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EXCHANGE RATE MISALIGNMENTS, GROWTH, AND INSTITUTIONS

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Exchange rate misalignments, growth, and institutions

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Abstract:
In this paper, we revisit the relationship between economic growth and exchange rate misalignments, especially undervaluations. In particular, we ask which countries benefit from undervaluations at most, and whether the impact of undervaluations on growth depends on institutional quality as suggested in previous literature. First, we separate countries into groups according to their institutional quality using the cluster analysis. Then, we estimate the relationship between growth and exchange rate misalignment while allowing for variation in coefficients across these clusters. Our results confirm the positive relationship between undervaluation and growth, and this relationship is the highest for countries with the highest quality of institutions rather than with a poor level of institutional quality. Therefore, our results reconcile the importance of good institutions and do not support the hopes that the countries can compensate for the poor institutional quality via undervaluation of currencies successfully.

JEL: F43, F31, 043
Keywords: exchange rate misalignments, undervaluation, economic growth, institutions, corruption

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1. Introduction

The empirical evidence increasingly supports the hypothesis that undervalued exchange rates foster long-term economic growth (see Frenkel and Rapetti, 2014, for a survey). These findings contradict the perspective of inherently harmful nature of any misalignments, that was embedded in the "Washington Consensus" of the 1990s, and that used to shape many policy recommendations in the previous decades (Berg and Miao, 2010). However, there exists substantial uncertainty, whether undervaluations are more favourable for developing or developed countries, and it remains unclear which mechanisms explain the positive link between undervaluation and long-term economic growth identified in the empirical literature.

More specifically, Rodrik (2008) shows that undervaluation is good for growth in developing countries, mainly through its impact on the share of tradables and industrial production. However, he did not confirm the positive effects of undervaluation for growth in developed countries. Subsequent replications revealed that the positive link between undervaluation and growth appears among the developed countries as well (Rapetti, Skott and Razmi, 2012) and that the empirical relationship might be blurred by potential nonlinearities in the sign and the size of the misalignment (Couharde and Sallenave, 2012, Libman, 2014, Iyke, 2018, and others).

In this paper, we focus on the role of institutional quality on the impact of undervaluation on growth. Such link between institutions and undervaluation was highlighted by Rodrik (2008) who reminds on the evidence that institutional weakness harms producers of tradables disproportionally more than producers of non-tradables.[1] Thus, Rodrik considers weak institutions as an additional tax levied on tradables, and the undervaluation serves as a form of compensation provided to the exporters for the weak institutions and higher transaction costs. Then, in his model, undervaluation increases both competitiveness and profits of the tradable sector, which further translate into higher growth in the overall economy. Finally, this effect is supposed to be more pronounced in developing countries than in developed countries, where such compensation for weak institutions is not a necessary precondition for the growth of production of tradables.

Importantly, the causal link between undervaluation and growth in Rodrik (2008) is based on an assumption of perfect capital mobility, so that the share of capital allocated to the production of tradables is allowed to increase with their profitability. However, the recent empirical literature suggests that worse institutions lead to imperfect capital mobility and larger input misallocations, which might limit the growth effects of currency undervaluation (Gamberoni, Giordano and Lopez-Garcia, 2016; Fidora, Giordano, and Schmitz, 2017). Additionally, Guzman, Ocampo, and Stiglitz (2017) present a theoretical model in which an active real exchange rate policy can promote growth in developing countries when the weakest exchange rate applies to tradables. However, such a policy mix of carefully determined real exchange rates specific to various sectors in the economy might be impossible to achieve when the institutional quality and governance is weak. Some governments tend to provide targeted support to industries and even specific firms as a response to their rent-seeking activities, rather than based on a careful analysis of the needs of the economy. Hence, it remains an open question whether the developing countries benefit from an active real exchange rate policy more than

[1] See for example Berkowitz, Moenius, and Pistor (2006).

developed countries and to what extent the developing countries can compensate for their institutional weakness by undervaluation of their exchange rate.

Thus, we contribute to the literature on the impact of undervaluations on growth by testing whether the differences in institutional quality explain the differences in the relationship between undervaluation and growth identified in the previous literature. We proceed as follows. First, we depart from verification of the positive relationship between undervaluation and growth with an updated edition of the Penn World Tables (PWT version 9.0; Feenstra, Inklaar and Timmer, 2016). Then, we use cluster analysis to separate the countries in our sample into groups according to their institutional quality. To assure that clusters are exogenous to growth, we transform the data on institutional quality to their relative terms by regressing institutions on the real GDP per capita first. Since we cluster over the Euclidean distance between the time series of the relative institutional qualities, the grouping of countries reflects not just the differences in levels of institutional quality but their evolutions as well. Third, following Rodrik (2008) and others, the index of under- and overvaluation is based on the real exchange rate adjusted for the impact of the Balassa-Samuelson effect. Finally, we estimate the differences in the undervaluation-growth relationship across clusters using cross country growth regressions. To tackle the bias in the dynamic panel models with fixed effects (Nickell, 1981), we employ the bootstrap-corrected fixed-effects model in our estimations(Everaert and Pozzi, 2007; De Vos, Everaert and Ruyssen, 2015).

Our results confirm the positive effects of undervaluation on economic growth. However, contrary to some of the previous literature and against the hypothesis of the prominent role of the institutional channel, we found that undervaluations, or exchange rate misalignments in general, have the highest effects in clusters of countries with the best quality of institutions. Thus, the undervaluation does not appear as a powerful compensation for institutional weakness for countries with relatively worst institutional quality, since these countries do not benefit from undervaluations as much as countries with better institutions. Nevertheless, we show that the empirical support for the hypothesis that undervaluation serves as compensation for the poor institutional quality reappears once the sample is extended to cover the 1980s and 1990s. This result suggests that the changes in the global economy in recent decades affected the relationship between undervaluation and growth as well.

Our paper is structured as follows. We start with a review of the recent empirical literature, and with a verification of the positive relationship between undervaluation and growth. The fourth section discusses why institutions might matter for the effects of undervaluation. In part five, we present the classification of countries according to their relative institutional quality. Section six contains our main results, that is the assessment of the effect of undervaluation on growth across groups of countries differentiated by their relative institutional quality, and section seven is filled with robustness checks. Main conclusions and policy implications close the paper.

2. Literature review

The research on the relationship between economic growth and undervaluation attracted a lot of attention in recent years. There appeared several recommendations that countries willing to accelerate their economic growth should adopt a strategy of a stable and competitive real exchange rate strategy, in other words, they

shall seek to achieve a stable and yet undervalued exchange rate. These recommendations challenge the conventional view that all disequilibria are bad and shall be avoided to assure long-term growth and overall macroeconomic stability. And while for example the IMF frequently recommended devaluation of the exchange rate in the past, the devaluations were almost always intended to correct the overvalued exchange rate, but not to maintain undervalued exchange rate continuously due to fears of inflationary pressures and reduced financial resources available for domestic investment (Williamson, 1990).

The policy of stable and competitive real exchange rate (SCRER; Frenkel and Rapetti, 2014) also differs significantly from the long-term consensus about the monetary policy that has gradually converged towards inflation targeting. While inflation targeting is characterised by a focus on domestic monetary conditions and the exchange rate is rarely used as a policy instrument (beyond occasional attempts to correct non-fundamental fluctuations, see Levi-Yeyati, Sturzenegger and Gluzmann, 2013), the policy of stable and competitive exchange rate requires relatively sophisticated policy coordination and utilisation of several policy instruments. Besides a necessity of a permanent presence of the central bank on the market, the policy needs to be supplemented by capital controls, relatively restrictive fiscal policy offsetting the potential of inflationary bias, and wage control, since undervaluation implies that wages are lower than they would be given the level of economic development.[2] Contrary to inflation targeting, the SCRER policy also lacks a generally accepted theoretical grounding that would indicate the superiority of this policy against other alternatives, although such attempts are present in the literature (Guzman, Ocampo, and Stiglitz, 2017, for example).

Despite certain risks associated with extended periods of undervalued currencies and limited anchoring of this policy in the economic theory, the empirical evidence that establishes a positive association between undervaluation and growth gradually increases. Rodrik (2008) proxies the equilibrium exchange rate by the purchasing power parity adjusted for the Balassa-Samuelson effect[3] and using this indicator of misalignments, he shows that as the overvaluation harms economic growth, the undervaluation facilitates it, especially in developing countries. The main channel how the undervaluation fosters long-term growth is the expansion of production of tradables due to their rising profitability, at the expense of non-tradables. Finally, Rodrik (2008) argues that tradables suffer from weak institutions disproportionately to non-tradables and undervaluation functions as a kind of compensation for institutional weakness to producers of tradables. Furthermore, Rodrik (2008) shows that the positive relationship between undervaluation and growth is stronger among the developing countries, where the institutional quality is in general worse than in developed countries. His results are based on splitting the sample at the threshold GDP per capita at $6000 in constant dollars of 2005, and at the thresholds defined by below-average, around-average, and above-average institutional quality measured by World Bank governance indices.

The positive relationship between undervaluation and growth has been then confirmed especially by Berg and Miao (2010) with misalignment identified using the FEER model along with the PPP-based measure utilised in Rodrik (2008). On the other hand, the authors point out that the determinants of misalignments

[2] Also, the policy of a stable and undervalued exchange rate can be easily considered as a "beggar thy neighbor" policy, and lead to escalation of political tensions.

[3] Thus, this approach reflects the Penn effect which is an increasing relationship between the price level and economic performance; more on this approach in section 3.

are likely to be independent drivers of economic growth as well, so identification of different channels is rather cumbersome.

Others, like Colin and Razin (2012), Aguirre and Calderon (2004), Couharde and Sallevane (2012), and Missio et al. (2015) focus on the differences between large and moderate devaluations, somewhat implicitly reflecting the consensual view that large misalignments might have a detrimental effect on growth, no matter the direction is. Indeed, these studies tend to confirm the positive impact of undervaluations on growth up to a certain threshold only. The notable exception is Berg and Miao (2010) who fail to confirm nonlinearity in the size of the misalignment.

Several studies confirm the positive relationship between undervaluation and growth but document the existence of the effect among the developed countries as well. Rapetti, Skott and Razmi (2012), for example, show the evidence for higher effects of undervaluation on growth in developing rather than in developed countries is sensitive to the choice of the threshold, and that the relationship is significant among the developed countries as well. Similar results are provided by Mbaye (2012). Iyke (2018) confirms the positive effects of undervaluation on a panel of middle-income countries, even after controlling for potential endogeneity using GMM.

Specifically for the EU, Comunale (2016) using panel cointegration documents significant, long-term effects of real misalignments on growth, with no significant differences between undervaluations and overvaluations. El-Shaggi, Lindner and von Schwinitz (2016) represent the perspective that countries in the EU-periphery had overvalued currencies before the 2008-crisis, implicitly pointing to negative effects of overvaluations on growth, although not explicitly testing it. Furthermore, it is widely documented that those euro area member states that experienced steady decreases in real unit labour costs before the Great Recession performed better than those member states observing the deterioration of their external competitiveness. Hence, there seems to be at least indirect evidence that undervaluation can foster growth in developed countries as well.

Although most of the empirical evidence of the recent decade usually finds supportive evidence for the positive effects of undervaluation on growth, see Frenkel and Rapetti (2014) for a survey, some notable exceptions appeared, too. In particular, Cumperayot and Kouwenberg (2016) and Gonclaves and Rodriguez (2017) show that the significance of the undervaluation in growth regressions disappears when controlling for the saving rate and when outliers are excluded from the sample. Exclusively on a panel of developing countries, Ribeiro, McCombie and Lima (2017) fail to identify a significant effect of undervaluations on growth when controlling for savings rate and inequality as well.[4]

[4] Furthermore, there seems to be some sensitivity of the results on the data that are used for estimation. Libman (2014) shows the size of the effect depends on the edition of the data from the Penn World Tables. Similarly, Cheung, Chinn and Nong (2017) show that even the size of the misalignment calculated from the Penn effect depends on a choice between the data source, and the coefficients are not robust when choosing between World Development Indicators and different editions of the Penn World Tables.

3. Undervaluation and growth: First-hand empirical evidence

Our preferred indicator of the real equilibrium exchange rate is based on the purchasing power parity, and it is precisely the same concept as in Rodrik (2008) and many more recent contributions to the literature.[5] The real exchange rate is calculated as a ratio of the nominal exchange rate XR_{it} of the national currency against the U.S. dollar and the purchasing power parity PPP_{it}:

$$ln(RER_{it}) = ln\left(\frac{XR_{it}}{PPP_{it}}\right) \quad (1)$$

where i represents a country index, t a time (in years)[6]. Note that the purchasing power parity conversion factor is being calculated over the GDP as a whole, so it includes the price level of both, tradables and non-tradables. Hence, the real exchange rate RER_{it} has to be adjusted for the Balassa-Samuelson effect, which implies higher real exchange rate in countries with higher GDP. Therefore, we estimate the regression

$$ln(RER_{it}) = \alpha + \beta\, ln(GDPPC_{it}) + \gamma\, f_t + u_t \quad (2)$$

with $GDPPC_{it}$ standing for the real GDP per capita (obtained from variables $RGDPE_{it}$ and POP_{it}), and f_t represents the time-fixed effects and u_t is the error term.

