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PHILIPP STRUTHMANN YABIBAL M. WALLE HELMUT HERWARTZ

Corruption Control, Financial Development, and Growth Volatility: Cross-Country Evidence

We examine the effect of corruption control on the volatility of economic growth using cross-country data that cover 131 economies worldwide for the period 1985–2018. To estimate the growth volatility model, we employ the system generalized method-of-moments estimator for dynamic panel data, which addresses potential endogeneity concerns using internal instruments. Our results show that corruption control significantly reduces growth volatility. This effect is robust to controlling for other measures of institutional quality. Moreover, we find some evidence for an indirect impact of corruption control on growth volatility through its role in reinforcing the volatility-dampening effect of financial development.

JEL codes: D73, E32, G21, O16, O43 Keywords: corruption, growth volatility, financial development

IN LIGHT OF NUMEROUS GLOBAL and regional recessions and recoveries over the last few decades, a lot of research effort has been devoted to studying the causes and consequences of economic volatility.¹ Empirically, there is substantial consensus that economies experiencing higher macro-economic volatility

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1. See Aghion and Banerjee (2005) for a concise summary of the theoretical literature on growth volatility.

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This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made. tend to grow slower (Ramey and Ramey 1995, Martin and Rogers 2000, Hnatkovska and Loayza 2004). Moreover, larger growth volatilities are not only associated with higher income inequality, but they have also been found to disproportionately harm the poor (Breen and García-Peñalosa 2005, Laursen and Mahajan 2005, Huang et al. 2015). As a result, investigating the causes of growth volatility and developing appropriate policy measures to reduce it have been high on the agenda of economic research for years. In this regard, the empirical literature to date has identified several drivers of growth volatility, including openness to trade (di Giovanni and Levchenko 2009), inflation (Beck, Lundberg, and Majnoni 2006), and financial development (e.g., Easterly, Islam, and Stiglitz 2001, Denizer, Iyigun, and Owen 2002, Beck, Lundberg, and Majnoni 2006, Beck, Degryse, and Kneer 2014). To our knowledge, however, the work of Evrensel (2010) is the only study that argues that corruption may be one of the most important determinants of growth volatility. The present study provides extensive empirical evidence that supports the claim by Evrensel (2010) that corruption control could indeed be a crucial and viable means of reducing growth volatility.

There are at least three main channels through which corruption can increase growth volatility. First, frequent macro-economic policy changes by corrupt policymakers may induce uncertainty in the economy (Evrensel 2010). Applying the corruption-growth framework of Ehrlich and Lui (1999) to study the corruptionvolatility nexus, Evrensel (2010) conjectures that monopolistic bureaucratic structures as well as changes in the extent to which governments exercise control over the economy lead to volatile returns on investments and eventually induce growth volatility. Second, highly corrupted governance may reflect a generally low level of institutional quality, which in turn increases a country's vulnerability to economic crises. Evrensel (2010) argues that the extent and effectiveness of corruption control policies is associated with the overall willingness of a country's bureaucrats to implement and enforce regulations. Hence, bureaucrats may cause growth volatility through two ways: First, by making frequent policy changes; and second, by deliberately setting substandard corruption control regulations and diluting their implementation. We refer to these two channels as the "direct" channels and provide extensive empirical evidence that complement the cross-sectional study of Evrensel (2010)-the only existing study on this topic-by employing a large panel data and an endogeneityrobust estimation strategy.

Third, as a new channel not proposed by Evrensel (2010), we argue that corruption could also increase growth volatility by impeding the volatility-reducing role of financial development or exacerbating its potentially volatility-increasing effects. Several authors argue that financial development decreases growth volatility through reducing information asymmetries (Bernanke and Gertler 1989, ,1990, Bacchetta and Caminal 2000), facilitating diversification (Acemoglu and Zilibotti 1997), or enabling efficient matching of investors and savers (Aghion, Banerjee, and Piketty 1999). However, financial development could also increase volatility as the increase in credit supply could lead to more and more finance being channeled toward risky and inefficient activities, eventually fostering economic instability and volatility (Matsuyama 2013). Moreover, rapid credit growth could lead to financial and banking crises, thereby

triggering macro-economic volatility (Kaminsky and Reinhart 1999, Schularick and Taylor 2012). A similar view has been echoed by Gertler and Kiyotaki (2010), who argue that financial development could contribute to macro-economic volatility because volatility of bank returns positively depends on the volume of aggregate financial intermediation. As the theoretical predictions, the empirical evidence on the link between financial development and growth volatility is mixed.² Against this background of potentially conflicting effects of financial development on growth volatility, it is plausible to expect that mitigating corruption could play a key role in increasing the likelihood that financial development contributes to reducing-rather than exacerbating-growth volatility. For instance, to the extent that a prolonged period of credit growth increases the likelihood that "more credit will be extended to finance some 'questionable' activities" (Matsuyama 2013) and that corruption in the financial sector increases the likelihood that financial resources are channeled to unproductive or even wasteful activities (Arcand, Berkes, and Panizza 2015, Tran, Walle, and Herwartz 2020), it is plausible to expect that corruption control policies decrease the likelihood that financial resources are diverted to risky and inefficient activities, thereby dampening macro-economic volatility. In this paper, we refer to this channel as the "indirect" channel and test it empirically by including an interaction term between corruption control and financial development in our econometric model for growth volatility.

For the empirical analysis, we employ panel data of 131 developing and developed economies for the period 1985–2018. In particular, we construct 5-year intervals and measure macro-economic volatility as the standard deviation of real per capita GDP growth within these time windows. To measure corruption control, we draw on two measures: First, we employ corruption data from the International Country Risk Guide (ICRG). Second, we use the Corruption Perceptions Index developed by Transparency International (TI). To quantify financial development, we draw on the International Monetary Fund (IMF)'s Financial Development Index. The main advantage of this indicator is that, unlike most common measures of financial sector development, such as domestic private credit or stock market capitalization to GDP, it captures several aspects of financial sector accessibility, efficiency, and depth. As an empirical strategy, we employ the general method of moments (GMM) dynamic panel data estimator suggested by Arellano and Bover (1995) and Blundell and Bond (1998). Not only does this estimator eliminate unobserved country-specific effects from the model, but it also enables us to account for endogeneity of all explanatory variables by using internal instruments.

