Supplement to "Economic uncertainty and structural reforms: Evidence from stock market volatility"

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SA. Model

We present here a simplified version of the model in Bonfiglioli and Gancia (2013), which builds on Rogoff (1990) and Holmström (1999). There are two periods: in the first, a politician of unknown type θ makes an investment in reforms r with a payoff in the second period. At the end of the first period and after observing noisy signals of θ and r, citizens can replace the incumbent with a new draw. Elections serve the purpose of ousting bad politicians.[1] We use the word citizens to denote the set of individuals holding the political power to change the government, but it could equally be an elite. Expected utility of the representative citizen is

$$W = \mathbb{E}[y_t + \beta y_{t+1}],$$

where y_t is a measure of economic performance in period t, which depends on political actions, and $\beta \in (0, 1]$ is the discount factor. At time t, a citizen is randomly selected to conduct economic policy and for this he receives a reward $\gamma > 0$ for each period in power. His expected utility is

$$U = W + \gamma + \beta p \gamma, \tag{SA1}$$

where p is the perceived probability of staying in power in the second period. Economic performance depends on the type of the politician, θ_t, his choice of reforms, r, and a

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[1] In Bonfiglioli and Gancia (2013), politicians also choose effort and elections have an additional disciplining effect, consistently with Aruoba, Drazen, and Vlaicu (2018).

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random shock ε_t:

$$y_t = \theta_t - r + \varepsilon_t,$$
$$y_{t+1} = \theta_{t+1} + f(r) + \varepsilon_{t+1}.$$

Investing in reforms has an immediate cost $-r$ and a future return $f(r)$, with $f'(r) > 0$, $f''(r) < 0$, $f'(0) = \infty$ and $f'(\infty) = 0$. Type, θ_t, is unknown both to the citizens and to the incumbent, it is persistent and is drawn from a known distribution $\theta \sim N(\overline{\theta}, \sigma_\theta^2)$. Finally, ε_t is an i.i.d. shock, $\varepsilon \sim N(0, \sigma_\varepsilon^2)$.

The model is solved backward. Citizens face an inference problem: they want to keep a politician with a high θ, but they only observe a noisy signal, $y_t = \theta_t - r + \varepsilon_t$. Thus, they must form expectations on θ conditional on y_t. Since they know all distributions, they can predict the equilibrium level of reforms, r^e. Their optimal strategy is to keep the incumbent if the expectation of his type is above average, that is, if $y_t \geq \overline{y} \equiv \overline{\theta} - r^e$.

We now turn to the problem of the politician. The incumbent chooses investment in reforms, r, so as to maximize his expected utility (SA1), before observing the realization of θ_t and ε_t, and given the voting strategy of citizens. Since $\mathbb{E}[\theta_t] = \overline{\theta}$ and $\mathbb{E}[\varepsilon] = 0$, his problem is

$$\max_r \left\{ \overline{\theta} - r + \gamma + \beta \left[\mathbb{E}\theta_{t+1} + f(r) + p\gamma \right] \right\}$$

subject to

$$p = \Pr(y_t \geq \overline{y}) = 1 - G(\overline{y} + r),$$

where $G(\cdot)$ is the c.d.f. of the realization $(\theta + \varepsilon_t)$, which is normally distributed with mean $\overline{\theta}$, variance $\sigma_\varepsilon^2 + \sigma_\theta^2$, and density $g(\cdot)$. Note that p is a decreasing function of reforms, because a marginal increase in r lowers the observed realization of y_t. The first-order condition for r is

$$\beta f'(r) = 1 - \frac{\partial p}{\partial r} \beta\gamma. \tag{SA2}$$

The LHS of (SA2) represents the marginal benefit of reforms, equal to the discounted marginal product of r. The RHS is the marginal cost, which comprises the social cost of r due to foregone output today and the cost to the politician due to the lower probability of staying in power.[2]

Imposing rational expectations, $r = r^e$, implies $\partial p / \partial r = -g(\overline{\theta})$ so that (SA2) becomes

$$\beta f'(r) = 1 + \beta\gamma \left[2\pi \left(\sigma_\theta^2 + \sigma_\varepsilon^2 \right) \right]^{-1/2},$$

because $G \sim N(\overline{\theta}, \sigma_\theta^2 + \sigma_\varepsilon^2)$. Equation (SA2) shows that more economic uncertainty, measured by the variance of y (i.e., $\sigma_\theta^2 + \sigma_\varepsilon^2$), increases the equilibrium level of reforms by lowering their political cost. To see why, recall that incumbents are reluctant to embark in reforms because they are afraid that the short-run economic cost may be interpreted

[2] Note also that, by distorting the signal, reforms may also affect $\mathbb{E}\theta_{t+1}$. However, in equilibrium the election rule maximizes $\mathbb{E}\theta_{t+1}$ given the choice of r. Therefore, an envelope argument guarantees that $\partial \mathbb{E}\theta_{t+1} / \partial r = 0$.

as a sign of low type. However, when shocks are highly dispersed, the replacement probability depends more on the realization of θ and ε, rather than on the choice of r, so that there is a lower incentive to inflate current performance.[3] Analytically,

$$\frac{\partial r}{\partial\left(\sigma_\theta^2+\sigma_\varepsilon^2\right)}=-\frac{\gamma}{f''(r)\left[2\left(\sigma_\theta^2+\sigma_\varepsilon^2\right)\right]^{3/2}\pi^{1/2}}>0.$$

Of course, uncertainty can affect differently other policies. In particular, as shown in Bonfiglioli and Gancia (2013), it may induce incumbents to exert lower effort and it needs not affect the incentive to implement reforms with immediate benefits.

SB. Variables and sample countries

In this Appendix, we describe the main variables used in the analysis. We also report the list of countries included in the sample, together with some of their characteristics (Table S1).

SB.1 *Liberalization indices*

These variables are sourced from Ostry, Prati, and Spilimbergo (2009).