Then, the undervaluation index is a simple difference between the actual real exchange rate and its fitted values ($\widehat{RER}$) as shown in equation (3).[7]

$$\ln(UNDERVAL_{it}) = \ln(RER_{it}) - \ln(\widehat{RER}_{it}) \quad (3)$$

For estimation, we used the Penn World Tables 9.0 (Feenstra, Inklaar and Timmer, 2016) that covers 182 countries over the years 1950-2014, of which we excluded the observations from the years 1950 to 1979, to eliminate a large amount of missing and extrapolated observations, as recommended by Feenstra, Inklaar and Timmer (2015). We show the results in Table 3.1, and the slope coefficient at $ln(GDPPC_{it})$ is almost identical to the estimates of Rodrik who obtained -0.24 (Rodrik, 2008, p. 371) on a different sample.[8]

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[5] Recently, Iyke (2018) studied the effects of undervaluation on growth of the middle-income countries and used the same indicator of undervaluations as we do as a benchmark. Then, he compared the results to other concepts of equilibrium exchange rate and misalignment, from a simple filtering using the Hodrick-Prescott filter to GARCH-based indicators, and his results were reasonably robust to a change of this underlying concept of misalignment.

[6] Our notation follows Rodrik (2008), although the variable definitions have changed between the Penn World Tables editions 7.0 and 8.0. Since the version 8.0, the inverse of the purchasing power parity variable ($1/PLGDPO_{it}$) is equivalent to the real exchange rate RER_{it}, and thus it is not necessary to calculate the ratio $XRAT_{it}/PPP_{it}$ first.

[7] Obviously, there are other methods to calculate the exchange rate misalignments. However, the approach that adjusts the real exchange rate for the purchasing power parity is the most popular in the literature investigating the effects of misalignments on growth, and the results are usually reasonably robust to a change of this underlying model, see for example Iyke (2018) for comparison. Since our intention was to investigate the effects of institutional quality on the relationship between undervaluation and growth that was highlighted by Rodrik (2008), we follow the same approach to keep our results comparable.

[8] Rodrik (2008) estimated his regressions on the sample 1950-2004.

Table 3.1: Estimation of undervaluation

VARIABLES	(1) RER equation
ln(GDPPC$_{ij}$)	-0.2355***
	(0.0056)
Constant	3.1297***
	(0.0586)
Observations	6,077
R-squared	0.3869
Country FE	NO
Year FE	YES

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1; sample 1980-2014

Subsequently, we use this index of undervaluation as an independent variable within the cross-country growth regression (4):

$$growth_{it} = \alpha + \beta_1 \, ln(GDPPC_{it-1}) + \beta_2 \, ln(UNDERVAL_{it}) + \gamma \, f_t + \delta \, f_i + u_t \quad (4)$$

The panel regression (4) contains the lag of real GDP as an independent variable, but the dependent variable $growth_{it} = ln(GDPPC_{it}) - ln(GDPPC_{it-1})$. Thus, the equation (4) is, in fact, a dynamic panel regression with a lag of the dependent variable among the independent variables. In this case, the fixed-effect estimator using OLS suffers by the so-called Nickell bias (Nickell, 1981), that is most pronounced when the number of time-units is small and decreases to 0 with $t \to \infty$. The usual treatment of the bias is to utilise the GMM methods developed for the panel data such as the system GMM and the difference GMM (Arellano and Bond, 1991, Arellano and Bover, 1995, and Blundell and Bond, 1998). In GMM, the lagged variable is instrumented by further lags of the variable itself and possibly other independent variables as well. However, in many circumstances, the implementation of the difference and system GMM appears challenging: The results are often very sensitive to even minor changes in the selection of instruments (highlighted by De Vos, Everaert, and Ruyssen, 2015), and the conventional test statistics such as the Hansen and Sargan tests are biased when the number of instruments is *large*.[9]

Therefore, we opted for the bootstrap-corrected fixed effects estimator developed by Everaet and Pozzi (2007) as an alternative and more robust option to the GMM. An intuitive description of the method is provided by De Vos et al. (2015).[10] Let us note that we obtained the initial values from 50 burn-in iterations and the confidence intervals were obtained directly from the bootstrap replications. Because our data are from well-

[9] The word "*large*" could be an acronym for *"almost always"*, due to proliferation of instruments in the difference and system GMM, see the discussion in Roodman (2007). Our experience supports the claim of De Vos et al., 2015 that the results from the GMM regression are sometimes extremely sensitive to instrument selection. We were, in fact, able to obtain even opposite coefficient signs in some of our regressions presented in the next section - just by a small changes in the number of lags used as instruments, and the specification tests did not provide us with almost any guidance to select which of the results are more relevant than others. Let us note that the results from our GMM experiments are available upon request, although not worth a red cent.

[10] The bootstrap corrected fixed effect model was estimated in Stata, using the `xtbfce` command (De Vos, Everaert, and Ruyssen, 2015).

identified cross-sectional units, and our time-sample is relatively small, we used resampling that allowed us to account for the contemporaneous cross-sectional dependence.

We estimated the equation (4) on annual data, as well as on the three- and five-year averages on a sample starting in 1996 and ending in 2014, for which the data on institutional quality are available. We show the results in Table 3.2. As we can see, these preliminary results indicate a mostly positive and statistically significant effect of undervaluation on economic growth, with highest coefficients on the annual data, and lowest and in case of the bootstrap-corrected FE model insignificant on the five-year averages. In the next sections, we consider the data with three-year averages as our benchmark, and the results for the five-year averages are provided as a sensitivity check.

The values of the coefficient estimates for the three-year and five-year averages range from 0.0106 to 0.279. Rodrik (2008) reports 0.017 for his sample 1950-2004, and 0.026 for a subsample of developing countries. Hence, our results are both qualitatively and quantitatively somewhat similar to the previous contributions to the literature, and Table 3.2 provides a reasonable starting point for more in-depth exploration of the impact of institutions on the relationship between undervaluation and growth.

Table 3.2: Undervaluation and growth - simple regressions

	(1)	(2)	(3)	(4)	(5)	(6)
	1Y data	1Y data	3Y data	3Y data	5Y data	5Y data
VARIABLES	FE	BC-FE	FE	BC-FE	FE	BC-FE
Growth(-1)		0.1924***		0.2105***		0.1088
		(0.0565)		(0.0667)		(0.0945)
$\ln(GDPPC_{ij}(-1))$	-0.1129***	-0.1108***	-0.1086***	-0.0851***	-0.1092***	-0.0988***
	(0.0065)	(0.0143)	(0.0062)	(0.0102)	(0.0064)	(0.0139)
lnUNDERVAL	0.0620***	0.0551***	0.0279***	0.0199**	0.0292***	0.0106
	(0.0070)	(0.0132)	(0.0074)	(0.0094)	(0.0078)	(0.0186)
Constant	1.2834***		0.7727***		0.7798***	
	(0.0750)		(0.0443)		(0.0448)	
Observations	3,173	3,006	1,169	1,002	668	501
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1; sample 1996-2014.
FE - fixed effects. BC-FE - bootstrap corrected fixed effects.

4. Institutions and the effect of undervaluation on growth

While the evidence of a robust positive association between undervaluation and growth is gradually increasing, there remains a wide disagreement about the mechanisms explaining why and how the undervalued exchange rates improve the long-term economic growth. The importance of institutions was highlighted by Rodrik (2008), for whom weak institutions are the most prominent reason why undervaluations foster the economic growth of the developing countries in particular.

Rodrik's argument proceeds as follows: While weak institutions affect all sectors negatively, firms in tradable sectors suffer disproportionately more than firms producing non-tradables.[11] Then, undervaluation can offset the impact of weak institutions to producers of tradables since their production becomes cheaper and more competitive on international markets. Their profits rise, and these firms are finally able to accumulate capital for the necessary investments. Hence, if the country is unable to improve its institutional framework, undervaluation is considered as the second-best solution on how to promote growth and to foster economic development. Rodrik supports his ideas by an empirical test in which countries are separated into three groups by the level of their institutional development (measured by World Bank governance indices), and by a formal model.

With the more recent data, we confirm the significant relationship between undervaluation and growth even after we control for the differences in the quality of institutions. As shown in Table 4.1, the results were robust to alternative indicators of institutional quality as we used as an approximation the Control of Corruption index, Rule of Law index, and the first principal component of variables from the World Bank World Governance Indicators database as well. The potential interplay between undervaluation and institutions is supported by the significance of cross-products between institutions and undervaluation (Table 4.2).

Table 4.1: Undervaluation and growth, controlling for institutional quality

	(1)	(2)	(3)	(4)	(5)	(6)
	3Y data	3Y data	3Y data	3Y data	3Y data	3Y data
VARIABLES	FE	FE	FE	BC-FE	BC-FE	BC-FE
Growth(-1)				0.1920***	0.1794***	0.1600***
				(0.0678)	(0.0688)	(0.0616)
$\ln(GDPPC_{ij}(-1))$	-0.1106***	-0.1150***	-0.1159***	-0.0914***	-0.0979***	-0.0975***
	(0.0062)	(0.0063)	(0.0062)	(0.0108)	(0.0117)	(0.0113)
lnUNDERVAL	0.0298***	0.0326***	0.0343***	0.0246***	0.0301***	0.0305***
	(0.0074)	(0.0074)	(0.0074)	(0.0095)	(0.0098)	(0.0100)
Control of Corruption	0.0128*			0.0189**		
	(0.0072)			(0.0092)		
Rule of Law		0.0275***			0.0308***	
		(0.0073)			(0.0090)	
Governance Indicators			0.0179***			0.0202***
			(0.0035)			(0.0047)
Constant	0.7680***	0.7841***	0.7893***			
	(0.0448)	(0.0441)	(0.0439)			
Observations	1,162	1,162	1,162	996	996	996
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1; sample 1996-2014.
FE - fixed effects. BC-FE - bootstrap corrected fixed effects.

[11] There are several reasons why productions of tradables suffer by weak institutions more than production of non-tradables. Most importantly, tradables are usually more sophisticated and their production more complex. On top of that, in developing countries, the production of tradables is often small, and underinvestment. When increasing returns are present, small firms are disadvantaged, and capital flows to the sector of non-tradables rather than tradables, so the growth prospects for firms in tradables deteriorate as well. See Rigobon and Rodrik (2005) and Berkowitz, Moenius, and Pistor (2006).

Table 4.2: Undervaluation and growth: Cross products of undervaluation and institutions

VARIABLES	(1) 3Y data FE	(2) 3Y data FE	(3) 3Y data FE	(4) 3Y data BC-FE	(5) 3Y data BC-FE	(6) 3Y data BC-FE
Growth(-1)				0.1903***	0.1910***	0.1886***
				(0.0645)	(0.0619)	(0.0662)
$\ln(GDPPC_{ij}(-1))$	-0.1075***	-0.1073***	-0.1067***	-0.0880***	-0.0874***	-0.0877***
	(0.0059)	(0.0059)	(0.0058)	(0.0101)	(0.0104)	(0.0101)
lnUNDERVAL*CCE	0.0133***			0.0108***		
	(0.0031)			(0.0037)		
lnUNDERVAL*RLE		0.0135***			0.0102***	
		(0.0031)			(0.0039)	
lnUNDERVAL*WGI			0.0067***			0.0057***
			(0.0015)			(0.0019)
Constant	0.7592***	0.7064***	0.7510***			
	(0.0417)	(0.0382)	(0.0411)			
Observations	1,162	1,162	1,162	996	996	996
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1; sample 1996-2014.
CCE = Control of Corruption, RLE = Rule of Law, WGI = Governance indicators, 1st principal component.
FE - fixed effects. BC-FE - bootstrap corrected fixed effects.

However, the role of the institutions can be more complex. Christiansen (2009), and more recently Nouira and Sekkat (2015), or Fidora, Giordano, and Schmitz (2017) stress the observation that better regulatory and institutional quality can affect the persistence of the REER misalignment itself. These authors argue that better institutions shape the political process in a form that favours certain groups to others less likely. Thus policy-makers tend to be more active in correcting existing disequilibria, including the real exchange rate misalignments. It shall be, however, noted that the effects of misalignments on growth are not explicitly estimated in those papers, and misalignments are not considered as instruments to correct for weak institutions. Instead, it seems that the authors view misalignments as a bad thing, in the spirit of the Washington Consensus view (Williamson, 1990).

Undoubtedly, institutions are not the only reason why undervaluation might increase economic growth. Frenkel and Rapetti (2014) recall what characterises the process of economic development: An intense structural transformation from low-productivity to high-productivity activities that are mostly tradable. The tradable-led growth channel is, however, possible under several conditions. First, there is a possibility of increasing returns to scale, and second, capital is allowed to flow to these high-productivity activities. The undervalued currency fosters capital accumulation in those high-productivity activities as it compensates for market failures caused by returns on learning. This perspective of growth characterised by structural change is supported by empirical findings by McMillan and Rodrik (2011). Using sectoral data of 38 countries, they show that undervaluation supports structural change in favour of modern tradables and flow of labour to high productivity sectors. The hypothesis of structural change induced by undervaluation is supported by Freund and Pierola (2012) and Cimoli, Fleitas and Porcile (2013) who find that undervaluation increases the extensive margins; thus it helps firms to enter new markets and to sell new products.

These empirical findings are consistent with a stylised two-period model developed by Guzman, Ocampo and Stiglitz (2017), in which they argue that for growth, multiple real exchange rates might be the optimal policy. The existence of multiple real exchange rates within one economy can be achieved in multiple ways, notably by complementary effects of targeted fiscal instruments to the aggregate intended exchange rate misalignment. Such economic policy can provide targeted support to that part of the tradable sector where the learning spillovers to the rest of the economy are highest, and so this sectoral industrial policy can bring benefits for the long-term growth and development.