Our results largely confirm that corruption control reduces growth volatility. In particular, we find a negative effect of both measures of corruption control on growth

^{2.} Although most of the existing empirical studies suggest a volatility-mitigating role of financial development (see, e.g., Easterly, Islam, and Stiglitz 2001, Denizer, Iyigun, and Owen 2002, or Kose, Prasad, and Terrones 2003), there are papers reporting that financial development has no (Beck, Lundberg, and Majnoni 2006) or a stimulating effect on growth volatility, at least in high-income countries (Beck, Degryse, and Kneer 2014). Similarly, Loayza and Rancière (2006) find financial liberalization to foster financial volatility in the short run.

volatility using different sets of control variables. This direct effect of corruption control is robust to using measures of institutional quality as an additional set of control variables, whereas the effects of these measures of institutional quality, namely, the levels of law and order and bureaucratic quality, lack significance. Hence, our results do not support Evrensel's (2010) conjecture that corruption control is just a proxy for overall institutional quality. Instead, we identify corruption control as the major institutional determinant of growth volatility. This finding is, moreover, robust to controlling for a set of other socioeconomic determinants of per capita GDP growth volatility. We also find some evidence for an indirect impact of corruption control on growth volatility through its role in reinforcing the volatility-dampening effect of financial development. Specifically, we document that the negative effect of financial development on growth variations is larger if corruption is controlled more effectively. Yet, the empirical evidence on this indirect effect is at times not significant and lacks robustness to adding alternative measures of institutional quality and socioeconomic covariates when corruption control is measured by means of the ICRG index.

Our paper makes two important contributions to the literature on the drivers of growth volatility. First, it provides empirical evidence on the crucial role of corruption control in reducing growth volatility. While Evrensel (2010) is the first to introduce corruption to the growth volatility literature, our paper complements Evrensel's (2010) work by, first, using a panel data set and, second, employing the system GMM dynamic panel data estimator, which allows us to address potential endogeneity concerns. Considering that corruption is prevalent "in all societies, at all stages of economic development" (Ehrlich and Lui 1999) and that national governments and leading multilateral institutions are making increasing commitments to fight corruption (Gans-Morse et al. 2018, Sobrinho and Thakoor 2019), our findings bring corruption control to the forefront as an important and viable means of reducing growth volatility that policymakers should consider. Second, this paper provides some evidence on the complementarity between corruption control and financial development in their effects in mitigating growth volatility. While previous studies have documented significant interaction effects of the two factors in affecting economic growth or firm growth (Ahlin and Pang 2008, Wang and You 2012, Tran 2020), to our knowledge, we are the first to examine this complementarity in the context of growth volatility.

In Sections 1 and 2, we describe the data and the identification strategy, respectively. Section 3 discusses empirical results and robustness checks. Section 4 summarizes our main findings and concludes.

1. DATA

For our empirical analysis, we employ data from 131 countries covering the period from 1985 until 2018 (34 years, see Table A1 for a list of all countries in the sample). Due to improvements in data availability, our data set covers both low- and high-income economies. However, although data on financial development and several

TABLE 1	
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SUMMARY STATISTICS

Variable	Obs	Mean	Std. Dev.	Min	Max
Growth volatility	879	2.75	2.29	0.18	16.67
CC(ICRG)	871	2.98	1.28	0.00	6.00
CC(TI)	604	2.76	1.39	0.00	5.88
Financial development (FD)	879	32.38	22.42	0.00	94.49
GDP	879	14,135	18,568	183	109,498
Inflation	878	44.43	314.03	-6.22	6,945.24
Government size	829	15.58	5.61	1.15	69.00
Trade openness	841	81.81	54.41	0.22	425.16
Financial openness	865	4.71	20.77	0.12	370.88
Law and order	871	3.72	1.39	0.73	6.00
Bureaucratic quality	871	3.34	1.70	0.00	6.00
ToT volatility	717	9.88	9.69	0.00	94.26
Crop dependency	798	4.60	8.91	0.00	86.86
Population growth	879	1.60	1.45	-1.51	15.74
Education	677	7.04	3.12	0.29	13.42

NOTE: See Table A2 in the Appendix for detailed information on all variables. All variables are obtained between 1985 and 2018.

control variables are available prior to 1984, our focus on corruption control and its interaction with financial development restricts available data to post-1984 years. Most of our data are obtained from the World Bank's World Development Indicators (WDI), the ICRG of the Political Risk Services Group, TI and financial databases of the World Bank, and the IMF (see Table A2 for detailed information on all variables).

For our analysis, we build seven nonoverlapping intervals of 5 years and measure growth volatility as the standard deviation of per capita GDP growth (in constant 2010 US\$) over each 5-year period. All explanatory variables are measured as the average over the respective period. To measure corruption control, we employ two alternative indicators. The first one is taken from the ICRG, which contains indices for different dimensions of institutional quality, of which corruption control is one. Covering 147 countries since 1984, the ICRG provides the richest and most commonly used international data base on corruption at the country level to date. As a second measure of corruption control, we employ TI's Corruption Perceptions Index. Unfortunately, the TI data start only in 1995 and include substantially fewer countries for years prior to 2003, which results in a smaller sample of 84 countries for our model based on corruption in terms of the TI index. Yet, the TI measure of corruption control has two major strengths. First, it summarizes information on corruption from up to 13 different sources, making it a multidimensional and thus particularly reliable quantification of corruption control. Second, assigning a score between 0 and 100, the TI data capture even small variation in corruption control, whereas the ICRG ranks country based on only 13 realizations (0-6 in steps of 0.5). For better comparability, the TI measure is rescaled to a range between 0 and 6, where 6 represents a high level of corruption control.

To measure financial development, we employ the IMF's Financial Development Index. Some commonly used measures of financial development in the

finance-growth literature, for example, domestic private credit or stock market capitalization as a share of GDP, have been criticized for being unidimensional quantifications of the size of the financial sector that ignore aspects of accessibility and efficiency of financial institutions and markets. Addressing this problem, the Financial Development Index comprises information not only on depth, but also on accessibility and efficiency of financial institutions and financial markets (Svirydzenka 2016). In addition, our model includes a set of control variables that are common in the existing literature on growth volatility: Per capita GDP, inflation, government size, trade openness, and financial openness. Furthermore, as robustness checks, we employ alternative measures of institutional quality as well as several additional socioeconomic control variables.

Summary statistics of all variables are documented in Table 1. Ranging from 0.18 to 16.67, the average standard deviation of per capita GDP growth over 5 years is 2.75. Corruption control in terms of the ICRG measure has a mean score of around 3 and ranges from 0 in, for example, the Democratic Republic of Congo, Bangladesh, or the Bahamas in the 1980s or 1990s to 6 in many high-income countries in recent years. Similarly, the rescaled TI index of corruption control takes a minimum of 0 in Bangladesh in 1990 and a maximum of 5.88 in Finland in 2000 with a mean of 2.76. The Financial Development Index, initially coded between 0 and 1, is recoded to a scale between 0 and 100. It has a mean of 32.38 and ranges between 0 in, for example, Angola in 1985 and 1990 and 94.49 in Switzerland in 2015.