- *Trade* This index is based on average tariff rates or, when missing, on implicit weighted tariff rates. The index is rescaled so that it takes on values between 0 (tariffs above 60%) and 1 (zero tariffs).
- *Current account* This index measures how free the proceeds from international goods and services are from government restrictions, in compliance with IMF's Article VII. It is the sum of two components, capturing the restrictions on trade in visibles and invisibles (e.g., financial services) for residents (on receipts for exports) and nonresidents (on payments for imports). The original index, taking on values between 0 (max restriction) and 8 (full compliance), is rescaled to range from 0 to 1.
- *Product markets* This index captures the degree of liberalization in the telecom and electricity markets. It accounts for the degree to which: the government directly regulates these sectors; the generation, transmission, and distribution of electricity are unbundled; the wholesale market for electricity and the telecom interconnection changes are liberalized; privatizations were made in both sectors; and the local telecom services markets are competitive. The original index, taking on values between 0 (fully regulated) and 2 (fully liberalized), is rescaled to the [0, 1] interval.

[3] This is true despite the fact that the equilibrium p is just the unconditional probability that the incumbent be more able than the average, which is not affected by the choice of reform. For evidence that reelection probability is not negatively affected by reforms; see Peltzman (1992), Alesina, Perotti, and Tavares (1998), Alesina, Carloni, and Lecce (2013), and Brender and Drazen (2008); consistently, Alesina, Furceri, Ostry, Papageorgiou, and Quinn (2020) show that the effect of reforms on electoral outcomes is confounded with that of the business cycle.

TABLE S1. Countries included in the sample.

	Data on Reforms Since	Data on Volatility Since	EU Member	OECD Member	CEE	LDC	Advanced
Argentina	1973	1973	No	No	No	No	No
Australia	1973	1973	No	Yes	No	No	Yes
Austria	1973	1985	since 1995	Yes	No	No	Yes
Bangladesh	1973	2005	No	No	No	Yes	No
Belgium	1973	1985	Yes	Yes	No	No	Yes
Brazil	1973	1973	No	No	No	No	No
Canada	1973	1976	No	Yes	No	No	Yes
Chile	1973	1975	No	No	No	No	No
China	1973	1991	No	No	No	No	No
Colombia	1973	1992	No	No	No	No	No
Czech Rep	1973	1994	since 2004	since 1995	Yes	No	Yes
Denmark	1973	1979	Yes	Yes	No	No	Yes
Ecuador	1973	1994	No	No	No	No	No
Egypt	1973	1993	No	No	No	Yes	No
Finland	1973	1987	since 1995	Yes	No	No	Yes
France	1973	1973	Yes	Yes	No	No	Yes
Germany	1973	1973	Yes	Yes	No	No	Yes
Greece	1973	1989	since 1981	Yes	No	No	Yes
Hungary	1973	1995	since 2004	since 1996	Yes	No	No
India	1973	1979	No	No	No	Yes	No
Indonesia	1973	1983	No	No	No	Yes	No
Iran	1973	1991	No	No	No	No	No
Ireland	1973	1987	Yes	Yes	No	No	Yes
Israel	1973	1973	No	No	No	No	Yes
Italy	1973	1973	Yes	Yes	No	No	Yes
Japan	1973	1973	No	Yes	No	No	Yes
Kenya	1973	1991	No	No	No	Yes	No
Korea	1973	1973	No	since 1996	No	No	Yes
Luxembourg	1973	1985	Yes	Yes	No	No	Yes
Malaysia	1973	1980	No	No	No	No	No
Mexico	1973	1985	No	since 1994	No	No	No
Morocco	1973	1995	No	No	No	Yes	No
Netherlands	1973	1983	Yes	Yes	No	No	Yes
New Zealand	1973	1973	No	Yes	No	No	Yes
Nigeria	1973	1989	No	No	No	Yes	No
Norway	1973	1983	No	Yes	No	No	Yes
Pakistan	1973	1989	No	No	No	Yes	No
Peru	1973	1992	No	No	No	No	No
Poland	1973	1994	since 2004	since 1996	Yes	No	No
Portugal	1973	1986	since 1986	Yes	No	No	Yes
Romania	1973	1998	No	No	Yes	No	No
Russia	1973	1995	No	No	No	No	No
Saudi Arabia	1973	1994	No	No	No	No	No
Singapore	1973	1973	No	No	No	No	Yes
South Africa	1973	1986	No	No	No	No	No
Spain	1973	1973	since 1986	Yes	No	No	Yes

(*Continues*)

TABLE S1. *Continued.*

	Data on Reforms Since	Data on Volatility Since	EU Member	OECD Member	CEE	LDC	Advanced
Sweden	1973	1980	since 1995	Yes	No	No	Yes
Switzerland	1973	1973	No	Yes	No	No	Yes
Thailand	1973	1973	No	No	No	No	No
Tunisia	1973	1998	No	No	No	Yes	No
Turkey	1973	1988	No	Yes	No	No	No
United Kingdom	1973	1973	Yes	Yes	No	No	Yes
United States	1973	1973	No	Yes	No	No	Yes
Ukraine	1973	1998	No	No	No	Yes	No
Venezuela	1973	1994	No	No	No	No	No
Viet Nam	1973	2001	No	No	No	Yes	No

- *Agriculture* This index measures how free the main agricultural export commodity market is from government intervention. The index takes on four possible values between 0 and 1: 0 if there is public monopoly or monopsony in production, transportation, or marketing; 1/3 in the presence of administered prices; 2/3 in the presence of public ownership in relevant producers and/or of concession requirements; 1 if there is no public intervention.

- *Domestic finance* This index measures the degree of liberalization of the domestic banking and security markets. For banks, it takes into account whether there are controls on interest rates and/or credit; competition restrictions; state ownership; and the quality of supervision and regulation. For security markets, it evaluates the policies to develop equity and bond markets, and to open to foreigners the access to the domestic stock market. The original index, taking on values between 0 (fully regulated) and 3 (fully liberalized), is rescaled to the [0, 1] interval.