Obviously, we need to ask to what extent structural change and economic development characterises only the developing countries as the developed countries need to continuously adjust to structural changes in the global economy as well. These changes might include globalisation, increasing internationalisation of global production (Baldwin, Lopez-Gonzales, 2015), a gradual shift towards green technologies, automatisation, artificial intelligence and others. Essentially, undervaluation, along with subsidies, might help to gain a competitive advantage when increasing returns and learning spillovers are present, no matter whether the country is developing or developed one. On top of that, not only undervaluation might help to compensate for weak institutions, good institutions might help to exploit the benefits and opportunities provided by the undervalued real exchange rate as well. Good institutions facilitate the reallocation of capital and labour to the highly productive sectors (for the evidence for the EU countries, see Gamberoni, Giordano and Lopez-Garcia, 2016, Fidora, Giordano, and Schmitz, 2017), and adoption of structural policies that fit the needs of the highly productive sectors rather than individual firms engaged in rent-seeking or political corruption. Thus, good institutions might intensify the positive effects of undervaluations for sound theoretical reasons as well.

5. Classification of countries according to their institutional development

Our exploration of the role of institutions for the impact of undervaluations on growth starts with a classification of countries with respect to their institutional quality. A similar step was taken already by Dany Rodrik who divided the countries by using the World Bank governance indices into three subgroups, based on their relative institutional quality (Rodrik, 2008, p. 395-397, Table 9 in particular). He proceeded as follows. He took a simple average of 4 subindices over the years 1996-2004, and regressed these country averages on log GDP per capita, obtaining a value of institutional index consistent with the country's GDP. Then, he divided the sample into three groups of equal size of countries with above-average, around-average, and below-average institutional quality. Then, he found support for the positive effects of institutions only for countries with below and around average institutions.

Our approach is different. Rather than relying on averages over indicators and years, we utilised cluster analysis which allows clustering based on both, levels and evolution of institutional indicators because it estimates the distance for each point in time.

Previously, Paulus and Krištoufek (2015) used a similar approach. They clustered countries depending on the Freedom from corruption index by the Heritage Foundation. However, many institutional indicators are closely correlated with the GDP, thus clustering over them contains a risk that one would cluster over the

respective economic development rather than over the institutions itself. Thus, the endogeneity problem arises there.

Therefore, we start with regressing three alternative indicators of institutional quality on real GDP, similarly as with the real exchange rate regression in equation (2):

$$Institutions_{it} = \alpha + \beta\, ln(GDPPC_{it}) + \gamma\, f_t + u_t \qquad (5)$$

As a proxy for $Institutions_{it}$ we use three alternative indicators of institutional quality available at the World Bank. First, the Control of Corruption, second, the Rule of Law index, and finally, the first principal component of all series included in the World Governance Indicators database. For the estimation of equation (5), we use the data from 1996 to 2014. Until 2000, the institutional data were published bi-annually, so we interpolated the data to annual frequency.

The results of the first-step regression (equation 5) are provided in Table 5.1. Again, we are mainly interested in residuals which indicate the difference between the observed institutional quality and institutional quality consistent with the level of economic development of the particular countries, and we will refer to these residuals as the relative institutional quality.

Table 5.1: Regressions: Relative institutional quality

VARIABLES	(1) Control of Corruption	(2) Rule of Law	(3) Governance indicators
ln(GDPPC$_{ij}$)	0.6103***	0.6100***	1.4144***
	(0.0098)	(0.0088)	(0.0202)
Constant	-2.7785***	-2.8087***	-7.3063***
	(0.0967)	(0.0895)	(0.2010)
Observations	3,282	3,288	3,265
R-squared	0.5576	0.5879	0.6022
Country FE	NO	NO	NO
Year FE	YES	YES	YES

Note: Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1; sample 1996-2014

Then, we perform cluster analysis of these three relative indices of institutional quality. We estimate the Euclidean distance d_{xy} between time series in different countries as

$$d_{xy} = \sqrt{\sum_{t=1}^{T} (x_t - y_t)^2}$$

and construct a distance matrix D. For clustering itself, we use the Ward linkage method. The resulting dendrograms indicate the existence of 5 clusters with approximately similar numbers of countries in each cluster. Resulting dendrogram for the Control of Corruption index is depicted in Figure 5.1, and some main statistics are provided in Table 5.2. Clusters are ordered from one to five according to the relative institutional

quality, with cluster 1 including countries with lowest relative institutional quality, and cluster 5 with the best institutions. Usually, the countries were selected into the same cluster no matter which institutional variable was used for clustering, although there were some occasional shifts to neighbouring clusters. Nevertheless, the positions of countries did not differ for more than one cluster at all, so the country groups can be considered as relatively robust to a choice of the institutional variable.

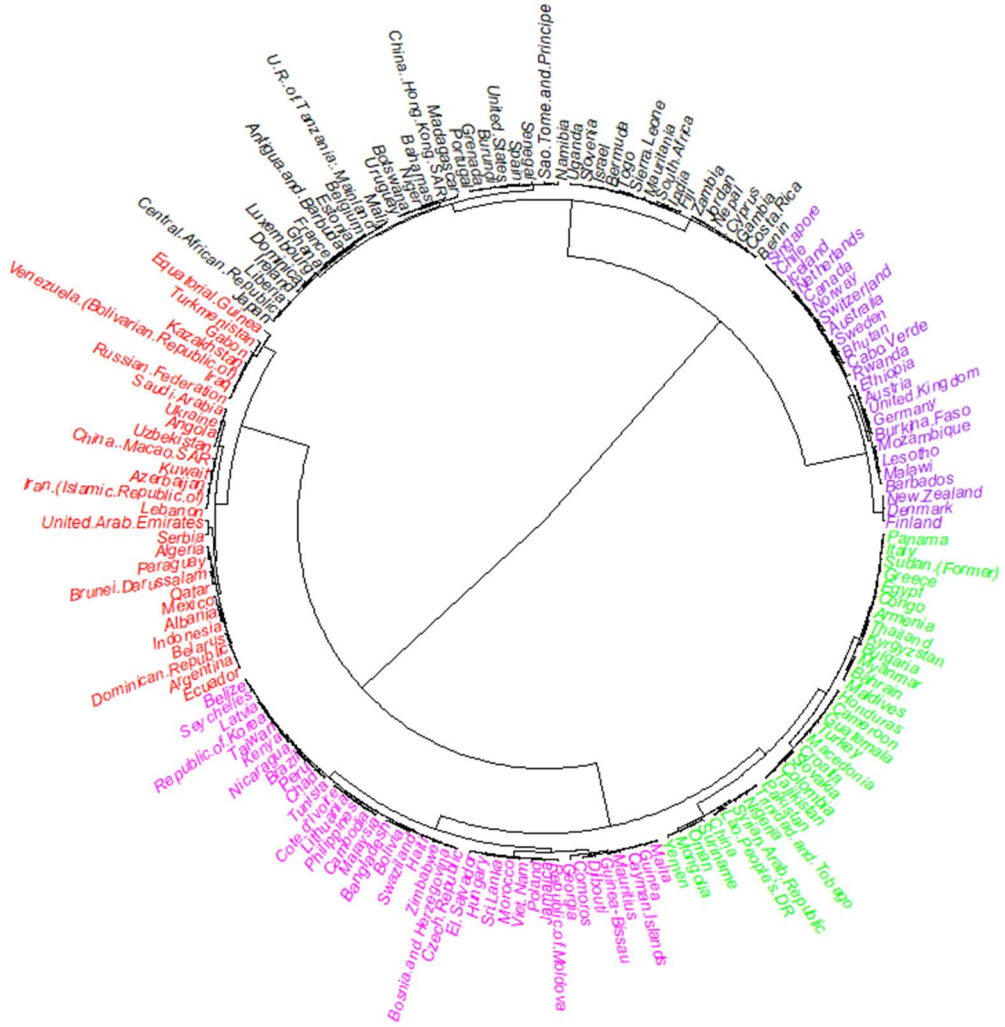
Note that the countries in cluster 1 are not necessarily the poorest economies, due to clustering over residuals from regressions from Table 5.1. Quite interestingly, the average GDP per capita in cluster 1 is the highest, because of many oil-producing countries included there (Saudi Arabia, Qatar, United Arab Emirates and Kuwait). China, for example, along with Egypt, Italy or Latin American countries, appear in Cluster 2. On the other hand, most of the advanced high-income countries appear in clusters 4 or 5, depending on the variable upon which the cluster analysis is performed. Some countries from Africa or South Asia managed to appear in the cluster of countries with the best institutional quality as well, such as Ethiopia, Rwanda or Senegal, as their institutional quality is much better than would correspond to their real GDP per capita. The composition of clusters can be found in Appendix 1.

Table 5.2: Clusters - Descriptive statistics

	N	CCE_rel	CCE	rGDPpc	N	RLE_rel	RLE	rGDPpc	N	WGI_rel	WGI	rGDPpc
Cluster 1	28	-0,929	-0,652	18642	30	-0,92	-0,763	17339	21	-2,243	-2,003	18828
Cluster 2	34	-0,416	-0,511	9450	39	-0,368	-0,547	8312	38	-0,99	-1,302	9564
Cluster 3	38	-0,135	-0,264	8978	26	-0,049	-0,331	8611	32	-0,197	-0,539	9955
Cluster 4	40	0,402	0,302	12878	39	0,362	0,485	15183	48	0,825	0,81	13067
Cluster 5	28	0,993	1,163	19379	37	0,781	0,808	16951	27	1,846	2,129	18884

Note: N is the number of countries within a given cluster. rGDPpc is the average real GDP per capita within a given cluster. CCE = Control of Corruption, RLE = Rule of Law, WGI = Governance indicators, 1st principal component. _rel indicates average values of residuals from the regression of institutional indices on real GDP per capita (equation 5).

Figure 5.1: Dendrogram of clustering over the Control of corruption index



Note: Control of corruption, data 1996-2014. Ward linkage method. Group 1: red, Group 2: green, Group 3: pink, Group 4: black. Group 5: violet. Clustering over the alternative institutional variables - Appendix 3.

6. Main results

To estimate how the impact of undervaluation on economic growth depends on institutions, we use the growth regressions extended for the interaction terms between undervaluation and dummy variables C_{ji} being one when country i belongs to cluster j. Thus, our benchmark regression is:

$$growth_{it} = \alpha + \beta_1 ln(GDPPC_{it-1}) + \delta_1 C_{1i}\, ln(UNDERVAL_{it}) + \delta_2 C_{2i}\, ln(UNDERVAL_{it}) + \\ + \delta_3 C_{3i}\, ln(UNDERVAL_{it}) + \delta_4 C_{4i}\, ln(UNDERVAL_{it}) + \delta_5 C_{5i}\, ln(UNDERVAL_{it}) + u_{it} \quad (6)$$

Additionally, the regression (6) includes the country and time fixed effects, and it might be extended for additional control variables. Equation (6) is estimated using the fixed effects and bootstrap-corrected fixed effects that account for the Nickell bias in dynamic panels.[12] The observations were aggregated using three-year averages to smooth out the short-term fluctuations.[13]

We present our main results in Table 6.1. Generally, undervaluation has a positive effect on growth in almost all clusters, but it is not always significant in particular when we used the bootstrap-corrected fixed effects estimator by Everaet and Pozzi (2007). The most conclusive evidence supporting the hypothesis of positive effects of undervaluation on growth appears in the 5th cluster, thus among countries with the highest relative institutional quality, then positive effects appear in cluster 3 identified with the data from the World Governance Indicators. Least conclusive results in terms of size and sign of the coefficient appear for countries with the lowest relative institutional quality (cluster 1).

Next, we include a set of control variables often used in growth regressions, such as investment, population growth, human capital, government expenditures, openness to trade, terms of trade and volatility of the exchange rate. These results are reported in Table 6.2. Along with the previous results, the weakest support for the positive impact of undervaluation on growth appears in countries from cluster 1 with the relatively lowest quality of institutions. Also, undervaluation appears as most growth-enhancing in cluster 5 with countries with relatively best institutions. However, the significantly positive effects of undervaluation now appear consistently in cluster 2, although the coefficient is somewhat smaller than in cluster 1, and occasionally in clusters 3 and 4.

Thus, our main results do not support the hypothesis that undervaluation helps in countries with low-quality institutions, which was suggested by Rodrik (2008) based on the data from a period 1950-2004. Instead, based on our estimates, at least some level of relative institutional and governance quality is needed to allow countries to benefit from undervaluations, as seen in the results in Table 6.2 for cluster 2. In those countries, the role of the institutional channel in the transmission of undervaluation to economic growth might be

[12] The alterantive specification of equation (6) would be as follows:

$$growth_{it} = \alpha + \beta_1 ln(GDPPC_{it-1}) + \delta_1\, ln(UNDERVAL_{it}) + \delta_2 C_{2i}\, ln(UNDERVAL_{it}) + \\ + \delta_3 C_{3i}\, ln(UNDERVAL_{it}) + \delta_4 C_{4i}\, ln(UNDERVAL_{it}) + \delta_5 C_{5i}\, ln(UNDERVAL_{it}) + u_{it}$$

Here, the coefficients δ_2 ... δ_5 represent the difference in the effect of undervaluations on growth in clusters 2 to 5 with respect to cluster 1. We estimated this alternative specification as well and the results were generally equivalent to those obtained from equation (6).

