3.987***	-14.207***	-24.455***	-20.669***	-21.437***	-24.944***
	(0.083)	(2.456)	(2.796)	(3.030)	(3.442)	(2.902)
Duration dependence						
Ln(α)	0.491***	0.519***	0.672***	0.650***	0.663***	0.676***
	(0.013)	(0.014)	(0.014)	(0.016)	(0.017)	(0.014)
Observations	4050	3999	3614	2481	2481	3614
Region and sector FEs	Y	Y	Y	Y	Y	Y
Sample	All	All	All	Greenfield only	Greenfield only	All

[1] Note: ***p<0.01, **p<0.05, *p<0.1; Standard errors are corrected for heteroskedasticity. The regression includes the log of GDP per capita in 2000 and the square term, and the average growth rate of real GDP per capita during the contractual period.

Obsolescing bargain: Dispute risk rises as contract matures, especially above 14 years of contract age



PPP Contract Type and PFM System

	(1) Greenfield: BOT availability-pay	(2) Greenfield: BOT user-pay	(3) Concession	(4) Greenfield: w/ guarantee	(5) Greenfield: w/o guarantee
Partnership with IFI[1]	-0.694**	0.174	-0.289	-0.442	0.050
	(0.305)	(0.200)	(0.248)	(0.868)	(0.172)
Private share above 80% = x	-0.127	0.454***	0.636***	0.081	0.451***
	(0.184)	(0.069)	(0.102)	(0.323)	(0.067)
$x \times$ IFI	0.211	-0.602***	-0.070	-0.739	-0.514***
	(0.344)	(0.209)	(0.272)	(0.925)	(0.181)
Change in real GDP per capita	-3.019**	-1.307**	-3.490***	-9.413***	-1.794***
	(1.309)	(0.594)	(0.782)	(2.793)	(0.563)
Democracy	0.115	-0.486***	-0.043	0.784	-0.498***
	(0.192)	(0.081)	(0.141)	(0.553)	(0.076)
Change in input cost	1.023	1.231***	3.291***	1.549	1.095***
	(1.014)	(0.411)	(0.619)	(1.710)	(0.375)
Better PFM system	-0.366	-0.215**	-0.342	0.504	-0.255***
	(0.305)	(0.092)	(0.255)	(0.482)	(0.084)
Constant	-15.668**	-21.222***	-30.357***	-10.319	-19.643***
	(6.941)	(3.507)	(7.458)	(15.595)	(3.207)
Duration dependence					
Ln(α)	0.910***	0.619***	0.805***	0.786***	0.645***
	(0.047)	(0.018)	(0.028)	(0.059)	(0.017)
Observations	317	2019	1126	129	2207
Region and sector FEs	Y	Y	Y	Y	Y
Sample	All	All	All	All	All

[1] Note: ***p<0.01, **p<0.05, *p<0.1; Robust standard errors are in parenthesis. The regression includes the log of GDP per capita in 2000 and the square term.

Cohort analysis

	(1)		(2)		(3)	
	Cohort 1	Cohort 2	Cohort 1	Cohort 2	Cohort 1	Cohort 2
Partnership with IFI[1]	0.207	-0.231	0.308	-0.076	-0.026	-0.412
	(0.226)	(0.187)	(0.274)	(0.220)	(0.357)	(0.298)
Private share above 80% $= x$	-0.047	0.251***	-0.195*	0.228***	0.112	0.401***
	(0.091)	(0.064)	(0.107)	(0.074)	(0.220)	(0.104)
$x \times$ IFI	-0.317	-0.106	-0.445	-0.253	0.177	0.066
	(0.241)	(0.203)	(0.289)	(0.237)	(0.387)	(0.343)
Democracy	0.086	-0.188**	0.201	-0.232**	-0.352	-0.243
	(0.114)	(0.081)	(0.133)	(0.093)	(0.292)	(0.160)
Change in input cost	-0.048	0.943**	-0.041	0.312	0.509	1.996**
	(0.608)	(0.433)	(0.719)	(0.506)	(1.763)	(0.924)
Concession	0.151*	0.103*				
	(0.079)	(0.054)				
Sovereign guarantee			0.338	0.529***		
			(0.299)	(0.105)		
Oil, Gas, and Mining sector	0.251*	-0.335***	0.404**	-0.423***	-0.662**	-0.162
	(0.144)	(0.086)	(0.160)	(0.102)	(0.278)	(0.119)
Energy sector	0.169**	0.544***	0.324***	0.575***	-0.249	0.315
	(0.084)	(0.062)	(0.094)	(0.071)	(0.216)	(0.220)
Transport sector	-0.095	0.255***	-0.038	0.147*	-0.408**	0.284***
	(0.089)	(0.064)	(0.113)	(0.088)	(0.181)	(0.096)
Duration dependence						
Ln(α)	1.876***	0.825***	1.887***	0.806***	1.971***	0.916***
	(0.020)	(0.017)	(0.023)	(0.021)	(0.052)	(0.033)
Observations	1395	2219	940	1541	455	678
Region FE	Y	Y	Y	Y	Y	Y
Sample	All	All	Greenfield	Greenfield	Concession	Concession

[1] Note: ***p<0.01, **p<0.05, *p<0.1; Robust standard errors are in parenthesis. The regression includes the log of GDP per capita in 2000 and the square term, the average growth rate of real GDP per capita during the contractual period, and the constant term.

Conclusion

- Contracts transferring larger risk to private parties (especially user-pay contract and concession) faced more firm-led disputes.
- Dispute risk has been elevated in recent years due to the fuel cost overruns.
- The better PFM quality reduces disputes for the user-pay contract by strengthening project appraisal.
- Generally, PPP contract is more likely to be honored if government faces tighter political constraints (especially when multilateral partners are involved).
- Issuing sovereign guarantees could increase government-led disputes by accumulating contingent liabilities.
- Fiscal prudence is important in developing PPPs.

Next steps

- Disputes in the advanced economy?
- Effects of the PPP model contract and the standardized operational procedure (India, UK's business case model, Canada etc) on disputes?
- Robustness check based on the PPP-specific PFM quality (the PIMA index developed by IMF (2015))
- PPP and debt sustainability