- *Capital Account* This index captures the degree of restriction on financial credits and personal capital transactions of residents, on financial credits to nonresidents, and on the use of multiple exchange rates. The original index, taking on values between 0 (fully restricted) and 3 (fully liberalized), is rescaled to the [0, 1] interval.

SB.2 *Other variables*

Stock market variables

- *Volatility* Annual mean of the standard deviation of daily returns on the main stock market index (from the Global Financial Database) computed quarterly. Weekly or monthly returns are used for some countries in the absence of daily data. Source: Baker and Bloom (2013).

- *Average stock returns* Annual mean of daily returns on the main stock market index (from the Global Financial Database). Weekly or monthly returns are used for some countries in the absence of daily data. Source: Baker and Bloom (2013).

Crisis indicators and controls for economic and financial conditions

- *Inflation* Annual change in the GDP deflator. Source: World Bank World Development Indicators.
- *Recession* This indicator takes on value 1 in a year if the growth rate of real per-capita GDP is negative.
- *Bank crisis* This indicator takes on value 1 in the year of the onset of a banking crisis, based on the classification of Laeven and Valencia (2012). Source: Laeven and Valencia (2012).
- *Currency crisis* This indicator takes on value 1 in the year of the onset of a currency crisis, based on the classification of Laeven and Valencia (2012). Source: Laeven and Valencia (2012).
- *Sovereign crisis* This indicator takes on value 1 in the year of a sovereign debt default, based on the classification of Laeven and Valencia (2012). Source: Laeven and Valencia (2012).
- *Recession (past 3 years)* This indicator takes on value 1 in a year if a recession has taken place over the previous 3 years.
- *Bank crisis (past 3 years)* This indicator takes on value 1 in a year if a banking crisis has taken place over the previous 3 years.
- *Currency crisis (past 3 years)* This indicator takes on value 1 in a year if a currency crisis has taken place over the previous 3 years.
- *Sovereign crisis (past 3 years)* This indicator takes on value 1 in a year if a sovereign crisis has taken place over the previous 3 years.

Development indicators

- *GDP p.c.* Real per-capita GDP. Source: World Bank World Development Indicators.
- *EU member* This indicator takes on value 1 if 2 years later the country is a member of the EU.
- *OECD member* This indicator takes on value 1 if the country is a member of the OECD in a given year.

Political variables

- *Democracy* Indicator of democracy based on the polity2 index. It takes on values between 0 (max. autocracy) and 1 (max. democracy) instead of -10 and 10. Source: Polity IV database.
- *Presidential* Indicator of presidential systems based on the classification provided in the DPI (2012). It takes on value 1 if the country directly elects the president (system = pres), and 0 otherwise. Source: World Bank Database of Political Institutions.

- *Left* Indicator of left-wing governments based on the classification provided in the DPI (2012). It takes on value 1 if the main party in the executive has a left-wing orientation with respect to economic policy (execrlc = left), and 0 otherwise. Source: World Bank Database of Political Institutions.

- *Election year* This indicator takes on value 1 if any national election (legislative or executive) takes place during the year, and 0 otherwise. Source: World Bank Database of Political Institutions.

Spillover variables

- *Spillovers (reforms)* Arithmetic average of reforms implemented within a sector in countries $j \neq c$ multiplied by the log inverse bilateral distance from country c.

- *Spillovers (GDP p.c.)* Arithmetic average of log real per-capita GDP in countries $j \neq c$ multiplied by the log inverse bilateral distance from country c.

- *Spillovers (inflation)* Arithmetic average of inflation in countries $j \neq c$ multiplied by the log inverse bilateral distance from country c.

- *Spillovers (interest rates)* Arithmetic average of the lending rate in countries $j \neq c$ multiplied by the log inverse bilateral distance from country c. Lending rates are sourced from the World Bank World Development Indicators.

Other variables

- *Stock Market Capitalization* Stock market capitalization in 2006. Source: World Bank World Development Indicators.

- *CEE* This indicator takes on value 1 for Central and Eastern European countries.

- *LDC* This indicator takes on value 1 for low-income and lower-middle income countries according to the World Bank classification.

- *Advanced* This indicator takes on value 1 for advanced economies as classified by the International Monetary Fund.

- *IMF sba*5 This indicator takes on value 1 in country-year pairs with at least 5 months of Standby Arrangement (SBA) with the IMF. Source: Dreher (2006), updated in 2012.

- *IMF saf*5 This indicator takes on value 1 in country-year pairs with at least 5 months of Structural Adjustment Facility Arrangement (SAF) with the IMF. Source: Dreher (2006), updated in 2012.

- *IMF eff*5 This indicator takes on value 1 in country-year pairs with at least 5 months of Extended Fund Facility Arrangement (EFF) with the IMF. Source: Dreher (2006), updated in 2012.

- *Abortion index* Average of seven subindices specifying whether (value 1) or not (value 0) the law allows abortion under the following circumstances: intervention to

save the life of the woman (life grounds); preservation of the physical health of the woman (narrow health grounds); preservation of the mental health of the woman (broad health grounds); termination of pregnancy resulting from rape or incest (juridical grounds); suspicion of fetal impairment (fetal defect); termination of pregnancy for economic or social reasons (social grounds); availability upon request. Source: Compiled by Bloom, Canning, Fink, and Finlay (2009) from the United Nations Population Division Department of Economic and Social Affairs.

- *EPU* Economic Policy Uncertainty index. Source: Baker, Bloom, and Davis (2016), data downloaded from www.policyuncertainty.com.
- IDU Index of idiosyncratic uncertainty measuring disagreement among professional forecasters. Source: Ozturk and Sheng (2018).