[13] All regressions in this section were estimated using annual data as well. The results were qualitatively consistent, but the coefficients δ_j were higher and more often significant even with the BC-FE model. These results are available upon request.

indeed important. At the same time, our results point to the prominent role of high institutional quality for economic development, and that the potential of undervaluations to serve as a compensation mechanism for low-quality institutions is limited.

On the other hand, the effects of undervaluation did not vanish even after inclusion of additional control variables in the growth regressions. So, our results are more on the side of the literature which accepts that undervaluation might increase the pace of economic growth, rather than on the side of sceptics (Cumperayot and Kouwenberg, 2016; Gonclaves and Rodriguez 2017) who failed to confirm the positive effects of undervaluations when additional control variables were included in their growth regressions. In the next sections, we will show that these main results survive a battery of robustness checks.

Table 6.1: Impact of undervaluation on growth across clusters

VARIABLES	(1) FE CCE	(2) BC-FE CCE	(3) FE RLE	(4) BC-FE RLE	(5) FE WGI	(6) BC-FE WGI
Growth(-1)		0.1963***		0.1997***		0.1963***
		(0.0657)		(0.0665)		(0.0664)
ln(GDPPC$_{ij}$(-1))	-0.1090***	-0.0847***	-0.1110***	-0.0859***	-0.1106***	-0.0858***
	(0.0062)	(0.0116)	(0.0062)	(0.0120)	(0.0062)	(0.0118)
Cl1_ lnUNDERVAL	-0.0159	0.0126	-0.0060	0.0189	-0.0082	0.0154
	(0.0146)	(0.0312)	(0.0146)	(0.0252)	(0.0154)	(0.0308)
Cl2_ lnUNDERVAL	0.0453***	0.0100	0.0511***	0.0137	0.0516***	0.0085
	(0.0128)	(0.0154)	(0.0123)	(0.0148)	(0.0121)	(0.0141)
Cl3_ lnUNDERVAL	0.0486***	0.0241	0.0509***	0.0370	0.0490**	0.0694**
	(0.0148)	(0.0154)	(0.0168)	(0.0331)	(0.0223)	(0.0292)
Cl4_ lnUNDERVAL	0.0020	0.0095	-0.0120	-0.0023	0.0037	0.0060
	(0.0171)	(0.0255)	(0.0165)	(0.0172)	(0.0128)	(0.0147)
Cl5_ lnUNDERVAL	0.0727***	0.0725***	0.0650***	0.0502**	0.0885***	0.0731***
	(0.0201)	(0.0161)	(0.0190)	(0.0251)	(0.0222)	(0.0171)
Constant	0.7634***		0.7689***		0.7742***	
	(0.0444)		(0.0442)		(0.0441)	
Observations	1,169	1,002	1,169	1,002	1,169	1,002
R-squared	0.5005		0.5007		0.5011	
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
F test	0.000338	0.0373	0.000296	0.520	0.000196	0.00347

Note: Models are estimated using 3-year averages on a sample 1995 - 2014. FE = Fixed effects, BC-FE = Bootstrap-corrected fixed effects. Columns (1) and (2): clustering over the control of corruption index. Columns (3) and (4): clustering over the rule of law. Columns (5) and (6): clustering over the first principal component of the World Governance Indicators data. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. F-test reports the p-value of the test the restriction that all coefficients at the interaction terms are the same (p-value).

Table 6.2: Impact of undervaluation on growth across clusters II

VARIABLES	(1) FE CCE	(2) BC-FE CCE	(3) FE RLE	(4) BC-FE RLE	(5) FE WGI	(6) BC-FE WGI
Growth(-1)		0.1707***		0.1760***		0.1696***
		(0.0609)		(0.0614)		(0.0599)
ln(GDPPC$_{ij}$(-1))	-0.1187***	-0.1184***	-0.1204***	-0.1198***	-0.1205***	-0.1190***
	(0.0077)	(0.0126)	(0.0078)	(0.0136)	(0.0078)	(0.0133)
Cl1_ lnUNDERVAL	-0.0083	-0.0031	0.0071	0.0090	0.0016	-0.0036
	(0.0199)	(0.0489)	(0.0201)	(0.0477)	(0.0222)	(0.0584)
Cl2_ lnUNDERVAL	0.0686***	0.0340*	0.0720***	0.0461**	0.0737***	0.0366**
	(0.0145)	(0.0176)	(0.0143)	(0.0193)	(0.0142)	(0.0172)
Cl3_ lnUNDERVAL	0.0535***	0.0377*	0.0607***	0.0406	0.0303	0.0525
	(0.0179)	(0.0215)	(0.0197)	(0.0465)	(0.0285)	(0.0521)
Cl4_ lnUNDERVAL	0.0302*	0.0457	0.0100	0.0268	0.0248*	0.0323*
	(0.0182)	(0.0318)	(0.0181)	(0.0192)	(0.0139)	(0.0183)
Cl5_ lnUNDERVAL	0.0841***	0.0998***	0.0713***	0.0709**	0.1016***	0.1046***
	(0.0207)	(0.0230)	(0.0189)	(0.0305)	(0.0224)	(0.0268)
Investment	0.0196***	0.0231***	0.0194***	0.0211***	0.0212***	0.0242***
	(0.0059)	(0.0081)	(0.0059)	(0.0079)	(0.0059)	(0.0079)
Government cons.	-0.0194***	-0.0051	-0.0191***	-0.0070	-0.0183***	-0.0055
	(0.0061)	(0.0122)	(0.0062)	(0.0113)	(0.0061)	(0.0125)
Human capital	0.0842*	0.0735	0.0920**	0.0757	0.0805*	0.0695
	(0.0459)	(0.0500)	(0.0456)	(0.0557)	(0.0456)	(0.0550)
Population growth	0.1837	-0.0004	0.1394	-0.0463	0.1611	-0.0211
	(0.1814)	(0.3620)	(0.1823)	(0.3113)	(0.1813)	(0.3339)
Openness	0.0176**	0.0050	0.0162**	0.0057	0.0154**	0.0046
	(0.0072)	(0.0138)	(0.0072)	(0.0145)	(0.0072)	(0.0129)
Terms of trade	-0.0375	-0.0431	-0.0389	-0.0466	-0.0365	-0.0445
	(0.0332)	(0.0418)	(0.0333)	(0.0405)	(0.0332)	(0.0445)
RER volatility	-0.0052**	-0.0057**	-0.0057***	-0.0060***	-0.0054***	-0.0060***
	(0.0020)	(0.0023)	(0.0020)	(0.0021)	(0.0020)	(0.0023)
Constant	1.1992***		1.2026***		1.2230***	
	(0.0982)		(0.0991)		(0.0991)	
Observations	1,001	858	1,001	858	1,001	858
R-squared	0.4733		0.4728		0.4753	
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
F test	0.00277	0.102	0.00392	0.722	0.000624	0.0804

Note: Models are estimated using 3-year averages on a sample 1995 - 2014. FE = Fixed effects, BC-FE = Bootstrap-corrected fixed effects. Columns (1) and (2): clustering over the control of corruption index. Columns (3) and (4): clustering over the rule of law. Columns (5) and (6): clustering over the first principal component of the World Governance Indicators data. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. F-test reports the p-value of the test the restriction that all coefficients at the interaction terms are the same (p-value).

7. Robustness checks

7.1 Controlling for institutional quality

The first robustness check is very straightforward. When institutions are supposed to matter for the undervaluation-growth relationship, we should control for institutional quality in the growth regression directly to see if the clustering makes a difference. These results are presented in Table 7.1, which is equivalent

to Tables 6.1 and 6.2 but extended for our three institutional variables within regressions. As it can be seen there, the results are virtually identical, confirming the most significant positive effects of undervaluation on growth in cluster 5, followed by cluster 2.

Table 7.1: Undervaluation and growth, controlling for institutional quality

VARIABLES	(1) BC-FE CCE	(2) BC-FE CCE	(3) BC-FE RLE	(4) BC-FE RLE	(5) BC-FE WGI	(6) BC-FE WGI
Growth(-1)	0.1762**	0.1705***	0.1721**	0.1731***	0.1448**	0.1516***
	(0.0704)	(0.0658)	(0.0680)	(0.0622)	(0.0678)	(0.0572)
ln($GDPPC_{ij}$(-1))	-0.0916***	-0.1134***	-0.0987***	-0.1180***	-0.1024***	-0.1262***
	(0.0124)	(0.0138)	(0.0120)	(0.0131)	(0.0119)	(0.0145)
Cl1_ lnUNDERVAL	0.0267	0.0025	0.0376	0.0128	0.0404	0.0106
	(0.0283)	(0.0501)	(0.0298)	(0.0517)	(0.0324)	(0.0572)
Cl2_ lnUNDERVAL	0.0154	0.0321*	0.0204	0.0465**	0.0272*	0.0527***
	(0.0162)	(0.0178)	(0.0160)	(0.0199)	(0.0143)	(0.0192)
Cl3_ lnUNDERVAL	0.0233	0.0335	0.0487	0.0477	0.0731**	0.0644
	(0.0155)	(0.0212)	(0.0304)	(0.0372)	(0.0294)	(0.0479)
Cl4_ lnUNDERVAL	0.0090	0.0414	0.0001	0.0185	0.0093	0.0252
	(0.0268)	(0.0354)	(0.0174)	(0.0212)	(0.0173)	(0.0214)
Cl5_ lnUNDERVAL	0.0836***	0.0900***	0.0588**	0.0594*	0.0901***	0.0973***
	(0.0158)	(0.0237)	(0.0237)	(0.0312)	(0.0167)	(0.0239)
Control of Corruption	0.0197**	0.0158				
	(0.0090)	(0.0116)				
Rule of Law			0.0322***	0.0213**		
			(0.0094)	(0.0102)		
Governance Indicators					0.0223***	0.0206***
					(0.0051)	(0.0063)
Investment		0.0179**		0.0152*		0.0150*
		(0.0084)		(0.0083)		(0.0083)
Government cons.		-0.0052		-0.0081		-0.0072
		(0.0130)		(0.0125)		(0.0128)
Human capital		0.0824		0.0917*		0.0940*
		(0.0545)		(0.0532)		(0.0547)
Population growth		0.1211		0.0968		0.0368
		(0.3718)		(0.2979)		(0.3915)
Openness		0.0078		0.0078		0.0004
		(0.0142)		(0.0147)		(0.0138)
Terms of trade		-0.0599		-0.0709*		-0.0649
		(0.0450)		(0.0417)		(0.0475)
RER volatility		-0.0054**		-0.0053**		-0.0047**
		(0.0023)		(0.0023)		(0.0022)
Observations	996	852	996	852	996	852
R-squared	0.478		0.4778		0.4889	
Year FE	YES	YES	YES	YES	YES	YES
F test	0.00696	0.195	0.311	0.662	0.00348	0.143

Note: Models are estimated using 3-year averages on a sample 1995 - 2014. BC-FE = Bootstrap-corrected fixed effects. Columns (1) and (2): clustering over the control of corruption index. Columns (3) and (4): clustering over the rule of law. Columns (5) and (6): clustering over the first principal component of the World Governance Indicators data. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. F-test reports the p-value of the test the restriction that all coefficients at the interaction terms are the same (p-value). The fixed effects results are provided in Table A4.1 in Appendix.

7.2 Economic complexity index as an additional control

The undervaluation or overvaluation of the exchange rate, in particular when sustained for a protracted period, has the potential to influence the structure of the economy. Undervaluation enhances growth in the tradable sector, and especially of industrial activities, while overvaluation favours non-tradables relative to tradables where the profitability diminishes, due to diminishing price competitiveness. At the same time, high openness and a high share of tradables increase the potential of undervaluation to increase the rate of economic growth. Similarly, the effects of the exchange rate misalignment might be different in diversified economies, exporting a wide range of products, some with a high degree of sophistication, and different in economies which heavily depend on the export of few products or product categories.

To tackle the need to control for the structure of the economy, we extended the set of control variables for the economic complexity index (ECI; Hidalgo and Hausmann, 2009) which measures both the diversity of a country's export and their sophistication. However, although the reasons for the inclusion of such variable are compelling, the index of economic complexity appeared insignificant, namely when the estimates were performed with the bootstrap-corrected fixed effect. Nevertheless, the interaction terms combining the dummy variable assigned to each cluster and undervaluation are more often statistically significant than in our baseline, and the highest coefficients at cluster five are confirmed (Tables 7.2).