2. METHODOLOGY

In order to assess the joint impact of financial development and corruption control on growth volatility, we use the following econometric model:

$$GVOLA_{i,t} = \alpha_0 + \mu_i + \alpha_1 CC_{i,t} + \alpha_2 FD_{i,t} + \alpha_3 CC_{i,t} \times FD_{i,t} + X_{i,t}\beta + \gamma GVOLA_{i,t-1} + \epsilon_{i,t},$$
(1)

where $GVOLA_{i,t}$, $CC_{i,t}$, and $FD_{i,t}$ refer to the standard deviation of per capita GDP growth, the level of corruption control, and financial development in country *i* in period *t*, respectively. The vector $X_{i,t}$ contains several control variables, namely, initial GDP per capita, inflation, government size, trade openness, and financial openness. To account for initial growth volatility and unobserved country-specific effects, we also include the first lag of growth volatility and a country-specific effect μ_i in addition to the idiosyncratic error term $\epsilon_{i,t}$. To evaluate the direct effect of corruption control, we employ a restricted version of (1) without the interaction term $CC_{i,t} \times FD_{i,t}$. In this restricted model, α_1 describes the effect of corruption control on growth volatility while controlling for financial development and the set of other covariates. In the full model as displayed in (1), α_3 represents the indirect effect of corruption control,

		CC(IC	RG)			CC((TI)	
	(1)	(2)	(3)	(4)	(5)	(9)	(7)	(8)
Initial volatility	0.0232	0.0227	0.0861	-0.0123	-0.0641	-0.0739	-0.0819	-0.157^{**}
CC	-0.389^{*}	-0.330	-0.479^{*}	-0.424^{*}	-0.864^{**}	(16000)	(0.000) -1.181^{**}	(0.000.0)
	(0.188)	(0.179)	(0.197)	(0.185)	(0.270)	(0.261)	(0.313)	(0.249)
FD	-0.725^{*}	-0.792^{*}	-0.337	-0.805^{*}	-0.397	-0.448	-0.472	-0.457
GDP	(0.366) 0.569^{*}	(0.391) 0.596^{*}	(0.384) 0.375	(0.388) 0.390	(0.623) 0.912^{*}	(0.643) 0.824^{*}	(0.746) 0.596	(1.095) 0.252
	(0.247)	(0.240)	(0.219)	(0.226)	(0.372)	(0.326)	(0.358)	(0.555)
Inflation	0.533**	0.507**	0.516**	0.667**	0.366*	0.595**	0.671**	0.623**
	(0.131)	(0.121)	(0.145)	(0.158)	(0.184)	(0.189)	(0.247)	(0.221)
Government size	0.596) (0.596)			(0.542)	-0.109 (0.844)			(0.817)
Trade openness	~	0.290		0.233	~	1.003^{*}		0.173
		(0.369)		(0.482)		(0.448)		(0.755)
Financial openness			0.492*	0.530*			1.481** (0.400)	1.497**
Observations	708	719	740	702	369	371	369	365
Number of countries	129	129	130	128	84	84	83	83
AR(1) <i>p</i> -value	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.002
AR(2) <i>p</i> -value	0.352	0.411	0.178	0.571	0.489	0.425	0.360	0.142
Hansen <i>p</i> -value	0.223	0.286	0.297	0.317	0.185	0.157	0.216	0.199
Number of instruments	108	108	108	118	78	78	78	74

TABLE 2

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TABLE 3								
THE INDIRECT EFFECT OF C	CORRUPTION CON	TROL						
		CC(IC	RG)			CC((TI)	
	(1)	(2)	(3)	(4)	(5)	(9)	(7)	(8)
Panel A Initial volatility	0.0290	0.0277	0.0754	-0.00852	-0.0845	-0.0727	-0.0876	-0.160**
cc	(0.0629) 1.191	(06000) 1.201	(0.0614) 1.183	0.815	(0.0586) 2.082	(280.0) 0.00171	(0.0632) 1.900	(0.0010) 3.148
FD	0.301	(1.04/) 0.163	0.420)	(666.0) -0.0349	(1.148) 0.892	(1.08/) -0.0404	1.085	(1.720) 1.266
CC×FD	-0.443	-0.415	(0/C/0) -0.443	-0.324	$(0.70)^{(0.709)}$	-0.163	(cc/.0) *90/00-	-0.972^{*}
GDP	(0.247) 0.707^{*}	(0.282) 0.635^*	(0.241) 0.504^{*}	(0.271) 0.420	(0.298) 1.134*	(0.271) 0.814^{**}	(0.294) 0.519	(0.432) 0.417
Inflation	(0.309) 0.491^{**}	(0.254) 0.456^{**}	(0.240) 0.469^{**}	(0.257) 0.610^{**}	(0.457) 0.410^{*}	(0.312) 0.642^{**}	(0.330) 0.700^{**}	(0.441) 0.662^{**}
Government size	(0.124) 0.269 (0.244)	(0.111)	(0.126)	(0.147) 0.858 0.4883	(0.167) -0.532	(0.173)	(0.226)	(0.205) -0.192
Trade openness	(0.044)	0.465		(0.488) 0.213 0.457)	(106.0)	1.021*		(0.8/0) -0.179 (0.731)
Financial openness		(0,77.0)	0.594**	0.573°		(00+.0)	1.354** (0.413)	(1577^{**})
Observations	708	719	740	702	369 8.4	371 84	369	365
AR(1) <i>p</i> -value	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.002
AR(2) <i>p</i> -value Hansen <i>n</i> -value	0.293 0.347	0.306	0.123 0.398	0.485 0.424	0.299 0.248	0.407	0.266	0.0870
Number of instruments	125	125	125	132	86	86	86	80
								(Continued)