SC. Predicted bilateral trade

To build the predicted trade variable used in the construction of the alternative instrument (see Section 6.1), we draw on Frankel and Romer (1999) and estimate the following gravity-type equation across all countries in our sample, using data on bilateral trade for the pre-sample year 1972:

$$\ln T_{c,j} = \eta_c + \eta_j + \boldsymbol{\beta}\mathbf{X}_{c,j} + \boldsymbol{\epsilon}_{c,j}. \tag{SC1}$$

In equation (SC1), $T_{c,j}$ is bilateral trade between countries c and j, η_c and η_j are origin and destination country fixed effects, and $\mathbf{X}_{c,j}$ is a vector of geographical and historical characteristics of the country pair, including log distance, a dummy for the existence of a common border, a dummy equal to 1 if both countries are landlocked, and four dummies taking on value 1 if the two countries share a common religion, a common legal origin, a common language, or a colonial relationship.[4] Then we construct log predicted bilateral trade as

$$\ln \hat{T}_{c,j} = \hat{\boldsymbol{\beta}}\mathbf{X}_{c,j},$$

where $\hat{\boldsymbol{\beta}}$ is the vector of coefficients on the bilateral characteristics estimated from equation (SC1). This variable isolates the component of bilateral trade that is explained by predetermined characteristics of the country pair, while netting out origin- and destination-specific characteristics (captured by the fixed effects η_c and η_j) that could have a direct impact on reforms.

SD. Further empirical analysis

SD.1 *Additional results and robustness*

This Appendix contains the additional results and robustness checks mentioned in the text. In Figure S1, we plot the relationship between the index of volatility connectedness constructed by Diebold and Yilmaz (2015) and the distance of each country from

[4] The bilateral variables are sourced from CEPII's Gravity Database.

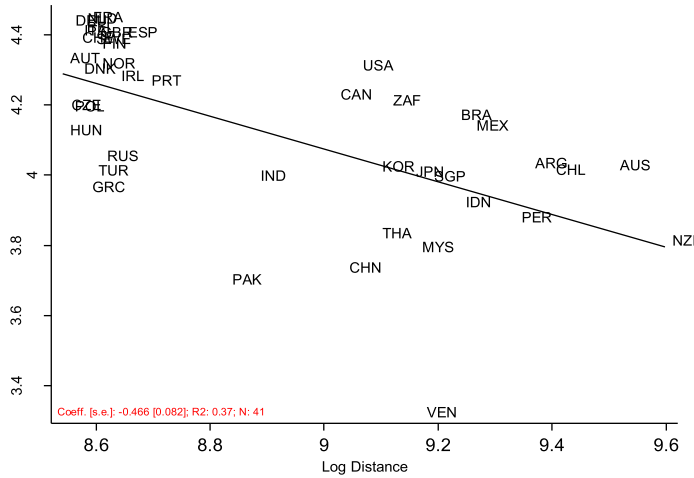

FIGURE S1. Volatility connectedness and geographical distance. *Note*: The volatility connectedness indexes are constructed by Diebold and Yilmaz (2015) and sourced from http://financialconnectedness.org/data.html. For each country, the figure shows the arithmetic mean of the index across all available time periods and the arithmetic mean of the distance from the other countries in the sample.

the others. The index of volatility connectedness provides an estimate of the volatility spillovers received by a country from abroad. To construct the index, Diebold and Yilmaz (2015) use daily stock market index return volatilities for 45 countries starting from January 1, 2004, and a generalized variance decomposition (with 10-day forecast horizon) obtained from a VAR(3) model of daily range volatilities. The VAR model is estimated using the elastic net shrinking and selection procedure, which combines Lasso and Ridge estimators.[5] Of the 45 countries considered by Diebold and Yilmaz (2015), 41 are part of our sample. To draw Figure S1, we average the index of volatility connectedness of each country over all available time periods and plot the log of the resulting variable against the log of the average distance of the country from the other economies in our sample.

In Tables S2 and S3, we report the complete list of regression coefficients from equation (1) estimated with OLS and 2SLS, respectively. Finally, in Figure S2, we study the sensitivity of inference about the effect of volatility on reforms to the use of alternative ways of clustering the standard errors. In particular, we plot the baseline 2SLS estimate of β_2 (see column 3 of Table 4) along with 95% confidence intervals corresponding to alternative clustering schemes. The confidence interval labeled "Baseline" is based on standard errors corrected for clustering at the country level. The next four confidence intervals are based on standard errors corrected for clustering at the year, sector-year, area-year, or area-sector-year level. These clustering structures respectively allow for correlation in the residuals across: all sectors and countries within the same year; all

[5] Further details on the methodology, as well as the data on the index, can be found at http://financialconnectedness.org/index.html.

TABLE S2. Baseline estimates, OLS.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
vol	0.743	0.657	0.363	0.747	0.965	0.947	0.941
	[0.115]	[0.105]	[0.103]	[0.212]	[0.257]	[0.263]	[0.259]
lib			−0.169	−0.186	−0.195	−0.195	−0.209
			[0.015]	[0.016]	[0.018]	[0.018]	[0.021]
average stock returns				0.013	0.007	0.007	0.007
				[0.016]	[0.014]	[0.014]	[0.014]
inflation				−0.001	−0.002	−0.002	−0.002
				[0.000]	[0.001]	[0.001]	[0.001]
recession				−0.003	−0.005	−0.005	−0.004
				[0.002]	[0.003]	[0.003]	[0.002]
bank crisis				−0.011	−0.011	−0.012	−0.01
				[0.006]	[0.006]	[0.006]	[0.006]
currency crisis				−0.009	−0.010	−0.010	−0.010
				[0.010]	[0.010]	[0.010]	[0.010]
sovereign crisis				−0.049	−0.057	−0.057	−0.055
				[0.018]	[0.021]	[0.021]	[0.021]
recession (past 3 years)				0.004	0.001	0.001	0.002
				[0.003]	[0.004]	[0.004]	[0.004]
bank crisis (past 3 years)				0.001	−0.001	−0.001	−0.001
				[0.006]	[0.005]	[0.005]	[0.005]
currency crisis (past 3 years)				0.008	0.011	0.01	0.01
				[0.004]	[0.004]	[0.004]	[0.004]
sovereign crisis (past 3 years)				−0.027	−0.034	−0.034	−0.033
				[0.010]	[0.012]	[0.012]	[0.012]
log GDP p.c.					−0.065	−0.069	−0.062
					[0.038]	[0.039]	[0.037]
EU member					0.003	0.003	0.003
					[0.009]	[0.010]	[0.009]
OECD member					−0.009	−0.008	−0.008
					[0.010]	[0.011]	[0.011]
democracy						−0.007	−0.009
						[0.013]	[0.013]
presidential						0.013	0.012
						[0.009]	[0.009]
left						0.003	0.002
						[0.002]	[0.002]
election year						0.001	0.001
						[0.002]	[0.002]
Spillovers (reforms)							0.354
							[0.098]
Spillovers (GDP p.c.)							0.000
							[0.009]
Spillovers (inflation)							−0.002
							[0.003]
Spillovers (interest rates)							0.000
							[0.000]