Table 7.2: Controlling for economic complexity

VARIABLES	(1) BC-FE CCE	(2) BC-FE CCE	(3) BC-FE RLE	(4) BC-FE RLE	(5) BC-FE WGI	(6) BC-FE WGI
Growth(-1)	0.2435***	0.1684**	0.2404***	0.1444*	0.2098**	0.1980***
	(0.0870)	(0.0803)	(0.0902)	(0.0815)	(0.0883)	(0.0755)
ln(GDPPC$_{ij}$(-1))	-0.1152***	-0.1323***	-0.1217***	-0.1452***	-0.1265***	-0.1381***
	(0.0172)	(0.0185)	(0.0183)	(0.0208)	(0.0177)	(0.0188)
Cl1_ lnUNDERVAL	0.0304	0.0346	0.0440*	0.0474	0.0456*	0.0575
	(0.0221)	(0.0422)	(0.0263)	(0.0490)	(0.0261)	(0.0588)
Cl2_ lnUNDERVAL	0.0410**	0.0530**	0.0432**	0.0733**	0.0511***	0.0560**
	(0.0164)	(0.0230)	(0.0214)	(0.0285)	(0.0191)	(0.0272)
Cl3_ lnUNDERVAL	0.0304	0.0586**	0.0483*	0.0545	0.0584*	0.0661**
	(0.0256)	(0.0286)	(0.0292)	(0.0352)	(0.0299)	(0.0305)
Cl4_ lnUNDERVAL	0.0526**	0.0711**	0.0321	0.0404	0.0397***	0.0541**
	(0.0257)	(0.0292)	(0.0195)	(0.0298)	(0.0153)	(0.0228)
Cl5_ lnUNDERVAL	0.1162***	0.1189***	0.1112***	0.1016***	0.1289***	0.1219***
	(0.0251)	(0.0228)	(0.0253)	(0.0326)	(0.0309)	(0.0291)
Investment		0.0328***		0.0332**		0.0329**
		(0.0121)		(0.0135)		(0.0143)
Government cons.		-0.0158		-0.0172		-0.0121
		(0.0210)		(0.0225)		(0.0216)
Human capital		0.1314*		0.1289		0.1065
		(0.0758)		(0.0920)		(0.0736)
Population growth		-0.4814		-0.4780		-0.4916
		(0.6219)		(0.5284)		(0.5751)
Openness		0.0051		0.0053		0.0049
		(0.0183)		(0.0194)		(0.0208)
Terms of trade		-0.0419		-0.0474		-0.0438
		(0.0590)		(0.0750)		(0.0700)
RER volatility		-0.0068**		-0.0076**		-0.0062*
		(0.0032)		(0.0032)		(0.0034)
Control of Corruption	0.0197					
	(0.0152)					
Rule of Law			0.0268*			
			(0.0143)			
Governance Indicators					0.0208**	
					(0.0087)	
ECI	-0.0030	0.0067	-0.0025	0.0089	-0.0037	0.0139
	(0.0133)	(0.0132)	(0.0131)	(0.0133)	(0.0141)	(0.0124)
Observations	580	530	580	530	580	530
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
F test	0.0505	0.197	0.126	0.685	0.101	0.310

Note: Models are estimated using 5-year averages on a sample 1980 - 2014. FE = Fixed effects, BC-FE = Bootstrap-corrected fixed effects. ECI: Economic complexity index. Columns (1) and (4): clustering over control of corruption index. Columns (2) and (5): clustering over the rule of law. Columns (3) and (6): clustering over the first principal component of the World Governance Indicators data. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. F-test reports the p-value of the test the restriction that all coefficients at the interaction terms are the same (p-value). The fixed effects results are provided in Table A4.2 in Appendix.

7.3 Are low-income or high-income countries different?

Our classification of countries mixes within clusters the low-income countries with the middle and the high-income countries, and so it does not allow to derive direct conclusions for those more common groups of countries. To address this issue, we separated countries according to the World Bank classification, that is, to the low-income, lower medium-income, upper medium-income, and high-income countries.[14] Then, we re-estimated the equation (6) with the cross-products of the cluster-dummy and undervaluation for each income-group of countries.

However, even with this experiment, we have not found any robust hypothesis that undervaluation is useful, particularly for developing countries with lower quality of institutions. Rather, the coefficients at the interaction terms between undervaluation and institutional clusters are positive and at least somewhat significant for countries with the highest institutional quality in lower and medium-income countries (both lower- and upper-). In low-income countries, undervaluation works in Cluster 3 as well. Among the high-income countries, the highest effects of undervaluations on growth appear mainly among the countries with the highest institutional quality as well. Besides, we observe positive and statistically significant coefficients for the high-income countries of cluster 5 as well.

[14] We separated the countries according to the data from 2005, which is near the middle of our sample. All the historical classifications can be accessed at https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.

Table 7.3: Undervaluation and growth, World-bank classification of countries

VARIABLES	(1) BC-FE CCE	(2) BC-FE CCE	(3) BC-FE RLE	(4) BC-FE RLE	(5) FE WGI	(6) BC-FE WGI
Growth(-1)	0.1999***	0.1785***	0.1991***	0.1739***	0.1960**	0.1663**
	(0.0721)	(0.0615)	(0.0719)	(0.0649)	(0.0812)	(0.0694)
ln($GDPPC_{ij}$(-1))	-0.0925***	-0.1218***	-0.0942***	-0.1255***	-0.0952***	-0.1258***
	(0.0146)	(0.0157)	(0.0133)	(0.0154)	(0.0141)	(0.0155)
Cl1_lnUNDERVAL_LIC	-0.0195*		-0.0154	0.0354	-0.0159	0.0453
	(0.0111)		(0.0169)	(0.0351)	(0.0194)	(0.0371)
Cl2_lnUNDERVAL_LIC	0.0194	0.0531*	0.0212	0.0617	0.0237	0.0652**
	(0.0311)	(0.0321)	(0.0218)	(0.0478)	(0.0247)	(0.0294)
Cl3_lnUNDERVAL_LIC	0.0427	0.0840	0.1574**	0.2709**	0.1377*	0.2283
	(0.0360)	(0.0647)	(0.0619)	(0.1116)	(0.0706)	(0.1475)
Cl4_lnUNDERVAL_LIC	0.0242	0.0570	-0.0097	0.0227	-0.0045	0.0201
	(0.0518)	(0.0638)	(0.0502)	(0.0474)	(0.0401)	(0.0431)
Cl5_lnUNDERVAL_LIC	0.0655***	0.1004***	0.0231	0.0504	0.0585**	0.1076***
	(0.0228)	(0.0353)	(0.0374)	(0.0454)	(0.0275)	(0.0368)
Cl1_lnUNDERVAL_LMIC	-0.0508	-0.0907	-0.0347	-0.0946	-0.0527	-0.1449
	(0.0488)	(0.0652)	(0.0566)	(0.0785)	(0.0705)	(0.1104)
Cl2_lnUNDERVAL_LMIC	0.0026	0.0352	0.0112	0.0463*	0.0014	0.0380*
	(0.0191)	(0.0255)	(0.0232)	(0.0241)	(0.0171)	(0.0205)
Cl3_lnUNDERVAL_LMIC	0.0122	0.0492	-0.0025	0.0366	-0.0098	0.0167
	(0.0366)	(0.0439)	(0.0315)	(0.0454)	(0.0300)	(0.0393)
Cl4_lnUNDERVAL_LMIC	0.0541***	0.0921***	0.0189	0.0502	0.0236	0.0620
	(0.0185)	(0.0255)	(0.1833)	(0.2927)	(0.0585)	(0.0695)
Cl5_lnUNDERVAL_LMIC	0.0376*	-0.0031	0.0408*	-0.0049	0.0407*	-0.0047
	(0.0206)	(0.0205)	(0.0226)	(0.0194)	(0.0223)	(0.0179)
Cl1_lnUNDERVAL_UMIC	0.0473	0.0811	0.0468	0.0777	0.0509	0.1063
	(0.0702)	(0.0804)	(0.0583)	(0.0719)	(0.0942)	(0.1246)
Cl2_lnUNDERVAL_UMIC	-0.0046	-0.0124	0.0056	0.0366	0.0028	0.0138
	(0.0240)	(0.0341)	(0.0183)	(0.0302)	(0.0254)	(0.0420)
Cl3_lnUNDERVAL_UMIC	0.0102	0.0072	-0.0459	-0.0409	-0.0573	-0.0139
	(0.0191)	(0.0302)	(0.0540)	(0.0685)	(0.0718)	(0.0844)
Cl4_lnUNDERVAL_UMIC	-0.0216	-0.0066	0.0064	0.0117	0.0069	0.0111
	(0.0352)	(0.0918)	(0.0206)	(0.0242)	(0.0185)	(0.0231)
Cl5_lnUNDERVAL_UMIC	0.1127*	0.1618**	0.1119**	0.1616**	0.1181*	0.1875**
	(0.0651)	(0.0655)	(0.0480)	(0.0649)	(0.0645)	(0.0868)
Cl1_lnUNDERVAL_HIC	0.0776	0.1138*	0.0777	0.1158*	0.0746	0.1121
	(0.0556)	(0.0660)	(0.0578)	(0.0668)	(0.0634)	(0.0747)
Cl2_lnUNDERVAL_HIC	0.1032	0.1543	0.0909	0.1463	0.0936	0.1607
	(0.1150)	(0.1231)	(0.1225)	(0.1330)	(0.1225)	(0.1479)
Cl3_lnUNDERVAL_HIC	0.0971	0.0085	0.1065	0.0101	0.1036*	0.0531
	(0.0806)	(0.0869)	(0.0907)	(0.1039)	(0.0617)	(0.0702)
Cl4_lnUNDERVAL_HIC	-0.0155	0.0310	-0.0136	0.0340	-0.0076	0.0424
	(0.0298)	(0.0323)	(0.0279)	(0.0295)	(0.0299)	(0.0294)
Cl5_lnUNDERVAL_HIC	0.0735**	0.0725***	0.0965***	0.0861***	0.0909***	0.0853***
	(0.0311)	(0.0261)	(0.0346)	(0.0279)	(0.0348)	(0.0308)
Other growth determinants	NO	YES	NO	YES	NO	YES
Observations	1002	858	1002	858	1002	858
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Note: Models are estimated using 3-year averages on a sample 1995 - 2014. BCFE = Bootstrap-corrected fixed effects; FE = Fixed effects. CCE: clustering over control of corruption index. RLE: clustering over the rule of law. WGI: clustering over the first principal component of the World Governance Indicators data. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. The fixed effects results are provided in Table A4.3 in Appendix. Other growth determinants include investment, government consumption, human capital, population growth, openness, terms of trade and volatility of the real exchange rate.

7.4 Results with five-year averages

Next, we turn our attention to the aggregation of data. Since our dataset has a relatively limited length of 20 years, we used three-year averages as a compromise between the need to smooth out the effects of short-term fluctuations and to have a sufficient number of time observations. Nevertheless, even the initial estimates of the effects of undervaluation on growth (Table 3.2) revealed some differences in the size and significance of the coefficients between the three- and five-year averages, namely with the bootstrap-corrected fixed effects estimator. Therefore, we re-estimated our baseline specifications with five-year averages, and the results are presented in Table 7.4.

Table 7.4: Undervaluation and growth, 5-year averages

VARIABLES	(1) BC-FE CCE	(2) BC-FE CCE	(3) BC-FE RLE	(4) BC-FE RLE	(5) BC-FE WGI	(6) BC-FE WGI
Growth(-1)	0.0865	0.0034	0.0544	-0.0212	0.0996	0.0142
	(0.0956)	(0.0746)	(0.0928)	(0.0891)	(0.0968)	(0.0834)
ln($GDPPC_{ij}$(-1))	-0.0934***	-0.1009***	-0.0977***	-0.1035***	-0.0929***	-0.0969***
	(0.0116)	(0.0132)	(0.0116)	(0.0140)	(0.0121)	(0.0140)
Cl1_ lnUNDERVAL	-0.0248	-0.0548	-0.0175	-0.0501	-0.0243	-0.0577
	(0.0332)	(0.0530)	(0.0351)	(0.0525)	(0.0358)	(0.0642)
Cl2_ lnUNDERVAL	-0.0331	-0.0335	0.0024	-0.0002	-0.0264	-0.0348
	(0.0217)	(0.0240)	(0.0187)	(0.0261)	(0.0232)	(0.0238)
Cl3_ lnUNDERVAL	0.0282**	0.0111	-0.0091	-0.0315	0.0425*	0.0112
	(0.0142)	(0.0287)	(0.0419)	(0.0478)	(0.0237)	(0.0422)
Cl4_ lnUNDERVAL	0.0124	0.0403	-0.0004	0.0144	0.0105	0.0215
	(0.0205)	(0.0267)	(0.0159)	(0.0219)	(0.0140)	(0.0214)
Cl5_ lnUNDERVAL	0.1219*	0.1390*	0.0989*	0.1173**	0.1156*	0.1427**
	(0.0646)	(0.0728)	(0.0511)	(0.0584)	(0.0599)	(0.0663)
Investment		0.0175**		0.0155*		0.0190**
		(0.0082)		(0.0083)		(0.0077)
Government cons.		0.0044		0.0008		0.0044
		(0.0117)		(0.0118)		(0.0117)
Human capital		0.0057		-0.0065		0.0020
		(0.0626)		(0.0593)		(0.0586)
Population growth		-0.2867		-0.2769		-0.3013
		(0.3905)		(0.4469)		(0.3915)
Openness		-0.0071		-0.0062		-0.0052
		(0.0151)		(0.0157)		(0.0150)
Terms of trade		-0.0483		-0.0563		-0.0660
		(0.0493)		(0.0462)		(0.0476)
RER volatility		0.0026		0.0019		0.0026
		(0.0031)		(0.0028)		(0.0031)
Observations	501	429	501	429	501	429
R-squared						
Year FE	YES	YES	YES	YES	YES	YES
F test	0.0366	0.0593	0.359	0.250	0.0206	0.0186

Note: Models are estimated using 5-year averages on a sample 1980 - 2014. BC-FE = Bootstrap-corrected fixed effects. Columns (1) and (4): clustering over control of corruption index. Columns (2) and (5): clustering over rule of law. Columns (3) and (6): clustering over the first principal component of the World Governance Indicators data. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. F-test reports the p-value of the test the restriction that all coefficients at the interaction terms are the same (p-value). With the fixed effect estimator, the positive effect of undervaluation on growth was positive and significant for cluster 2 and cluster 3 (see Appendix, Table A4.4).

However, the results are consistent with our benchmark results. The most significant positive effects of undervaluation on growth appear in cluster 5, and in smaller models (columns 1-3), cluster 3 has significant positive coefficients as well. The differences between the coefficients at the interaction terms are statistically significant as well.