$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Continued)								
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	I		CC(ICI	RG)			CC	(II)	
$ \begin{array}{c} \mbox{PANEL B. Marginal effects of financial development} \\ \hline CC(25\%) & -0.585 & -0.6666 & -0.466 & -0.682 & -0.368 & -0.329 & -0.329 & -0.329 & -0.329 & -0.329 & -0.327 & -0.368 & -0.329 & -0.329 & -0.377 & -0.377 & -0.387 & -0.374 & -0.3714 & -0.3733 & -0.3733 & -0.3733 & -0.3733 & -0.3733 & -0.3733 & -0.3733 & -0.3733 & -0.3395 & -1.1.666^{\circ} & -0.3385 & -0.3385 & -1.1.266^{\circ} & -0.3385 & -0.3385 & -0.3305 & -0.3301 & 0.3071 & (0.3071 & 0.3071 & 0.3071 & 0.3071 & 0.3071 & 0.3071 & 0.3071 & 0.3071 & 0.3071 & -0.3316 & -0.3310 & 0.3171 & -0.3288 & -0.5306 & -0.3310 & 0.3171 & -0.3288 & -0.5306 & -0.3301 & -0.3211 & -0.3$		(1)	(2)	(3)	(4)	(5)	(9)	(2)	(8)
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	ANEL B. Marginal effects of	financial develo	opment						
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	CC(25%) -	-0.585	-0.666	-0.466	-0.682	-0.368	-0.329	-0.154	-0.461
$ \begin{array}{ccccc} {\rm CC}(75\%) & & (0.432) & (0.334) & (0.406) & (0.704) & (0.617) \\ {\rm CC}(75\%) & & (0.655) & (0.605) & (0.504) & (0.538) & (0.538) & (0.617) \\ {\rm (0.655)} & & (0.6504) & (0.538) & (0.538) & (0.638) & (0.638) \\ {\rm (0.76\%)} - (25\%) & & (0.517) & (0.426) & (0.501) & (0.700) & (0.638) & (0.638) \\ {\rm PANEL C. Marginal effects of corruption control } \\ {\rm FD}(25\%) & & (0.3017) & (0.426) & (0.501) & (0.700) & (0.638) & (0.638) & (0.501) & (0.700) & (0.638) & (0.538) & (0.501) & (0.700) & (0.638) & (0.538) & (0.501) & (0.700) & (0.638) & (0.538) & (0.501) & (0.700) & (0.638) & (0.538) & (0.501) & (0.700) & (0.638) & (0.538) & (0.501) & (0.700) & (0.638) & (0.538) & (0.501) & (0.700) & (0.638) & (0.539) & (0.541) & (0.556) & (0.556) & (0.539) & (0.539) & (0.541) & (0.556) & (0.539) & (0.541) & (0.556) & (0.556) & (0.539) & (0.541) & (0.556) & (0.556) & (0.556) & (0.539) & (0.541) & (0.556) & (0.539) & (0.541) & (0.556) &$		(0.402) -0.877*	$(0.352) -0.929^{*}$	-0.703^{*}	(0.400) -0.887^{*}	(0.627) -0.874	(19C.0) -0.446	(0.607) -0.652	(0.70) -1.149
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	CC(75%)	(0.432) -1.405*	$(0.383) -1.426^{*}$	(0.354) -1.250^{*}	(0.406) -1.281*	(0.704) -2.034*	(0.617) -0.714	(0.661) -1.827	(0.900) -2.758
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	75%)-(25%)	(0.605) -0.820 (0.457)	(0.604) -0.760 (0.517)	(0.544) -0.783 (0.426)	(0.581) -0.599 (0.501)	(1.034) -1.666^{*} (0.700)	(0.858) -0.385 (0.638)	(0.969) -1.673^{*} (0.696)	(1.456) -2.298^{*} (1.021)
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	ANEL C. Marginal effects of	corruption con	trol						
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	⁷ D(25%)	0.00317	0.102	0.0163	-0.0512	-0.188	-0.518	-0.331	0.0481
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	- - -	(0.286) - 0.321	(0.330) -0.206	(0.317) -0.301	(0.307) -0.288	(0.319) -0.536	(0.306) -0.601^{*}	$(0.372) -0.697^{*}$	(0.408) -0.436
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		(0.188) 0 545**	(0.180) -0.419*	(0.193) -0 540**	(0.179) -0.450*	(0.277) -0.895**	(0.239) -0.684**	(0.305) -1 056**	(0.270) -0.926**
(75%)-(25%) $-0.54%$ -0.522 -0.556 $-0.39%$ $-0.70%$ -0.166 $-0.30%$ $0.20%$ $0.75%$ $0.75%$ $0.75%$		(0.204)	(0.177)	(0.170)	(0.186)	(0.309)	(0.241)	(0.305)	(0.269)
	75%)-(25%)	-0.548	-0.522	-0.556	-0.398	-0.707*	-0.166	-0.725^{*}	-0.974^{*}
$(c_{1,2},0)$ $(c_{2,2},0)$ $(c_{2,2},0)$ $(c_{2,2},0)$ $(c_{2,2},0)$ $(c_{2,2},0)$		(0.305)	(0.355)	(0.303)	(0.333)	(0.297)	(0.275)	(0.301)	(0.433)

that is the average change of the effect of financial development on growth volatility when corruption control increases by one unit, *ceteris paribus*.

In a dynamic panel model of growth volatility endogeneity concerns can arise from different sources. First, the country-specific effects are by construction correlated with the lagged dependent variable. Removing the fixed-effects by means of the within transformation leads to the so-called Nickel bias that arises as a result of the ensuing correlation between the transformed error terms and the lagged dependent variables. Second, other explanatory variables could also be endogenous. Hence, instrumental variables are needed to address these endogeneity concerns. However, finding reliable instruments can be a serious challenge in practice. By employing the system GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998), we can rule out both sources of endogeneity. Through taking first differences, the difference GMM estimator (Arellano and Bond 1991) eliminates time-invariant country-specific effects, and by employing lagged levels as internal instruments for the differenced variables, it addresses the Nickel bias. As lagged levels could be weak instruments in cases where the time-series variables are persistent, the system GMM estimator mitigates small sample biases by complementing the equation in first differences by the equation in levels, where lagged differences are taken as instruments for lagged levels. While the one-step system GMM estimator suffers from inefficiency and lacks robustness to heteroskedasticity, the two-step estimator has been found to be both efficient and robust to heteroskedasticity (Roodman 2009a). However, as standard two-step GMM standard errors are known to be downward-biased, we employ robust standard errors as suggested by Windmeijer (2005). We assume all explanatory variables as potentially endogenous and thus employ second and further lags as instruments. To address the problem of too many instruments (Roodman 2009b), we restrict the maximal lag length to four. To test for the validity of these internal instruments, we employ and report two model diagnostics: The Hansen test for overidentification and a test for serial autocorrelation.

3. RESULTS

In this section, we provide empirical results on the direct and indirect effects of corruption control and financial development on growth volatility. In particular, we first present baseline results, which are obtained using the standard deviation of growth as a measure of growth volatility, and corruption control as the sole proxy for institutional quality. We then check the robustness of our results to controlling for other institutional quality indicators, considering additional set of socioeconomic covariates, and using log volatility measures.

3.1 Baseline Results

To assess the direct effect of corruption control, we first regress the standard deviation of per capita growth on corruption control, financial development, and other







Fig 1. Marginal Effects of Financial Development on Growth Volatility.

NOTES: The black points in each figure represent the marginal effect of financial development on growth volatility at different levels of corruption control in terms of the ICRG index (in image (a)) and the TI index (in image (b)). The gray signs mark the 95% confidence interval. The marginal effects on growth volatility are computed based on the corresponding results documented in columns (4) and (8) of Table 3. The histogram displays the distribution of the data with respect to corruption control.

control variables as in model (1), but exclude the interaction term between corruption control and financial development. These baseline results on the effect of corruption control on growth volatility are presented in Table 2. For the first four specifications shown in columns (1)–(4), we quantify corruption control in terms of the ICRG measure, while for the last four specifications in columns (5)–(8), we employ the TI index. Within each specification, we include financial development, initial GDP per capita, and inflation as key control variables. Moreover, we add three altering covariates: Government size (in columns (1) and (5)), trade openness (in columns (2) and (6)), financial openness (in columns (3) and (7)), and a comprehensive model with all control variables (in columns (4) and (8)). Unless stated otherwise, a nominal 5% level is used to evaluate the significance of coefficient estimates.