(*Continues*)

TABLE S2. *Continued.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Country-Sector FE	yes	yes	yes	yes	yes	yes	yes
Sector-Year FE	yes	yes	yes	yes	yes	yes	yes
Country-Specific Linear Trends	no	yes	yes	yes	yes	yes	yes
Observations	6725	6725	6725	6381	5833	5703	5703
R-squared	0.10	0.12	0.19	0.21	0.23	0.23	0.23

Note: The regressions are estimated on pooled data across countries, sectors of reform and years. The dependent variable is the annual change in the liberalization index for a sector within country c. *Vol* is the one-year lag of stock market volatility in country c, computed as the arithmetic mean of all quarterly volatility observations for the country in a year. *Lib* is the one-year lag of the liberalization index. All other regressors enter with a one-year lag, except for EU membership, which enters with a two-year lead. The standard errors, reported in square brackets, are corrected for clustering at the country level.

TABLE S3. Baseline estimates, 2SLS.

	(1)	(2)	(3)
	First Stage	Reduced Form	Second Stage
vol			2.055
			[0.545]
vol_shock	0.632	1.298	
	[0.069]	[0.371]	
lib	−0.001	−0.21	−0.207
	[0.001]	[0.021]	[0.022]
average stock returns	0.004	0.008	−0.000
	[0.003]	[0.014]	[0.014]
inflation	0.001	−0.001	−0.004
	[0.000]	[0.001]	[0.001]
recession	0.001	−0.004	−0.006
	[0.000]	[0.002]	[0.003]
bank crisis	0.000	−0.010	−0.01
	[0.001]	[0.006]	[0.006]
currency crisis	0.003	−0.008	−0.015
	[0.001]	[0.010]	[0.009]
sovereign crisis	0.007	−0.05	−0.064
	[0.002]	[0.020]	[0.022]
recession (past 3 years)	0.001	0.003	0.001
	[0.000]	[0.004]	[0.004]
bank crisis (past 3 years)	0.001	−0.000	−0.002
	[0.001]	[0.005]	[0.005]
currency crisis (past 3 years)	−0.001	0.009	0.011
	[0.001]	[0.004]	[0.004]
sovereign crisis (past 3 years)	0.001	−0.034	−0.035
	[0.001]	[0.012]	[0.013]
log GDP p.c.	0.01	−0.050	−0.072
	[0.004]	[0.034]	[0.038]
EU member	0.001	0.005	0.003
	[0.001]	[0.010]	[0.009]

(*Continues*)

TABLE S3. *Continued.*

	(1)	(2)	(3)
	First Stage	Reduced Form	Second Stage
OECD member	0.003	−0.007	−0.013
	[0.004]	[0.012]	[0.010]
democracy	0.005	−0.007	−0.016
	[0.004]	[0.014]	[0.015]
presidential	0.004	0.017	0.009
	[0.005]	[0.010]	[0.011]
left	0.001	0.003	0.002
	[0.000]	[0.002]	[0.002]
election year	0.000	0.001	0.001
	[0.000]	[0.002]	[0.002]
Spillovers (reforms)	0.003	0.359	0.353
	[0.004]	[0.098]	[0.098]
Spillovers (GDP p.c.)	0.001	0.001	−0.001
	[0.001]	[0.009]	[0.008]
Spillovers (inflation)	0.000	−0.001	−0.002
	[0.000]	[0.003]	[0.003]
Spillovers (interest rates)	0.000	0.000	0.000
	[0.000]	[0.000]	[0.000]
Country-Sector FE	yes	yes	yes
Sector-Year FE	yes	yes	yes
Country-Specific Linear Trends	yes	yes	yes
Kleibergen–Paap F-stat.	82.9		
Observations	5703	5703	5703
R-squared	0.86	0.23	0.23

Note: The regressions are estimated on pooled data across countries, sectors of reform and years. *Vol* is the one-year lag of stock market volatility in country c, computed as the arithmetic mean of all quarterly volatility observations for the country in a year. *Vol_shock* is the arithmetic average of the one-year lag of stock market volatility in all countries $j \neq c$ with non-missing observations, multiplied by the log inverse bilateral distance from country c. The dependent variable is *vol* in column (1) and the annual change in the liberalization index for a sector within country c in columns (2) and (3). The standard errors, reported in square brackets, are corrected for clustering at the country level.

countries within the same sector and year; all countries in a geographical area and all sectors within the same year; and all countries in a geographical area within the same sector and year. We also combine these four clustering structures with clustering at the country level (i.e., two-way clustering) so as to also allow for residual correlation across sectors and over time within a country.