7.5 Extending the dataset: 1980-2014 sample

In previous sections, the estimations were conducted on a sample starting in 1996, due to the data availability on the institutional quality. Therefore, we implicitly focused on the recent few decades that differ from the previous periods in various aspects. For example, the 1980s were considered as a lost decade in many countries, but in the 1990s, economic growth accelerated thanks to globalisation and the boom in the IT sector, which created numerous new opportunities. Also, the consensus about the most appropriate economic policy gradually evolved, and many international organisations increased their effort to decrease poverty around the World. Therefore, the importance of undervaluations for the economic growth of developing countries could have changed as well.

To address potential sensitivity of the results on the sample, we re-estimated our benchmark specification (equation 6) on a dataset starting in 1980 and with five-year averages. As a byproduct of the more extended sample is that our sample became more comparable to other empirical studies focused on the link between undervaluation and growth. On the other hand, the separation of countries into clusters is based on a shorter subsample, as the institutional data used for clustering are not available for the years before 1995.

The results are presented in Table 7.5. The cluster 5 does not stand out as a cluster with the highest coefficient at the interaction term between cluster dummies and undervaluation. In particular, the significant positive effects of undervaluation appear in clusters 2 and 3, and the point estimate of the coefficients are often highest in the first cluster, although accompanied by comparatively large standard error as well. Also, the null hypothesis of equality of coefficients at the interaction terms of clustering dummies and undervaluation is often accepted, suggesting rather narrower differences across clusters.

Still, the results reported in Table 7.5 are more in line with the results presented by D. Rodrik (2008) than our benchmark estimates reported in Table 6.1. Thus, this experiment confirmed our suspicion that the changes in the global economy could have affected the relationship between undervaluation and growth.

Table 7.5: 1980 - 2014 sample

VARIABLES	(1) FE CCE	(2) BC-FE CCE	(3) FE RLE	(4) BC-FE RLE	(5) FE WGI	(6) BC-FE WGI
Growth(-1)		0.2260**		0.2182**		0.2076**
		(0.0981)		(0.0947)		(0.0941)
$\ln(GDPPC_{ij}(-1))$	-0.0944***	-0.0939***	-0.0954***	-0.0960***	-0.0955***	-0.0966***
	(0.0058)	(0.0152)	(0.0058)	(0.0148)	(0.0057)	(0.0154)
Cl1_ lnUNDERVAL	0.0634***	0.0742	0.0723***	0.0869	0.0865***	0.1016*
	(0.0136)	(0.0544)	(0.0137)	(0.0538)	(0.0149)	(0.0604)
Cl2_ lnUNDERVAL	0.0655***	0.0491*	0.0573***	0.0508**	0.0577***	0.0473*
	(0.0133)	(0.0251)	(0.0132)	(0.0232)	(0.0123)	(0.0243)
Cl3_ lnUNDERVAL	0.0465***	0.0502**	0.0496***	0.0438**	0.0227	0.0272
	(0.0149)	(0.0201)	(0.0148)	(0.0205)	(0.0179)	(0.0230)
Cl4_ lnUNDERVAL	0.0180	0.0062	0.0249	0.0156	0.0328**	0.0274
	(0.0165)	(0.0222)	(0.0186)	(0.0146)	(0.0135)	(0.0182)
Cl5_ lnUNDERVAL	0.0681***	0.0693**	0.0452**	0.0401	0.0690***	0.0746*
	(0.0205)	(0.0346)	(0.0181)	(0.0367)	(0.0221)	(0.0381)
Constant	0.7123***		0.6538***		0.7895***	
	(0.0443)		(0.0428)		(0.0483)	
Observations	864	720	864	720	864	720
R-squared	0.4500		0.4484		0.4533	
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
F test	0.151	0.306	0.334	0.354	0.0271	0.508

Note: Models are estimated using 5-year averages on a sample 1980 - 2014. FE = Fixed effects, BC-FE = Bootstrap-corrected fixed effects. Columns (1) and (2): clustering over control of corruption index. Columns (3) and (4): clustering over the rule of law. Columns (5) and (6): clustering over the first principal component of the World Governance Indicators data. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. F-test reports the p-value of the test the restriction that all coefficients at the interaction terms are the same (p-value).

8. Concluding remarks

In this paper, we have revisited the impact of undervaluation and exchange rate misalignments in general on economic growth. We have employed the index of undervaluation based on the real exchange rate adjusted for the Balassa-Samuelson effect. Then, we have incorporated this undervaluation index within cross-country growth regressions, while allowing for different effects of undervaluation on growth across clusters of countries differing by their institutional quality. To assure that our classification of countries is exogenous to economic development, we clustered over institutional quality adjusted for the level of the real GDP per capita. Our growth regressions were estimated on relatively recent data starting in 1996 due to the availability of the data on institutional quality. Therefore, we focused on the period characterised by globalisation, relatively robust economic growth, especially in developing countries and a sharp decrease in poverty around the world. In terms of estimation method, we relied on both fixed effects and bootstrap-corrected fixed effects accounting for potential biases in dynamic panels.

First, we have confirmed the positive effects of undervaluation on economic growth, thus supporting the hypothesis that not all exchange rate misalignments are wrong. Then, we focused on the transmission mechanisms that cause those positive effects stemming beyond the short horizons. In particular, we tested whether the undervalued exchange rate serves primarily as a compensatory mechanism for the low-quality

institutional environment, as suggested by Dany Rodrik (2008). Although his hypothesis sounds compelling, we have not found robust support for its theoretical predictions that undervaluations shall help in countries with lower quality of institutional framework more than in countries with a better institutional framework. Actually, our results support the opposite: The most robust support for positive effects of undervaluation on growth appeared among the countries with the highest institutional quality relative to their level of economic development.

Further, we have shown that the positive effect of undervaluation on growth among countries with relatively good institutional quality is confirmed after controlling for the usual set of determinants of economic growth, such as the saving rate, human capital, institutional quality and others. Also, the results were robust after controlling for a degree of export sophistication and export diversity, measured by the index of economic complexity, and to a change of aggregation of the data from three-year to five-year averages.

Interestingly, quantitatively higher and more significant positive effects of undervaluation on growth in countries with low institutional quality reappear if we extend our sample to a starting year in 1980. Thus, the results in the previous literature that supported the hypothesis that undervaluation can boost growth, especially in countries with relatively lower institutional quality, were conditional on the data used for those estimations.

Our results have several policy implications. First, an institutional quality matters for the transmission mechanism of exchange rate misalignments on growth. However, at least some degree of institutional quality is apparently needed to allow countries to benefit from undervaluations. There might be several reasons why good institutions might help. In particular, good institutions are known to improve the efficiency of allocation of resources within economies; thus, they enable the flow of capital and labour into sectors of tradables that are supported by the undervalued exchange rate. Also, setting and sustaining an undervalued real exchange rate is requires some degree of policy coordination that might be hard to achieve in countries with lower quality of institutions and when the positive effects of undervaluation on growth do not materialize in rising incomes, which in turn, cannot appear if the allocation of resources remains inefficient. Thus, countries shall focus on improving the quality of their institutions rather than hope that they can compensate for their deficiencies via sustained undervaluation of their exchange rate.

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Appendix

Appendix 1: Clusters

Cluster 1			Cluster 2			Cluster 3		
Control of Corruption	Rule of Law	Governance Indicators	Control of Corruption	Rule of Law	Governance Indicators	Control of Corruption	Rule of Law	Governance Indicators
Angola	Angola	Angola	Armenia	Albania	Albania	Bangladesh	Armenia	Armenia
Albania	U. Arab Emirates	U. Arab Emirates	Bulgaria	Bulgaria	Argentina	Bosnia/Herzegovina	Bangladesh	Bangladesh
U. Arab Emirates	Argentina	Azerbaijan	Bahrain	Bahrain	Bahrain	Belize	Belize	Bulgaria
Argentina	Azerbaijan	Belarus	China	Bosnia/Herzegovina	Bosnia/Herzegovina	Bolivia	Central African Rep.	Belize
Azerbaijan	Belarus	Algeria	Cameroon	Bolivia	Bolivia	Brazil	Comoros	Brazil
Belarus	Brunei	Gabon	Congo	Brazil	Brunei	Côte d'Ivoire	Cayman Islands	Central African Rep.
Brunei	Congo	Eq. Guinea	Colombia	China	China	Comoros	Djibouti	Comoros
Dominican Rep.	Dominican Rep.	Iran	Egypt	Côte d'Ivoire	Côte d'Ivoire	Cayman Islands	Egypt	Cayman Islands
Algeria	Algeria	Iraq	Greece	Cameroon	Cameroon	Czech Rep.	Guinea	Djibouti
Ecuador	Ecuador	Kazakhstan	Guatemala	Colombia	Congo	Djibouti	Guinea-Bissau	Georgia
Gabon	Gabon	Kuwait	Honduras	Fiji	Colombia	Georgia	Greece	Guinea
Eq. Guinea	Eq. Guinea	Lebanon	Croatia	Georgia	Dominican Rep.	Guinea	Kenya	Guinea-Bissau
Indonesia	Guatemala	Myanmar	Haiti	Honduras	Ecuador	Guinea-Bissau	Mongolia	Greece
Iran	Iran	Qatar	Italy	Croatia	Egypt	Hungary	Mauritania	Honduras
Iraq	Iraq	Russia	Kyrgyzstan	Haiti	Fiji	Jamaica	Malaysia	Croatia
Kazakhstan	Kazakhstan	Saudi Arabia	Laos	Indonesia	Guatemala	Kenya	Philippines	Israel
Kuwait	Kuwait	Sudan	China, Macao	Italy	Haiti	Cambodia	Sierra Leone	Italy
Lebanon	Lebanon	Serbia	Maldives	Jamaica	Indonesia	Rep. of Korea	Slovakia	Kenya
Mexico	Mexico	Turkmenistan	Macedonia	Kyrgyzstan	Laos	Sri Lanka	Syria	Kyrgyzstan
Paraguay	Myanmar	Uzbekistan	Myanmar	Cambodia	China, Macao	Lithuania	Thailand	Cambodia
Qatar	Paraguay	Venezuela	Mongolia	Laos	Maldives	Latvia	Tunisia	Rep. of Korea
Russia	Qatar		Nigeria	China, Macao	Mexico	Morocco	Turkey	Sri Lanka
Saudi Arabia	Russia		Oman	Maldives	Macedonia	Moldova	Taiwan	Morocco
Serbia	Saudi Arabia		Pakistan	Macedonia	Nigeria	Malta	Viet Nam	Malaysia
Turkmenistan	Sudan		Panama	Nigeria	Oman	Mauritius	South Africa	Nicaragua
Ukraine	Serbia		Sudan	Nicaragua	Pakistan	Malaysia		Panama
Uzbekistan	Turkmenistan		Suriname	Oman	Paraguay	Nicaragua		Peru
Venezuela	Ukraine		Slovakia	Pakistan	Swaziland	Peru		Philippines
	Uzbekistan		Syria	Panama	Seychelles	Philippines		Suriname
	Venezuela		Thailand	Peru	Syria	Poland		Tunisia
			Tajikistan	El Salvador	Chad	El Salvador		Taiwan
			Trinidad a. Tobago	Suriname	Thailand	Swaziland		Viet Nam
			Turkey	Swaziland	Tajikistan	Seychelles		
				Seychelles	Trinidad a. Tobago	Chad		
				Chad	Turkey	Tunisia		
				Tajikistan	Ukraine	Taiwan		
				Trinidad a. Tobago	Yemen	Viet Nam		
				Yemen	Zimbabwe	Zimbabwe		
				Zimbabwe				

Appendix 1: Clusters (Cont.)