All specifications show negative effects of corruption control on growth volatility, which are throughout statistically significant in all models (yet at only 10% in specification (2)). Remembering that corruption control spans from 0 to 6, with a mean score of about 3 for both measures, a one-unit increase in corruption control is associated with a reduction of the standard deviation of per capita GDP growth between 0.33 and 1.18. To get a sense of the magnitude, let us consider a country at the 25th percentile of the ICRG (TI)-based corruption control distribution. If this country improves its level of corruption control and moves to the 75th percentile, results in the most comprehensive models (4) and (8) imply that its 5-year standard deviation of per capita growth will decrease by 0.78 (2.26) on average. These effects are significant in economic terms, as the mean growth volatility is 2.75. Comparing the coefficients of corruption control, we can see that the volatility-dampening effect of corruption control in terms of the TI measure is more than twice as large as that of corruption control quantified by means of the ICRG index. The significantly higher effect of the TI-based corruption index over the ICRG-based index is underscored by the fact that substantial differences remain even when we use the sample of 84 countries for which the TI index is available to estimate all eight specifications.³

The coefficient estimates of financial development are throughout negative, yet significant in only three of the eight specifications. Negative coefficient estimates are largely in line with empirical evidence in most of the literature on the effect of financial development on growth volatility (e.g., Hausmann and Gavin 1996, Easterly, Islam, and Stiglitz 2001, Denizer, Iyigun, and Owen 2002, Kose, Prasad, and Terrones 2003). Beck, Lundberg, and Majnoni (2006), however, also find no significant effect

3. The authors provide upon request results for all models that condition on corruption control measured in terms of the ICRG index and the sample of 84 countries for which the TI measure is available.







Fig 2. Marginal Effects of Corruption Control on Growth Volatility.

NOTES: The black points in each figure represent the marginal effect of corruption control in terms of the ICRG index (in image (a)) and the TI index (in image (b)) on growth volatility at different levels of financial development. The gray signs mark the 95% confidence interval. The marginal effects on growth volatility are computed based on the corresponding results documented in columns (4) and (8) of Table 3. The histogram displays the distribution of the data with respect to financial development.

of financial development on growth volatility. Similarly, Evrensel (2010) shows that financial development does not significantly affect volatility of growth if corruption control is included in the model.

Turning to other potential determinants of growth volatility, our baseline results show that inflation and financial openness significantly increase growth volatility. The result for inflation is in line with existing evidence in the literature (Beck, Lundberg, and Majnoni 2006, Bekaert, Harvey, and Lundblad 2006, Evrensel 2010). Existing evidence on the effect of financial openness on growth volatility is, however, scant. The only work we are aware of that considers financial openness as a potential driver of growth volatility is Kose, Prasad, and Terrones (2003). Unlike our results, however, Kose, Prasad, and Terrones (2003) do not find a significant effect of financial openness on growth volatility. At the same time, other variables often proposed to be of central importance in the growth volatility framework, for example, government size and trade openness, seem to lack a significant impact on volatility in GDP per capita growth in most models.

Finally, based on the specification tests, we can reject the presence of second- but not first-order autocorrelation of residuals for the model in first differences, suggesting that the second (and further) lags of the explanatory variables could be considered as potential instrumental variables for the GMM estimation. Furthermore, Hansen tests for overidentification show no evidence of invalid instruments, nor do they yield implausibly large *p*-values, which could have indicated a problem of too many instruments (Roodman 2009b). Hence, the specification tests confirm the validity of our internal instruments.

Regarding the indirect effect of corruption control on growth volatility, Table 3 documents results for the effects of corruption control, financial development, and their interaction on per capita growth volatility. Quantifying corruption control in terms of the ICRG measure, the interaction between corruption control and financial development is negative, yet only significant at the 10% level in specifications (1) and (3). If we measure corruption control by means of the TI index, however, the coefficients of the interaction term become significant, even at the 5% level. Similar to the restricted model without the interaction term, this difference can only be partly explained by the differences in the samples used. In fact, the estimated interaction effects remain mostly insignificant when estimating models (1)–(4) based on the sample of countries for which the TI models ((5)–(8)) were estimated. This indicates that corruption control in terms of the TI-based indicator significantly enhances the volatility-reducing effect of financial development, whereas the evidence for such an indirect effect for corruption control as quantified by the ICRG measure is not strong.

		CC(ICRG)			CC(TI)	
	(1)	(2)	(3)	(4)	(5)	(6)
Initial volatility	-0.0401	-0.0277	-0.0532	-0.144**	-0.154*	-0.135*
5	(0.0850)	(0.0822)	(0.0756)	(0.0546)	(0.0618)	(0.0635)
CC	-0.613*	-0.473*	-0.669*	-1.107**	-0.780*	-0.890**
	(0.294)	(0.241)	(0.292)	(0.289)	(0.314)	(0.325)
FD	-0.790	-0.492	-0.670	-0.213	-0.385	-0.179
	(0.470)	(0.485)	(0.423)	(0.797)	(0.653)	(0.628)
GDP	0.0769	0.203	0.0949	0.238	0.401	0.351
	(0.307)	(0.295)	(0.292)	(0.478)	(0.358)	(0.363)
Inflation	0.609**	0.616**	0.567**	0.549**	0.557**	0.508*
	(0.145)	(0.157)	(0.129)	(0.208)	(0.213)	(0.223)
Government size	1.271*	1.337*	1.092	0.372	0.258	0.274
	(0.634)	(0.671)	(0.580)	(0.728)	(0.685)	(0.826)
Trade openness	0.0538	-0.140	-0.0354	0.215	0.268	0.234
I.	(0.504)	(0.561)	(0.525)	(0.734)	(0.701)	(0.771)
Financial openness	0.804**	0.713*	0.786*	1.406**	1.332**	1.242*
	(0.306)	(0.337)	(0.319)	(0.527)	(0.449)	(0.496)
Law and order	0.331		0.375	0.157		0.143
	(0.260)		(0.257)	(0.370)		(0.320)
Bureaucratic quality		0.00401	-0.0263		-0.221	-0.228
1 2		(0.184)	(0.188)		(0.239)	(0.281)
Observations	702	702	702	365	365	365
Number of countries	128	128	128	83	83	83
AR(1) p-value	0.001	0.000	0.001	0.001	0.003	0.003
AR(2) <i>p</i> -value	0.686	0.666	0.701	0.184	0.164	0.239
Hansen <i>p</i> -value	0.216	0.262	0.211	0.187	0.231	0.448
Number of instruments	96	96	106	83	83	92

TABLE 4

THE DIRECT EFFECT OF CORRUPTION CONTROL WITH ADDITIONAL INSTITUTIONAL CONTROLS

NOTE: Windmeijer corrected standard errors in parentheses: **p < 0.01, *p < 0.05. The dependent variable is growth volatility, measured as the standard deviation of per capita GDP growth. All specifications include but do not report a constant and time-dummy variables. For more information, see Table 2.