The last five confidence intervals allow for arbitrary residual correlation across countries located in the same spatial cluster Conley (1999). We start by defining the spatial cluster of a country to include all other countries whose capital cities are within 8,929Km from the country's capital city; this distance is chosen to ensure that the spatial cluster of the most remote country consists of 5 countries. We subsequently increase the distance cut-off so that the spatial cluster of the most remote country includes 10, 15, 20, or 30

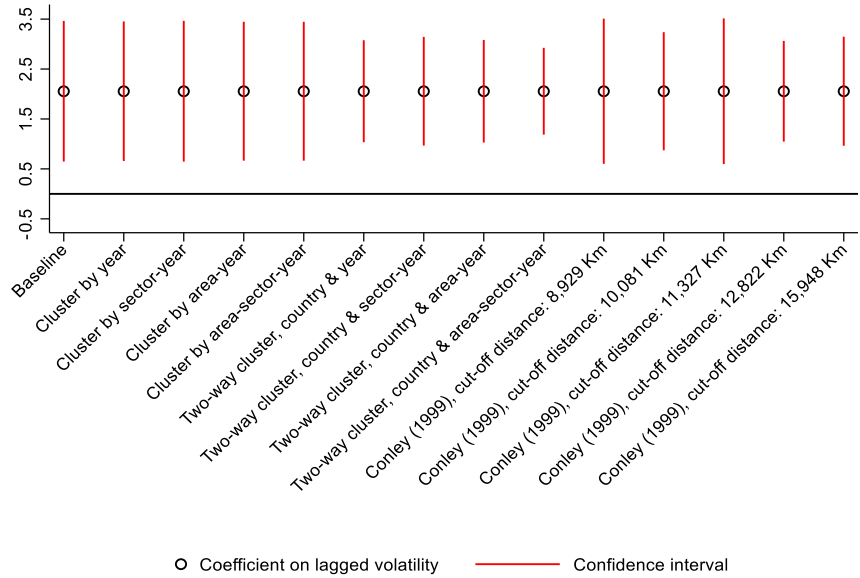

FIGURE S2. Alternative clustering schemes. *Note*: The figure plots the baseline coefficient on *vol* (obtained using the specification in column 3 of Table 4) along with 95 per cent confidence intervals corresponding to alternative clustering schemes, as indicated on the horizontal axis. The first confidence interval refers to standard errors corrected for clustering at the country level. The Conley (1999) confidence intervals allow for arbitrary residual correlation across countries located in the same spatial cluster, and are based on heteroskedastic and autocorrelation consistent standard errors and a time cut-off of fifteen years. The spatial cluster of a country c includes all countries $j \neq c$ whose capital cities are within the specified distance from country c's capital city.

countries.[6] Overall, Figure S2 shows that the confidence intervals corresponding to the alternative clustering structures are generally narrower than those based on standard errors corrected for clustering at the country level. Hence, the clustering scheme used in the main text delivers a conservative inference about the effect of volatility on reforms.

SD.2 *Comparing alternative explanations*

In this Appendix, we provide some additional evidence on the relationship between volatility and reforms. We start by considering other hypotheses on the determinants of reforms that have been proposed in the literature. One prominent view is that reforms depend on economic conditions, which may in turn vary systematically with volatility. Although we always include economic indicators in our regressions, we now want to study more in detail the effects of crises.

In column (1) of Table S4, we reestimate the baseline specification reporting the coefficients on the economic variables that are needed for comparability with subsequent

[6] While all previous clustering structures are characterized by nonoverlapping clusters, the spatial clusters do overlap with each other. We implement the Conley (1999) approach using the extension to 2SLS developed by Colella, Lalive, Sakalli, and Thoenig (2019).

TABLE S4. Other determinants of reforms.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2nd Stage or OLS Regression							
vol	2.055	2.074	2.05	4.608	5.062	2.402	
	[0.545]	[0.545]	[0.538]	[1.060]	[1.060]	[0.975]	
vol_shock							1.052
							[0.259]
lib	−0.207	−0.208	−0.207	−0.557	−0.825	−0.199	−0.139
	[0.022]	[0.022]	[0.022]	[0.051]	[0.061]	[0.020]	[0.004]
growth GDP p.c.		0.055					
		[0.049]					
democracy	−0.016	−0.016	−0.016	−0.016	0.023	0.012	0.018
	[0.015]	[0.014]	[0.014]	[0.029]	[0.051]	[0.017]	[0.004]
recession	−0.006		−0.006	−0.007	−0.011	−0.003	
	[0.003]		[0.003]	[0.008]	[0.009]	[0.003]	
bank crisis	−0.01	−0.010	−0.010	−0.006	0.008	−0.012	
	[0.006]	[0.006]	[0.006]	[0.010]	[0.013]	[0.006]	
currency crisis	−0.015	−0.014	−0.014	−0.007	−0.013	0.002	
	[0.009]	[0.009]	[0.009]	[0.009]	[0.010]	[0.009]	
sovereign crisis	−0.064	−0.066	−0.065	−0.106	−0.058	−0.062	
	[0.022]	[0.022]	[0.022]	[0.032]	[0.033]	[0.022]	
recession (past 3 years)	0.001	0.002	0.002	−0.001	−0.004	0.000	
	[0.004]	[0.004]	[0.004]	[0.006]	[0.007]	[0.004]	
bank crisis (past 3 years)	−0.002	−0.002	−0.001	0.009	0.002	−0.007	
	[0.005]	[0.005]	[0.006]	[0.008]	[0.014]	[0.006]	
currency crisis (past 3 years)	0.011	0.011	0.011	0.019	0.008	0.010	
	[0.004]	[0.004]	[0.004]	[0.010]	[0.011]	[0.006]	
sovereign crisis (past 3 years)	−0.035	−0.036	−0.036	−0.049	−0.047	−0.022	
	[0.013]	[0.013]	[0.013]	[0.030]	[0.035]	[0.013]	
IMF sba5			−0.004	−0.02	−0.019		
			[0.004]	[0.008]	[0.010]		
IMF saf5			−0.000	−0.005	−0.022		
			[0.012]	[0.022]	[0.014]		
IMF eff5			0.003	−0.021	−0.001		
			[0.007]	[0.016]	[0.023]		
Observations	5703	5697	5703	5081	4471	4474	16,588
R-squared	0.23	0.23	0.23	0.50	0.67	0.25	0.10
1st Stage Regression							
vol_shock	0.632	0.63	0.633	0.65	0.646	0.80	–
	[0.069]	[0.071]	[0.067]	[0.070]	[0.078]	[0.120]	–
Kleibergen–Paap F-stat.	82.9	78.9	89.6	85.0	68.4	44.7	–
Country-Sector FE	yes	yes	yes	yes	yes	yes	yes
Sector-Year FE	yes	yes	yes	yes	yes	yes	yes
Country-Specific Linear Trends	yes	yes	yes	yes	yes	yes	no
Control Variables	yes	yes	yes	yes	yes	yes	no