Cluster 4			Cluster 5		
Control of Corruption	Rule of Law	Governance Indicators	Control of Corruption	Rule of Law	Governance Indicators
Antigua and Barbuda	Antigua and Barbuda	Antigua and Barbuda	Australia	Australia	Australia
Burundi	Burundi	Burundi	Austria	Austria	Austria
Belgium	Belgium	Belgium	Burkina Faso	Burkina Faso	Benin
Benin	Benin	Bahamas	Barbados	Barbados	Burkina Faso
Bahamas	Bahamas	Bhutan	Bhutan	Canada	Barbados
Botswana	Bhutan	Botswana	Canada	Switzerland	Canada
Central African Rep.	Botswana	Costa Rica	Switzerland	Chile	Switzerland
Costa Rica	Costa Rica	Cyprus	Chile	Germany	Chile
Cyprus	Cyprus	Czech Rep.	Germany	Dominica	Germany
Dominica	Czech Rep.	Spain	Denmark	Denmark	Dominica
Spain	Spain	Estonia	Ethiopia	Ethiopia	Denmark
Estonia	Estonia	Ethiopia	Finland	Finland	Finland
Fiji	Grenada	France	United Kingdom	France	United Kingdom
France	China, Hong Kong	Gambia	Iceland	United Kingdom	Ghana
Ghana	Hungary	Grenada	Lesotho	Ghana	Ireland
Gambia	Israel	China, Hong Kong	Madagascar	Gambia	Iceland
Grenada	Jordan	Hungary	Mozambique	India	Lesotho
China, Hong Kong	Japan	India	Malawi	Ireland	Madagascar
India	Rep. of Korea	Jamaica	Netherlands	Iceland	Mali
Ireland	Liberia	Jordan	Norway	Lesotho	Mozambique
Israel	Sri Lanka	Japan	New Zealand	Madagascar	Malawi
Jordan	Lithuania	Liberia	Rwanda	Mali	Niger
Japan	Luxembourg	Lithuania	Senegal	Malta	Netherlands
Liberia	Latvia	Luxembourg	Singapore	Mozambique	Norway
Luxembourg	Morocco	Latvia	Sao Tome a.Principe	Mauritius	New Zealand
Mali	Moldova	Moldova	Sweden	Malawi	Senegal
Mauritania	Namibia	Malta	Uruguay	Niger	Sweden
Namibia	Nepal	Mongolia		Netherlands	
Niger	Poland	Mauritania		Norway	
Nepal	Portugal	Mauritius		New Zealand	
Portugal	Rwanda	Namibia		Senegal	
Sierra Leone	Singapore	Nepal		Sweden	
Slovenia	Sao Tome a.Principe	Poland		Tanzania	
Togo	Slovenia	Portugal		Uganda	
Tanzania	Togo	Rwanda			
Uganda	Uruguay	Singapore			
United States	United States	Sierra Leone			
South Africa	Zambia	El Salvador			
Zambia		Sao Tome a.Principe			
		Slovakia			
		Slovenia			
		Togo			
		Tanzania			
		Uganda			
		Uruguay			
		United States			
		South Africa			
		Zambia			

Appendix 2: Variables and sources

Variable	**Description**	**Sources and Notes**
$GDPPC_{it}$	real GDP per capita ($RGDPE_{it}/POP_{it}$)	Penn World Tables 9.0
RER_{it}	real exchange rate ($1/PL\_GDPO_{it}$)	Penn World Tables 9.0
Control of Corruption (CCE)	Original scale (-2.5; 2.5), rescaled to (0; 5)	World Governance Indicators, World bank
Rule of Law (RLE)	Original scale (-2.5; 2.5), rescaled to (0; 5)	World Governance Indicators, World bank
Governance indicators (WGI)	Principal component of variables in WGI (Voice and Accountability, Political Stability and Absence of Violence, Government Effectiveness, Regulatory Quality, Rule of Law, Control of Corruption); Original scale (-5; 5), rescaled to (0; 10)	World Governance Indicators, World bank
Investment	Share of gross capital formation at current PPPs; $\ln(CSH\_I_{ij})$	Penn World Tables 9.0
Government cons.	Share of government consumption at current PPPs; $\ln(CSH\_G_{ij})$	Penn World Tables 9.0
Human capital	Human capital index, $\ln(HC_{ij})$	Penn World Tables 9.0
Population growth	$\ln(POP_{it}) - \ln(POP_{it-1})$	Penn World Tables 9.0
Openness	$\ln(CSH\_X_{it} - CSH\_M_{it})$	Penn World Tables 9.0; note that the share of import, CSH_M has negative sign in PWT
Terms of trade	$\ln(PL\_X/PL\_M)$	Penn World Tables 9.0
RER Volatility	$\ln(\sqrt{((\ln(XR_{it}) - \ln(XR_{it-1}))^2})$	Penn World Tables 9.0
ECI	Economic complexity index	https://atlas.cid.harvard.edu/rankings

Appendix 3: Dendrograms over the alternative indicators of institutional quality

Figure A3.1: Dendrogram of clustering over the Rule of Law

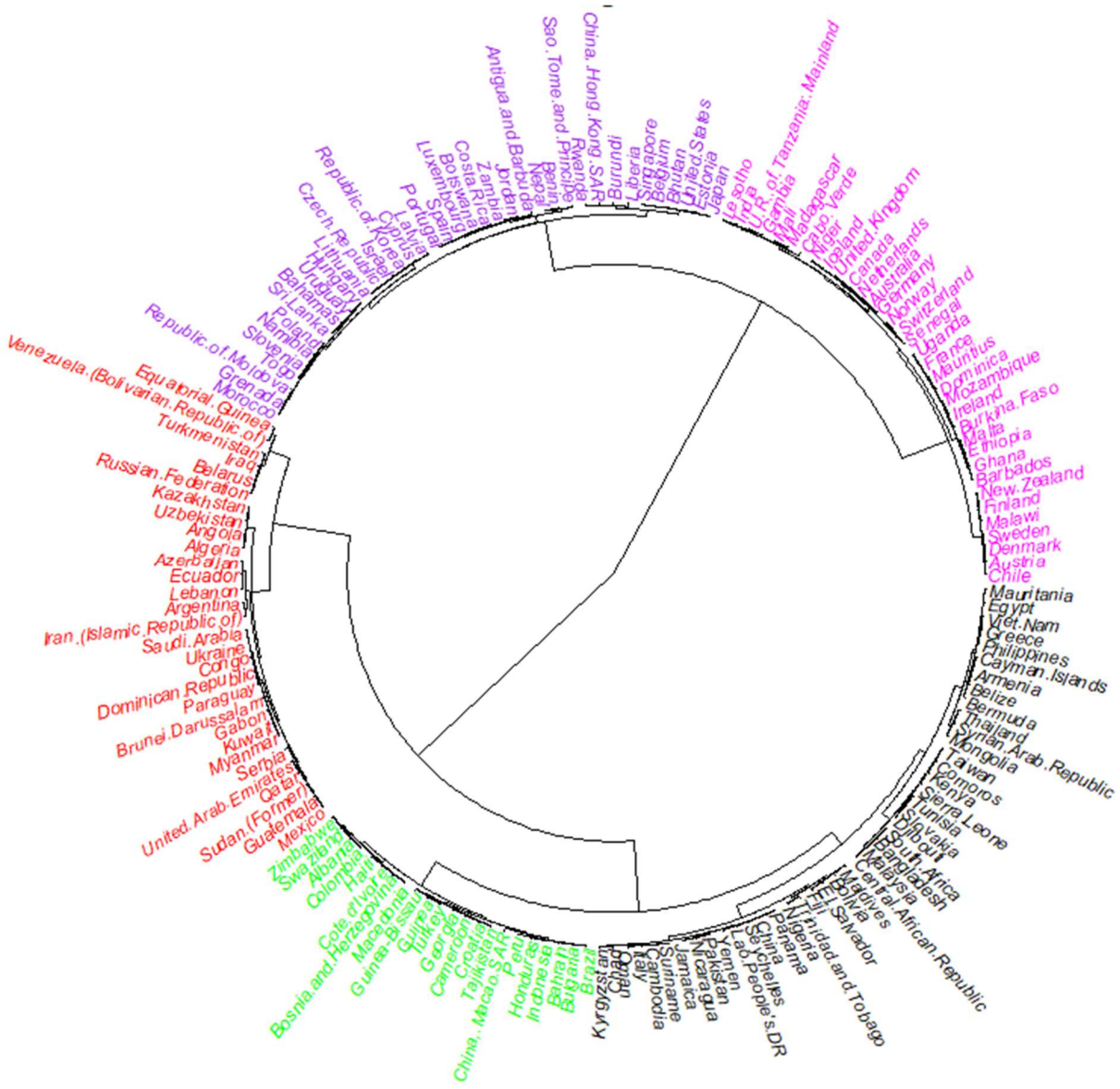
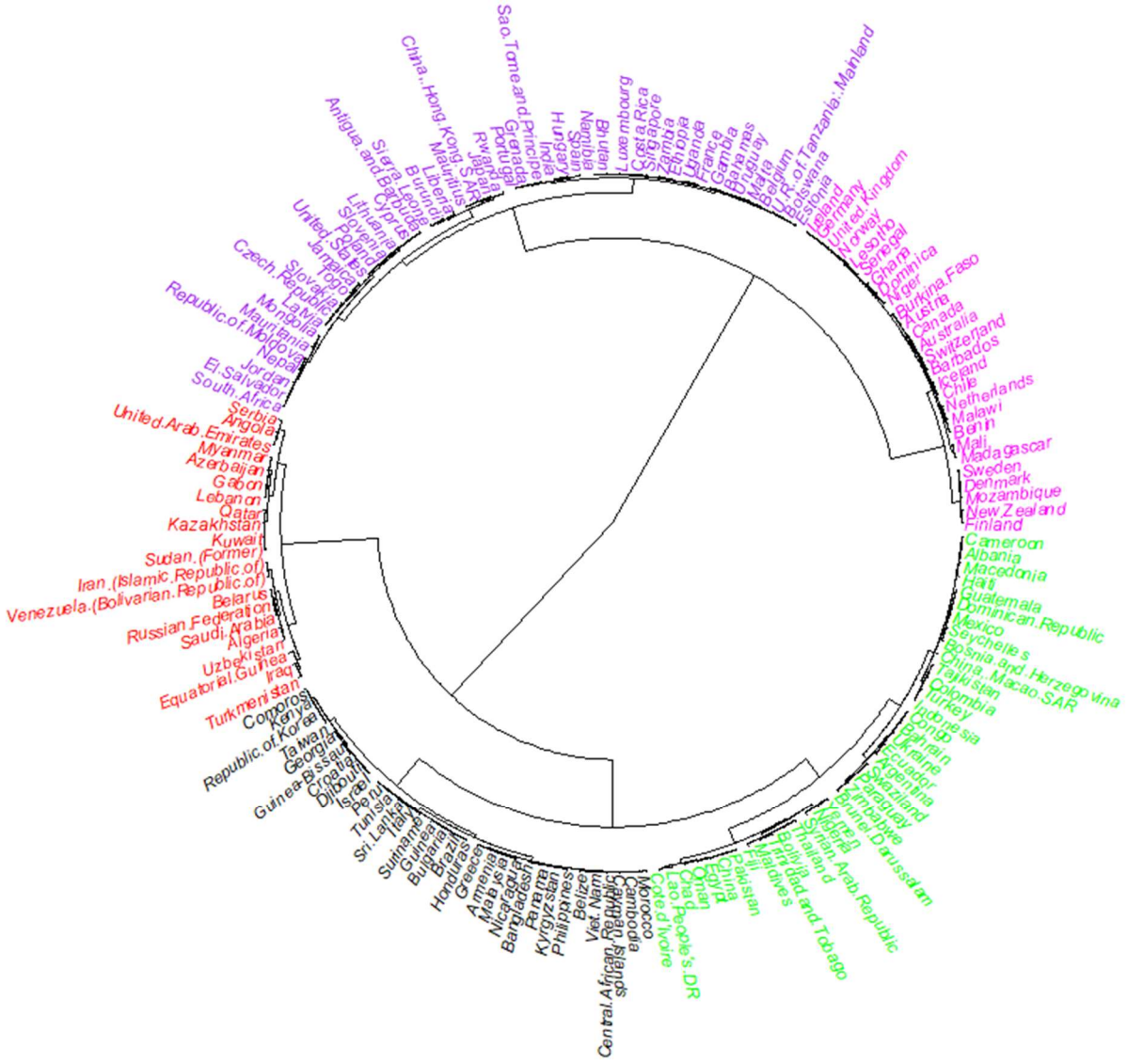


Figure A3.2: Dendrogram of clustering over the World Governance Indicators
(First principal component)



Appendix 4: Additional Tables

Table A4.1: Undervaluation and growth, controlling for institutional quality, Fixed effects

VARIABLES	(1) FE CCE	(2) FE CCE	(3) FE rle	(4) FE RLE	(5) FE WGI	(6) FE WGI
$\ln(GDPPC_{ij}(-1))$	-0.1109***	-0.1204***	-0.1174***	-0.1257***	-0.1185***	-0.1296***
	(0.0063)	(0.0078)	(0.0064)	(0.0080)	(0.0063)	(0.0079)
Cl1_ lnUNDERVAL	-0.0135	-0.0088	0.0018	0.0082	0.0013	0.0035
	(0.0146)	(0.0199)	(0.0146)	(0.0201)	(0.0153)	(0.0220)
Cl2_ lnUNDERVAL	0.0486***	0.0697***	0.0536***	0.0728***	0.0637***	0.0830***
	(0.0129)	(0.0146)	(0.0123)	(0.0143)	(0.0121)	(0.0142)
Cl3_ lnUNDERVAL	0.0462***	0.0513***	0.0589***	0.0673***	0.0461**	0.0259
	(0.0149)	(0.0181)	(0.0168)	(0.0199)	(0.0220)	(0.0282)
Cl4_ lnUNDERVAL	0.0000	0.0290	-0.0144	0.0030	0.0033	0.0189
	(0.0172)	(0.0183)	(0.0165)	(0.0182)	(0.0126)	(0.0138)
Cl5_ lnUNDERVAL	0.0737***	0.0825***	0.0675***	0.0699***	0.0904***	0.0968***
	(0.0201)	(0.0208)	(0.0189)	(0.0189)	(0.0219)	(0.0222)
Control of Corruption	0.0131*	0.0057				
	(0.0073)	(0.0078)				
Rule of Law			0.0285***	0.0192**		
			(0.0074)	(0.0079)		
Governance Indicators					0.0189***	0.0167***
					(0.0035)	(0.0037)
Investment		0.0188***		0.0170***		0.0174***
		(0.0060)		(0.0059)		(0.0059)
Government cons.		-0.0192***		-0.0196***		-0.0189***
		(0.0061)		(0.0061)		(0.0061)
Human capital		0.0916**		0.1066**		0.1063**
		(0.0461)		(0.0457)		(0.0454)
Population growth		0.1868		0.1362		0.1117
		(0.1818)		(0.1820)		(0.1800)
Openness		0.0163**		0.0139*		0.0103
		(0.0072)		(0.0072)		(0.0072)
Terms of trade		-0.0460		-0.0507		-0.0510
		(0.0336)		(0.0335)		(0.0331)
RER volatility		-0.0052**		-0.0054***		-0.0046**
		(0.0020)		(0.0020)		(0.0020)
Constant	0.7553***	1.1853***	0.7768***	1.1445***	0.7902***	1.1458***
	(0.0449)	(0.1043)	(0.0440)	(0.1046)	(0.0436)	(0.1027)
Observations	1,162	994	1,162	994	1,162	994
R-squared	0.5031	0.4748	0.5091	0.4778	0.5164	0.4889
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
F test	0.000343	0.00247	0.000189	0.00148	5.84e-05	7.36e-05

Note: Models are estimated using 3-year averages on a sample 1995 - 2014. FE = Fixed effects. Columns (1) and (2): clustering over control of corruption index. Columns (3) and (4): clustering over rule of law. Columns (5) and (6): clustering over the first principal component of the World Governance Indicators data. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. F-test reports the p-value of the test the restriction that all coefficients at the interaction terms are the same (p-value).