Regarding the validity of our instruments, we find evidence for first- but not secondorder autocorrelation and no evidence for invalid instruments, which again supports the employed instrumentation.

To get a better assessment of the interaction between corruption control and financial development, we additionally calculate the marginal effects of financial development on growth volatility at alternative levels of corruption control as well as marginal effects of corruption control at varying degrees of financial development. Marginal effects are documented in Panels B and C of Table 3. If corruption control is quantified by means of the ICRG index, the marginal effects of financial development are significantly negative at the 50th and 75th percentile of corruption control, whereas those at the 25th percentile are also negative but lack significance. For the models based on corruption control in terms of the TI measure, marginal effects of financial development are also entirely negative, but, except for specification (5), not significant even at the 75th percentile of corruption control.

To further investigate the interaction between financial development and corruption control in affecting growth volatility, we calculate the difference between the

		CC(ICRG)			CC(TI)	
	(1)	(2)	(3)	(4)	(5)	(6)
Initial volatility	-0.0414	-0.0216	-0.0326	-0.142*	-0.163**	-0.141*
-	(0.0715)	(0.0703)	(0.0641)	(0.0555)	(0.0614)	(0.0609)
CC	0.648	1.006	0.669	2.777	3.740*	2.987
	(0.824)	(0.955)	(1.010)	(1.680)	(1.453)	(1.942)
FD	-0.182	0.329	0.00454	1.471	1.742*	1.532
	(0.603)	(0.690)	(0.657)	(0.936)	(0.783)	(0.902)
CC×FD	-0.345	-0.396	-0.331	-0.908*	-1.069**	-0.907
	(0.221)	(0.253)	(0.258)	(0.422)	(0.367)	(0.489)
GDP	0.309	0.361	0.355	0.246	0.410	0.355
	(0.345)	(0.377)	(0.344)	(0.358)	(0.377)	(0.359)
Inflation	0.530**	0.543**	0.538**	0.645**	0.652**	0.593**
	(0.134)	(0.157)	(0.127)	(0.231)	(0.222)	(0.174)
Government size	0.962	1.000	0.594	-0.234	-0.348	-0.308
	(0.624)	(0.699)	(0.629)	(0.721)	(0.783)	(0.775)
Trade openness	-0.0360	-0.180	-0.0401	-0.0922	-0.168	-0.0945
1	(0.553)	(0.517)	(0.578)	(0.734)	(0.714)	(0.874)
Financial openness	0.734*	0.760*	0.776*	1.574**	1.586**	1.451**
	(0.326)	(0.342)	(0.308)	(0.541)	(0.451)	(0.533)
Law and order	0.359	``´´	0.298	0.150		0.157
	(0.196)		(0.224)	(0.314)		(0.296)
Bureaucratic quality		-0.0770	-0.0915	· · · · ·	-0.278	-0.284
1 2		(0.152)	(0.189)		(0.238)	(0.239)
Observations	702	702	702	365	365	365
Number of countries	128	128	128	83	83	83
AR(1) p-value	0.001	0.000	0.000	0.001	0.002	0.002
AR(2) <i>p</i> -value	0.573	0.556	0.516	0.118	0.081	0.132
Hansen <i>p</i> -value	0.539	0.428	0.392	0.358	0.294	0.640
Number of instruments	106	106	116	89	89	98

TABLE 5

THE INDIRECT EFFECT OF CORRUPTION CONTROL WITH ADDITIONAL INSTITUTIONAL CONTROLS

NOTE: Windmeijer corrected standard errors in parentheses: **p < 0.01, *p < 0.05. The dependent variable is growth volatility, measured as the standard deviation of per capita GDP growth. All specifications include but do not report a constant and time-dummy variables. For more information, see Table 2.

marginal effects of financial development at the 75th and those at the 25th percentiles of the corruption control distribution with the corresponding standard errors for all models. As already implied by the negative coefficients of the interaction terms in Panel A of Table 3, the calculated differences are negative, yet only significant in models (5), (7), and (8), where corruption control is measured in terms of the TI index. Economically, the most comprehensive models (4) and (8) imply that if a country were to move from the 25th to the 75th percentile of the distribution of corruption control as measured by the ICRG (TI) index, this would increase the volatility-reducing effect of financial development by about 0.6 (2.3) points, on average.

Figure 1 illustrates the marginal effect of financial development, not just at the three quartiles, but at all measurable levels of corruption control. The graphical displays are based on estimation results documented in columns (4) (Figure 1(a)) and (8) (Figure 1(b)) of Table 3. It can be seen that the marginal effect of financial development on volatility is almost entirely negative, yet very close to zero for small

THE DIRECT EFFECT OF COR	RUPTION CONTR	ol with Additig	DNAL SOCIOECON	OMIC CONTROLS				
		CC(IC	(RG)			CC((TI)	
	(1)	(2)	(3)	(4)	(5)	(9)	(1)	(8)
Initial volatility	-0.150^{*}	0.0341	-0.0416	-0.0177	-0.152^{*}	-0.154^{*}	-0.187**	-0.152
CC	-0.920^{**}	-0.451°	-0.484^{*}	-0.412 -0.412	-0.911	-0.944^{*}	-0.818^{*}	-0.592
FD	(0.293) -0.638	(0.207) -0.495	-0.781^{*}	-0.891	-0.712	(6/6.0)	0.165	0.250
GDP	(0.438) 0.308	(0.560) 0.139 0.239)	0.192	-0.000143	(928) 0.476 0.2000	(000) 0.608 0.608	(0.891) -0.349	(1.72) -1.051
Inflation	(0.323) 0.349	(0.382) 0.583^{**}	(0.528) 0.564^{**}	(0.358) 0.746**	0.464*	(0.348) 0.732^{**}	(0.782** 0.782**	(1.171) 0.574
Government size	(0.183) 1.045	(0.134) 1.349*	(0.152) 1.088	(0.190) 1.014	(0.219) 0.288	(0.224) 0.346	(0.240) -0.0341	(0.404) -1.809
Trade onenness	(0.597) 0.00194	(0.688) 0.0784	(0.615) -0.190	(0.890) 0.183	(1.052) 0.637	(0.772) 0.381	(0.792) -0.319	(1.867) -1.279
	(0.652)	(0.522)	(0.546)	(0.671)	(0.610)	(0.656)	(0.831)	(1.296)
Financial openness	0.738 (0.394)	0.752)	0.823°	1.043***	1.080"	1.134°	(0.576)	2.36/
ToT volatility	-0.0495				-0.0109			(10000)
Crop dependency	(1 000.0)	0.0601			(+770.0)	0.0951		
Population growth		(0.140)	-0.403			(701.07)	-0.867	
Education			(0/7.0)	0.841			(664.0)	3.715
				(01.10)				(000
								(Continued)