(*Continues*)

TABLE S4. *Continued.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sample/Specification	Baseline	Baseline	Baseline	3-Year Windows	5-Year Windows	Countries with Infrequent Crises	Giuliano, Mishra, and Spilimbergo (2013)
Estimator	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS

Note: The regressions are estimated on pooled data across countries, sectors of reform and years. Column (1) replicates the specification in column (3) of Table 4. The dependent variable is the change in the liberalization index for a sector within country c; the change is computed over one year in all columns except columns (4) and (5), where it is computed over three and five years, respectively. *Vol* is lagged stock market volatility in country c, computed as the arithmetic mean of all quarterly volatility observations for the country in a year; columns (4) and (5) use a three-year and a five-year lag, respectively, while all other columns use a one-year lag. *Vol_shock* is the arithmetic average of the one-year lag (three-year lag in column 4, five-year lag in column 5) of stock market volatility in all countries $j \neq c$ with non-missing observations, multiplied by the log inverse bilateral distance from country c. Control variables are those included in column (7) of Table 3. Time-varying controls are lagged three years in column (4), five years in column (5) and one year in the other columns; EU membership always enters with a two-year lead. The regression in column (6) is estimated on the sample that excludes countries with more than three episodes of any type of crisis over the sample period. The specification in column (7) is estimated by OLS with first-order autoregressive residuals on the sample used in Giuliano, Mishra, and Spilimbergo (2013), consisting of 143 countries and 6 sectors of reform over the 1971–2004 period. The controls for IMF programs used in columns (3)–(5) are dummy variables taking on value 1 in country-year pairs with at least 5 months of Standby Arrangement (SBA), Structural Adjustment Facility Arrangement (SAF) or Extended Fund Facility Arrangement (EFF) with the IMF. The standard errors, reported in square brackets, are corrected for clustering at the country level in columns (1)–(6) and allow for autoregressive residuals in column (7).

columns. The estimates suggest that recessions, banking crises and sovereign crises tend to be associated with lower reforms. On the contrary, currency crises in the previous 3 years are associated with more liberalizations. These results are broadly consistent with the theoretical predictions discussed in Section 2.1, and suggest that different crises may affect reforms differently. They also help explain why the empirical literature sometimes finds mixed results. For instance, Abiad and Mody (2005) and Mian, Sufi, and Trebbi (2014) also find that financial crises weaken governments and reduce the likelihood of financial reforms. Buera, Monge-Naranjo, and Primiceri (2011) also argue that economic crises may trigger a backlash against market-oriented policies. Ranciere and Tornell (2015) find instead that inflation crises, which are highly correlated with currency crises, promote trade liberalizations. Our results are also consistent with the literature on fiscal and macroeconomic stabilization (e.g., Alesina, Ardagna, and Trebbi (2006)). Similar to structural reforms, stabilizations are enacted when they are needed the most, an effect captured by a negative autoregressive term. However, differently from structural reforms, high government deficit and hyperinflation calling for fiscal correction happen during economic downturns.

More importantly for our purposes, these results suggest that economic volatility has an effect on reforms that goes beyond the effect of economic crises. We now explore the robustness of this conclusion. In column (2), we estimate the baseline specification replacing the recession dummy with the growth rate of real per-capita GDP. The coefficient on the new control turns out to be small, negative, and not statistically significant, while all other results are unchanged, suggesting that our main evidence is not driven by how we proxy for recessions.

Severe crises are often accompanied by the intervention of international institutions, such as the IMF, which may also prompt governments to adopt reforms. To control

for this possibility, in column (3), we add to our baseline specification dummies for the country-year pairs in which a Standby Arrangement (SAB), an Extended Fund Facility Arrangement (EFF), or a Structural Adjustment Facility Arrangement (SAF) with the IMF were in effect for at least 5 months.[7] To allow for some delay between interventions and reforms, in columns (4) and (5), we estimate the same specification by defining the dependent variable as the change in a liberalization index over a window of 3 and 5 years, respectively, and by lagging all explanatory variables accordingly. The coefficients on the IMF controls are small in magnitude, negative and largely statistically not significant, suggesting that these types of IMF interventions are not systematically associated with more structural reforms. In all cases, the coefficient on volatility is unaffected. Next, to make sure that these results are not driven by countries characterized by high economic instability, in column (6), we exclude countries with a frequency of crises of any type above the 75th percentile, corresponding to three episodes of crisis over the sample period. The coefficient for economic volatility remains positive and highly significant.

Finally, we compare our results to Giuliano, Mishra, and Spilimbergo (2013), who find that democracy promotes reforms. In our regressions, we always include a control for the level of democracy but its coefficient is imprecisely estimated. We believe the lack of precision to be driven by small power in our sample. In particular, due to missing data on stock market volatility, our analysis is performed on a smaller set of countries, which also tend to be more democratic. To show this, in column (7), we report estimates of the reduced-form relationship between reforms and our instrument, for the sample and specification used in Giuliano, Mishra, and Spilimbergo (2013). We can do this exercise because we do not need to observe a country's stock market volatility to compute its exposure to foreign volatility shocks, as captured by our instrument. In this broader sample, we confirm the positive correlation of reforms both with democracy and with exposure to volatility shocks.