Table A4.2: Undervaluation and growth, controlling for economic complexity, Fixed effects

VARIABLES	(1) FE CCE	(2) FE CCE	(3) FE RLE	(4) FE RLE	(5) FE WGI	(6) FE WGI
ln(GDPPC$_{ij}$(-1))	-0.1308***	-0.1382***	-0.1412***	-0.1408***	-0.1423***	-0.1381***
	(0.0098)	(0.0107)	(0.0101)	(0.0110)	(0.0101)	(0.0110)
Cl1_ lnUNDERVAL	0.0142	0.0348	0.0413**	0.0615**	0.0417**	0.0741**
	(0.0173)	(0.0247)	(0.0176)	(0.0255)	(0.0186)	(0.0297)
Cl2_ lnUNDERVAL	0.0808***	0.0957***	0.0855***	0.1013***	0.0955***	0.0980***
	(0.0157)	(0.0174)	(0.0156)	(0.0179)	(0.0152)	(0.0175)
Cl3_ lnUNDERVAL	0.0644***	0.0958***	0.0853***	0.0869***	0.0490	0.0542
	(0.0205)	(0.0225)	(0.0229)	(0.0233)	(0.0372)	(0.0368)
Cl4_ lnUNDERVAL	0.0398	0.0692**	0.0181	0.0512**	0.0366**	0.0678***
	(0.0316)	(0.0295)	(0.0230)	(0.0237)	(0.0174)	(0.0189)
Cl5_ lnUNDERVAL	0.0769***	0.1049***	0.0869***	0.1047***	0.0914***	0.1167***
	(0.0281)	(0.0280)	(0.0306)	(0.0299)	(0.0331)	(0.0330)
Investment		0.0360***		0.0354***		0.0354***
		(0.0083)		(0.0083)		(0.0084)
Government cons.		-0.0294***		-0.0273***		-0.0272***
		(0.0079)		(0.0080)		(0.0080)
Human capital		0.1611**		0.1621**		0.1418**
		(0.0702)		(0.0697)		(0.0699)
Population growth		-0.2282		-0.2589		-0.2875
		(0.2284)		(0.2284)		(0.2298)
Openness		0.0280**		0.0246**		0.0270**
		(0.0121)		(0.0121)		(0.0122)
Terms of trade		-0.0451		-0.0519		-0.0532
		(0.0509)		(0.0516)		(0.0515)
RER volatility		-0.0062**		-0.0070**		-0.0063**
		(0.0027)		(0.0027)		(0.0027)
Control of Corruption	0.0227**					
	(0.0101)					
Rule of Law			0.0424***			
			(0.0114)			
Governance Indicators					0.0250***	
					(0.0053)	
ECI	-0.0191**	0.0034	-0.0178*	0.0046	-0.0182*	0.0048
	(0.0097)	(0.0102)	(0.0097)	(0.0103)	(0.0096)	(0.0103)
Constant	1.2712***	1.2712***	1.5343***	1.2796***	1.5045***	1.2878***
	(0.1474)	(0.1474)	(0.1231)	(0.1476)	(0.1223)	(0.1490)
Observations	696	636	696	636	696	636
R-squared	0.4967	0.5339	0.5033	0.5325	0.5088	0.5315
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
F test	0.0399	0.156	0.0560	0.285	0.0409	0.408

Note: Models are estimated using 5-year averages on a sample 1980 - 2014. FE = Fixed effects. ECI: Economic complexity index. Columns (1) and (4): clustering over control of corruption index. Columns (2) and (5): clustering over rule of law. Columns (3) and (6): clustering over the first principal component of the World Governance Indicators data. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. F-test reports the p-value of the test the restriction that all coefficients at the interaction terms are the same (p-value).

Table A4.3: World-bank classification of countries, Fixed effects

VARIABLES	(1) FE CCE	(2) FE CCE	(3) FE rle	(4) FE rle	(5) FE WGI	(6) FE WGI
ln(GDPPC$_{ij}$(-1))	-0.1116***	-0.1347***	-0.1137***	-0.1387***	-0.1150***	-0.1398***
	(0.0074)	(0.0091)	(0.0075)	(0.0095)	(0.0075)	(0.0093)
o.Cl1_lnUNDERVAL_LIC	-0.0225	-	-0.0145	0.0374	-0.0149	0.0433
	(0.0832)		(0.0572)	(0.0783)	(0.0572)	(0.0781)
Cl2_lnUNDERVAL_LIC	0.0250	0.0581**	0.0268	0.0676***	0.0296	0.0716***
	(0.0229)	(0.0243)	(0.0220)	(0.0247)	(0.0221)	(0.0246)
Cl3_lnUNDERVAL_LIC	0.0488	0.0897	0.1743***	0.2968***	0.1596***	0.2588***
	(0.0363)	(0.0550)	(0.0436)	(0.0610)	(0.0469)	(0.0709)
Cl4_lnUNDERVAL_LIC	0.0236	0.0538*	-0.0120	0.0145	-0.0091	0.0141
	(0.0302)	(0.0296)	(0.0457)	(0.0468)	(0.0315)	(0.0312)
Cl5_lnUNDERVAL_LIC	0.0806**	0.1073***	0.0346	0.0560**	0.0743**	0.1120***
	(0.0337)	(0.0340)	(0.0271)	(0.0266)	(0.0328)	(0.0325)
Cl1_lnUNDERVAL_LMIC	-0.0408	-0.1090***	-0.0255	-0.1173***	-0.0380	-0.1862***
	(0.0309)	(0.0366)	(0.0322)	(0.0394)	(0.0363)	(0.0477)
Cl2_lnUNDERVAL_LMIC	0.0019	0.0349	0.0130	0.0482**	0.0004	0.0382*
	(0.0246)	(0.0256)	(0.0214)	(0.0223)	(0.0217)	(0.0227)
Cl3_lnUNDERVAL_LMIC	0.0135	0.0502**	-0.0006	0.0379	-0.0106	0.0124
	(0.0241)	(0.0251)	(0.0281)	(0.0291)	(0.0522)	(0.0545)
Cl4_lnUNDERVAL_LMIC	0.0670	0.1005**	0.0255	0.0535	0.0300	0.0662***
	(0.0481)	(0.0472)	(0.0446)	(0.0437)	(0.0248)	(0.0252)
Cl5_lnUNDERVAL_LMIC	0.0452	0.0020	0.0481	-0.0010	0.0481	0.0016
	(0.0778)	(0.0768)	(0.0774)	(0.0763)	(0.0774)	(0.0760)
Cl1_lnUNDERVAL_UMIC	0.0568**	0.0883*	0.0566**	0.0848*	0.0632**	0.1164*
	(0.0267)	(0.0469)	(0.0266)	(0.0465)	(0.0284)	(0.0598)
Cl2_lnUNDERVAL_UMIC	-0.0158	-0.0128	-0.0015	0.0380	-0.0058	0.0190
	(0.0406)	(0.0516)	(0.0417)	(0.0788)	(0.0376)	(0.0567)
Cl3_lnUNDERVAL_UMIC	0.0085	0.0131	-0.0594	-0.0397	-0.0597	-0.0138
	(0.0389)	(0.0446)	(0.0580)	(0.0564)	(0.0884)	(0.0851)
Cl4_lnUNDERVAL_UMIC	-0.0228	0.0014	0.0033	0.0169	0.0031	0.0146
	(0.0555)	(0.0833)	(0.0381)	(0.0424)	(0.0328)	(0.0351)
Cl5_lnUNDERVAL_UMIC	0.1386**	0.1818***	0.1410***	0.1879***	0.1504***	0.2167***
	(0.0558)	(0.0544)	(0.0524)	(0.0547)	(0.0564)	(0.0594)
Cl1_lnUNDERVAL_HIC	0.0934*	0.1318**	0.0946*	0.1350**	0.0887	0.1297**
	(0.0543)	(0.0567)	(0.0540)	(0.0563)	(0.0559)	(0.0585)
Cl2_lnUNDERVAL_HIC	0.1246**	0.1784***	0.1130**	0.1704***	0.1166**	0.1848***
	(0.0539)	(0.0548)	(0.0563)	(0.0574)	(0.0562)	(0.0573)
Cl3_lnUNDERVAL_HIC	0.1352**	0.0135	0.1469**	0.0101	0.1386***	0.0595
	(0.0576)	(0.1101)	(0.0583)	(0.1183)	(0.0536)	(0.0859)
Cl4_lnUNDERVAL_HIC	-0.0146	0.0376	-0.0133	0.0396	-0.0057	0.0508
	(0.0363)	(0.0468)	(0.0347)	(0.0433)	(0.0345)	(0.0427)
Cl5_lnUNDERVAL_HIC	0.0840*	0.0874*	0.1040**	0.1014**	0.0977*	0.0972**
	(0.0464)	(0.0451)	(0.0477)	(0.0464)	(0.0504)	(0.0489)
Constant	0.9304***	1.1312***	1.4563***	1.4546***	1.0544***	1.5578***
	(0.0571)	(0.0812)	(0.1179)	(0.1234)	(0.0879)	(0.1213)
Other growth determinants	NO	YES	NO	YES	NO	YES
Observations	1002	858	1002	858	1002	858
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

Note: Models are estimated using 3-year averages on a sample 1995 - 2014. BCFE = Bootstrap-corrected fixed effects. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Other growth determinants include investment, government consumption, human capital, population growth, openness, terms of trade and volatility of the real exchange rate.

Table A4.4: 5-year averages, Fixed effects

VARIABLES	(1) FE CCE	(2) FE CCE	(3) FE rle	(4) FE RLE	(5) FE WGI	(6) FE WGI
$ln(GDPPC_{ij}(-1))$	-0.1088***	-0.1117***	-0.1103***	-0.1132***	-0.1103***	-0.1124***
	(0.0064)	(0.0079)	(0.0065)	(0.0081)	(0.0064)	(0.0080)
Cl1_ lnUNDERVAL	-0.0020	-0.0086	0.0067	0.0009	0.0028	-0.0101
	(0.0153)	(0.0211)	(0.0155)	(0.0217)	(0.0160)	(0.0235)
Cl2_ lnUNDERVAL	0.0363***	0.0450***	0.0510***	0.0535***	0.0459***	0.0461***
	(0.0131)	(0.0150)	(0.0126)	(0.0147)	(0.0123)	(0.0145)
Cl3_ lnUNDERVAL	0.0595***	0.0450**	0.0365**	0.0199	0.0630***	0.0334
	(0.0155)	(0.0188)	(0.0178)	(0.0210)	(0.0241)	(0.0314)
Cl4_ lnUNDERVAL	-0.0176	-0.0092	-0.0158	-0.0104	-0.0039	0.0034
	(0.0183)	(0.0198)	(0.0177)	(0.0194)	(0.0136)	(0.0150)
Cl5_ lnUNDERVAL	0.0910***	0.0867***	0.0736***	0.0657***	0.1116***	0.1075***
	(0.0231)	(0.0237)	(0.0213)	(0.0213)	(0.0250)	(0.0254)
Openness		0.0133**		0.0131**		0.0161**
		(0.0064)		(0.0064)		(0.0064)
Terms of trade		-0.0183***		-0.0177***		-0.0181***
		(0.0064)		(0.0065)		(0.0064)
RER volatility		0.0852*		0.0937*		0.0775
		(0.0498)		(0.0494)		(0.0492)
Openness		0.0940		0.0376		0.0856
		(0.1920)		(0.1933)		(0.1917)
Terms of trade		0.0103		0.0067		0.0060
		(0.0081)		(0.0082)		(0.0081)
RER volatility		-0.0019		-0.0030		-0.0003
		(0.0364)		(0.0365)		(0.0363)
Openness		-0.0057**		-0.0070**		-0.0062**
		(0.0027)		(0.0027)		(0.0027)
Constant	0.7563***	0.7946***	0.7657***	0.7320***	0.7720***	0.8132***
	(0.0444)	(0.0611)	(0.0446)	(0.0667)	(0.0442)	(0.0616)
Observations	668	572	668	572	668	572
R-squared	0.6522	0.6115	0.6483	0.6091	0.6531	0.6138
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
F test	0.000204	0.00250	0.00246	0.00798	0.000111	0.000842

Note: Models are estimated using 5-year averages on a sample 1980 - 2014. FE = Fixed effects. Columns (1) and (4): clustering over control of corruption index. Columns (2) and (5): clustering over rule of law. Columns (3) and (6): clustering over the first principal component of the World Governance Indicators data. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. F-test reports the p-value of the test the restriction that all coefficients at the interaction terms are the same (p-value).

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