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		CC(I	CRG)			CC	(II)	
	(1)	(2)	(3)	(4)	(5)	(9)	(2)	(8)
Observations	612	664	702	526	343	363	365	267
Number of countries	128	126	128	115	83	83	83	LL
AR(1) <i>p</i> -value	0.002	0.000	0.001	0.001	0.001	0.003	0.004	0.007
AR(2) <i>p</i> -value	0.402	0.229	0.659	0.363	0.243	0.150	0.156	0.160
Hansen <i>p</i> -value	0.194	0.566	0.124	0.170	0.308	0.302	0.215	0.188
Number of instruments	96	96	96	104	83	83	83	64
NoTE: Windmeijer corrected standar	d errors in parenthese	s: ** $p < 0.01$, * $p < 0.0$	55. The dependent varia	the is growth volatility,	measured as the standa	rd deviation of per capi	ita GDP growth. All sp	scifications include

TABLE 6 (Continued)

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		CC(IC	.RG)			CC((II)	
	(1)	(2)	(3)	(4)	(5)	(9)	(2)	(8)
Initial volatility	-0.150^{*}	0.0155	-0.0473	0.00193	-0.147^{*}	-0.177^{**}	-0.173**	-0.155^{*}
СС	(0.0692) - 0.952	(0.0725) 1.588	(0.0716) 0.983	(0.0766) 0.422	(0.0580) 2.522	(0.0554) 4.011^*	(0.0624) 1.906	(0.0727) 4.541^*
FD	(1.021) -0.714	(0.921) 0.928 0.723	(0.896) 0.130	(0.813) -0.184	(1.431) 0.940	(1.757) 1.348 (0.000)	(1.879) 1.148 (1.025)	(1.997) 2.426
CC×FD	(0.728) 0.00362	(0.07)	-0.414	(1001) -0.232	-0.816°	(0.999) -1.192**	(0.039) -0.639	(100.1) -1.216^{**}
GDP	(0.2/2) 0.328	(1.242)	(0.241) 0.347	(0.211) 0.0157	0.468	(0.454) 0.722	(0.4/6) -0.147	(0.403) -0.846
Inflation	(0.293) 0.410^{*}	(0.450) 0.536^{**} (0.146)	(0.360) (0.494^{**})	(0.293) 0.624^{**}	(0.407) 0.514^{**}	(0.388) 0.749^{**}	(0.672) 0.807^{**}	(1.167) 0.440
Government size	(601.0) 1.180* 0.520)	0.880	(0.1.0) 0.689 0.616	(01.0) 0.761 (977.0)	-0.211 -0.211 -0.277	(0.2.0) -0.442	(0.241) -0.321 (0.882)	(0.250) -2.066
Trade openness	0.123	0.140	-0.334	-0.146	0.274	-0.261	-0.570	-1.273
Financial openness	0.746	0.759*	0.878*	1.089^{**}	(202.0) 1.278* (A04.0)	(0.732) 1.490** 0.566)	(0.019) 1.893** (0.561)	2.214* 2.214* 0 887)
ToT volatility	(0.493 - 0.0493)	(+00.0)	(0.441)	(700)	-0.00211	(00(0)	(10(-0))	(100.0)
Crop dependency	(0000)	0.0685			(((10:0))	0.0334		
Population growth		(001.0)	-0.449			(001.0)	-0.715	
Education			(000-0)	0.787				2.856
Observations Number of countries	612 128	664 126	702 128	526 115	343 83	363 83	365 83	267 267 77
								(Continued)

TABLE 7

		CC(IC	CRG)			CC	(II)	
	(1)	(2)	(3)	(4)	(5)	(9)	(2)	(8)
AR(1) <i>p</i> -value AR(2) <i>p</i> -value Hansen <i>p</i> -value Number of instruments	0.002 0.388 0.311 106	0.000 0.210 0.682 106	0.000 0.565 0.248 106	0.001 0.238 0.357 115	0.001 0.208 0.517 89	0.002 0.056 0.431 89	0.002 0.127 0.336 89	0.009 0.070 0.220 68
NoTE: Windmeijer corrected standar	d errors in parenthese.	s: ** $p < 0.01$, * $p < 0.0$	5. The dependent varia	ble is growth volatility,	measured as the standa	rd deviation of per capi	ita GDP growth. All spe	ecifications include

TABLE 7 (Continued)

but do not report a constant and time-dummy variables. For more information, see Table 2.

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levels of corruption control and continuously decreasing with higher levels of corruption control.

Panel C of Table 3 displays the marginal effects of corruption control on growth volatility at different levels of financial development. Similar to Panel B, the differences between the marginal effects at the 75th and the 25th percentile are negative but mostly lack significance. Moreover, the marginal effects of corruption control are significantly negative only at high levels of financial development, a fact which is also visible in Figure 2 where the marginal effects of financial development are plotted against levels of corruption control. Similar to the marginal effects of financial development at different levels of corruption control, the marginal effects of corruption control on growth volatility consistently decrease with financial development. Yet, unlike the marginal effect of financial development conditional on corruption control, the significantly negative effect of corruption control at high levels of financial development conditional on corruption control.

In a nutshell, the results confirm that corruption control reduces growth volatility. Moreover, we find some evidence for an indirect effect of corruption control through enhancing the volatility-dampening effect of financial development. Yet, this indirect effect mostly lacks significance if corruption control is quantified by means of the ICRG index. Thus we find strong evidence for a direct negative effect of corruption control on growth volatility independent of the degree of financial development and some weak evidence for an indirect effect of corruption control through the channel of financial development. Hence, our results imply that corruption control policies are a promising strategy to reduce macro-economic volatility. Yet, corruption control policies may not attain their full direct volatility-reducing potential until a sufficiently high level of financial development is achieved. Thus, policymakers should consider simultaneously promoting both corruption control and financial development as a promising strategy to reduce growth volatility.

3.2 Robustness Checks

Since corruption control is the only indicator of institutional quality included in our baseline estimations, the question arises whether and to what extent corruption control is a proxy for overall institutional quality. In other words, one could suspect that the direct effect of corruption control on growth volatility as well as the indirect effect through the channel of financial development may not be driven by corruption control itself, but by overall institutional quality.

To isolate and evaluate the separate effect of corruption control, we add additional control variables of institutional quality to our most comprehensive baseline models represented by columns (4) and (8) in Tables 2 and 3. Table 4 shows our baseline models for both measures of corruption control without the interaction term, extended with the level of law and order (specifications (1) and (4)), the level of bureaucratic quality (specifications (2) and (5)), and both (specifications (3) and (6)). All specifications show significantly negative coefficients of corruption control, whereas the effects of both, law and order and bureaucratic quality, lack significance throughout.

This implies that the negative effect of corruption control is largely robust to including additional measures of institutional quality and that corruption control is the only significant institutional determinant of growth variations.