In Table S5, we study other aspects of the relationship between economic volatility and reforms in an attempt to assess the alternative theoretical hypothesis discussed in Section 2.1. We start by asking whether volatility promotes deregulations, that is, positive changes in our liberalization indices, or also their reversals. This may help discerning if turbulent times have a "smoke screen" effect, which allows politicians to enact any policy change, or rather if they promote market-oriented reforms. To this end, we now convert our dependent variable into two dummies, capturing positive and negative changes in the liberalization indices separately.[8] Column (1) confirms the positive and strong effect of economic volatility on the liberalization dummy. The negative coefficient in column (2) suggests instead that economic volatility does not promote liberalization reversals, although the lack of precision may reflect the relatively lower frequency of this type of reforms. In columns (3) and (4), we instead reestimate the baseline specification by excluding from the sample observations with negative and positive changes in the indices, respectively. Once more, the coefficient for economic volatility is statistically significant when restricting attention to liberalizations, while it is smaller and not precisely estimated for negative changes in the reform indices.

[7] These series are sourced from Dreher (2006), updated in 2012.

[8] The dummy for positive changes is equal to 1 if $ref_{s,c,t} > 0$ and to 0 if $ref_{s,c,t} = 0$. The dummy for negative changes is defined accordingly.

TABLE S5. Uncertainty and reforms: Additional evidence.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Dummy for Positive Reforms	Dummy for Negative Reforms	No Negative Reforms	No Positive Reforms	Abortion Reforms	Idiosyncratic Uncertainty	Economic Policy Uncertainty
2nd Stage or OLS Regression							
vol	7.62	−1.642	1.394	0.400	−1.035		
	[3.387]	[1.316]	[0.664]	[0.313]	[1.093]		
idu						0.101	
						[0.048]	
epu						0.000	
						[0.000]	
Observations	5308	4526	5308	4526	971	1538	1363
R-squared	0.46	0.66	0.26	0.25	0.35	0.45	0.36
1st Stage Regression							
vol_shock	0.63	0.62	0.63	0.62	0.61	–	–
	[0.071]	[0.059]	[0.071]	[0.059]	[0.075]	–	–
Kleibergen–Paap F-stat.	79.6	108.4	79.6	108.4	67.6	–	–
Country-Sector FE	yes	yes	yes	yes	yes	yes	yes
Sector-Year FE	yes	yes	yes	yes	yes	yes	yes
Country-Specific Linear Trends	yes	yes	yes	yes	yes	yes	yes
Control Variables	yes	yes	yes	yes	yes	yes	yes
Estimator	2SLS	2SLS	2SLS	2SLS	2SLS	OLS	OLS

Note: The regressions are estimated on pooled data across countries, sectors of reform and years, except in column (5), which uses pooled data across countries and years. In columns (1) and (2), the dependent variables are dummies that take on value 1 if the annual change in the liberalization index for a sector within country c is positive and negative, respectively, and value 0 in case of no change in the index. In column (5), the dependent variable is the annual change in the abortion index for country c. In columns (3)–(4) and (6)–(7), the dependent variable is the annual change in the liberalization index for a sector within country c; in columns (3) and (4), the sample excludes observations with negative and positive changes in the index, respectively. *Vol* is the one-year lag of stock market volatility in country c, computed as the arithmetic mean of all quarterly volatility observations for the country in a year. *Vol_shock* is the arithmetic average of the one-year lag of stock market volatility in all countries $j \neq c$ with non-missing observations, multiplied by the log inverse bilateral distance from country c. *EPU* is the index of Economic Policy Uncertainty (Baker, Bloom, and Davis (2016)), available for 22 countries over the 1976–2006 period. *IDU* is the index of idiosyncratic uncertainty Ozturk and Sheng (2018), capturing disagreement among professional forecasters and available for 28 countries over the 1989–2006 period. Control variables are those included in column (7) of Table 3. In column (5), the one-year lag of the liberalization index is replaced by the one-year lag of the abortion index. The standard errors, reported in square brackets, are corrected for clustering at the country level.

In a similar spirit, we can also assess whether volatility is associated with noneconomic reforms. This exercise can be useful to gauge if economic uncertainty lowers political resistance to any legislative change. To this end, in column (5), we estimate our baseline specification using as the dependent variable the change in an index of how restrictive abortion laws are, sourced from Bloom et al. (2009). In our sample, this index exhibits variation that is comparable to that of our measures of liberalization: its mean increased from 0.52 in 1973 to 0.69 in 2006, with a standard deviation across countries of around 0.34. However, the abortion index reflects social values that should be orthogonal to economic considerations. The results show that there is no statistically significant association between changes in abortion laws and volatility.

Finally, we consider alternative measures of uncertainty used in the literature. In particular, in column (6), we reestimate the baseline specification replacing volatility with the measure of disagreement across professional forcasters proposed in Ozturk and Sheng (2018). Although this index is available for a smaller sample (28 countries in our sample over the 1989–2014 period), OLS estimates confirm a positive correlation with reforms. This suggests that stock market volatility may indeed be capturing the effect of broader economic uncertainty. In column (7), we use instead the index of Economic Policy Uncertainty (EPU) from Baker, Bloom, and Davis (2016). This measure reflects the frequency of articles on possible policy changes, and hence media attention on reforming effort and is available for 22 countries only. In this case, OLS estimates show no statistically significant correlation between EPU and economic reforms. We interpret this finding as consistent with the hypothesis that, while economic uncertainty may divert attention from policy actions, a high EPU can actually make it harder to escape the scrutiny of the electorate, possibly because of a higher media coverage.

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