Table 5 displays analogous regressions to Table 4 but including the interaction between financial development and corruption control. As expected, the coefficients of the interaction term lack significance when corruption is quantified by means of the ICRG index. The interaction between corruption control in terms of the TI measure and financial development, however, remains significant (at least at a nominal 10% level). We thus consider the indirect effect of corruption control in terms of the TI index on growth volatility as found in Table 3 to be robust against including additional measures of institutional quality. As in Table 4, neither the level of law and order nor the level of bureaucratic quality exerts a significant effect on the volatility of per capita GDP growth.

As a second robustness check, we expand our comprehensive models (4) and (8) from Tables 2 and 3 with a set of socioeconomic control variables used in parts of the empirical literature, namely, volatility of terms of trade, crop dependency, population growth, and education. As documented in Table 6, the effect of corruption control remains negative and significant (at a nominal 10% level) whenever including one of the aforementioned socioeconomic variables. Meanwhile, none of the added variables exerts a significant impact on the standard deviation of per capita GDP growth. Analogously, Table 7 shows that the interaction between corruption control as measured by the TI index and financial development in affecting growth volatility is largely robust to including socioeconomic control variables. Yet, as expected, the interaction between corruption control in terms of the ICRG index and financial development mostly lacks significance.

Lastly, our results on the direct effect as well as those on the indirect effect of corruption control by means of the TI measure are also robust to using a logarithmic specification of our dependent variable, that is, using the log of the standard deviation of GDP growth to measure growth volatility. This suggests that our findings are not driven by extreme volatility in some economies.⁴

4. CONCLUSION

In this paper, we examined the role of corruption control in affecting volatility in the growth of aggregate income. Following the theoretical reasoning and crosscountry evidence on the relation between corruption control and growth volatility by Evrensel (2010) and motivated by research on interactions between corruption and financial development in affecting growth by Ahlin and Pang (2008), we addressed two questions: First, does corruption control dampen growth volatility? And second, does

4. These results are available from the authors upon request.

corruption control exert an indirect effect on growth variations through the impact of financial development on growth volatility?

Employing data from 131 developing and developed economies for the period 1985–2018 and applying the system GMM dynamic panel estimator to address endogeneity concerns, our results confirm the volatility-dampening effect of corruption control. Regarding the indirect effect through financial development, we find the interaction term between corruption control and financial development as well as the difference in marginal effects of financial development at distinct percentiles of corruption control to be negative, although significance is limited to regression models where corruption control is quantified by means of TI's Corruption Perceptions Index. In these specifications, the negative impact of financial development on growth volatility is significantly larger at higher levels of corruption control. Hence, we show that corruption control dampens growth volatility directly as well as indirectly through strengthening the volatility-reducing impact of financial development on growth volatility.

Our findings on the direct effect of corruption control are robust to employing the level of law and order and the level of bureaucratic quality as additional measures of institutional quality, whereas both, law and order and bureaucratic quality, do not exert a significant effect on growth volatility. Our results therefore suggest that corruption control is perhaps the most effective and the only significant institutional determinant of growth variations. The indirect effect of corruption control quantified in terms of the TI measure on growth volatility through the channel of financial development is similarly robust to alternative measures of institutional quality. Moreover, we show that both the direct effect and the indirect effect of corruption control are robust to adding several socioeconomic control variables. Hence, although the evidence on the indirect role of control through increasing the volatility-dampening effect of financial development is not robust across alternative specifications and thus remains a topic for future research, our results highlight the importance of considering corruption control and its interaction with financial development when devising policies aimed at reducing macro-economic volatility.

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TABLE A1

APPENDIX A: SAMPLE AND DATA INFORMATION

COUNTRIES INCLUDED IN SAMPLE High income Australia, Austria, Bahamas, Bahrain, Belgium, Brunei Darussalam, Canada, Chile, Croatia, Cyprus, Czech Řepublic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong SAR, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Rep., Kuwait, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, New Zealand, Norway, Oman, Panama, Poland, Portugal, Qatar, Saudi Arabia, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Trinidad and Tobago, United Arab Emirates, the United Kingdom, the United States, and Uruguay Albania, Algeria, Argentina, Armenia, Azerbaijan, Belarus, Botswana, Brazil, Bulgaria, China, Colombia, Costa Rica, Dominican Republic, Upper-middle income Ecuador, Gabon, Guatemala, Guyana, Iran, Jamaica, Jordan, Kazakhstan, Lebanon, Malaysia, Mexico, Namibia, Paraguay, Peru, Romania, Russian Federation, South Africa, Sri Lanka, Suriname, Thailand, Turkey, and Venezuela Angola, Bangladesh, Bolivia, Cameroon, Congo Rep., Cote d'Ivoire, Egypt, El Salvador, Ghana, Honduras, India, Indonesia, Kenya, Lowermiddle income Moldova, Mongolia, Morocco, Myanmar, Nicaragua, Nigeria, Pakistan, Papua New Guinea, Philippines, Senegal, Sudan, Tunisia, Ukraine, Vietnam, and Zambia Guinea-Bissau, Haiti, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Sierra Leone, Tanzania, Togo, Uganda, and Yemen Low income

NOTE: Income categories according to World Bank classification (2018).

TABLE A2 Definitions and Sou	JRCES	
Variable	Description	Source
Growth volatility	Standard deviation of per capita GDP growth over 5-year interval	World Development Indicators 2019 (WDI 2019)
CC(ICRG)	Corruption control, measured as ICRG corruption index. The index takes values between 0 and 6, where 6 indicates the highest level of corruption control	PRS' International Country Risk Guide (ICRG 2015)
CC(TI)	Transparency International's Corruption Perceptions Index, rescaled to a range between 0 and 6	Transparency International
FD	IMF's Financial Development Index at beginning of period × 100	IMF Financial Development Index database
GDP	GDP per capita in constant 2010 US\$	WDI 2019
Inflation	GDP deflator (annual %)	WDI 2019
Government size	General government consumption expenditure relative to GDP	WDI 2019

(Continued)

TABLE A	2
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(CONTINUED)

Variable	Description	Source
Trade openness Financial openness	Sum of exports and imports relative to GDP Sum of total assets and total liabilities relative to GDP	WDI 2019 Lane and Milesi-Ferretti 2017
Law and order	ICRG Law and Order index. The index combines information on strength and impartiality of the legal system and popular observance of the law. The index takes values between 0 and 6, where 6 represents the highest level of law and order.	ICRG 2015
Bureaucratic quality	ICRG index of bureaucratic quality. Initially takes values between 0 and 4, but is normalized to a scale between 0 (low bureaucratic quality and 6 (high bureaucratic quality) to fit measures of corruption and law and order.	ICRG 2015
ToT volatility	Volatility of terms of trade, measured as the standard deviation of terms of trade (ratio of export to import unit value indexes, relative to the base year 2000) over 5-year interval	WDI 2019
Crop dependency	Agricultural raw materials exports relative to total merchandise exports	WDI 2019
Population growth Education	Annual population growth rate Average years of schooling attained	WDI 2019 Barro and Lee 2013

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