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REGULATION, TRADE AND ECONOMIC GROWTH

Jens Koeniger
Magdalene Silberberger

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

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Abstract

The role of regulatory quality as one of the so-called deep determinants of growth has emerged as an important issue in economic research in the past 20 years. The positive or negative growth effects of a country's regulatory framework are amplified by economic integration, which makes factors and producers more mobile and enables them to avoid burdensome regulation. Therefore, the two potential determinants to growth might be interlinked. So far there is very little empirical evidence on the impact of the regulatory framework in an integrated economy on growth. We deal with the most common problems in estimating growth equations by using internal instruments to identify a causal relationship between regulation and growth in the presence of international trade and find evidence that both regulation and trade have a significant positive influence on growth, with the effect of regulation being especially pronounced for countries that have worse regulatory quality and for middle-income countries.

1 Introduction

In the past 20 years the role of a good regulatory framework for a country's development has been emphasized by policy makers, researchers and international organizations alike. The regulations of a country are part of its economic institutions, which – in turn – are shaped by the political institutions (Acemoglu and Robinson 2012). In general, institutions of a country are defined as the arrangements that structure the political, economic and social interaction among its members. Their main function is to reduce uncertainties that result from incomplete information due to information asymmetries and transaction costs (North 1990). This facilitates market interaction and improves the functioning of markets in general. In contrast, poorly designed institutions can significantly increase costs and hinder economic activity and specialization (Lee 2008, Borrmann et al. 2006).

Closely linked to regulation is trade liberalization or economic integration that can amplify the effects of good or bad regulation. Through increased integration into world markets firms and production factors have become more mobile. Consequently, regulation can become a competitive advantage or disadvantage and can either attract firms or become one of the reasons they move into another country with more favorable regulation. Therefore, the growth effect of regulation could depend on the country's level of economic integration.

Despite econometric issues, such as data availability and endogeneity, there have been attempts to look at the simultaneous influence of general institutions and trade, in most cases finding joint validity of both (Alcalá and Ciccone 2002, Dollar and Kraay 2003a, Rodrik et al. 2004). This view, however, is challenged by Dollar and Kraay (2003b), who argue that the instruments used in those studies (e.g., historical and geographical factors) have good explanatory power for both the trade and the institutions variable in the first stage and therefore they cannot determine the partial effect of trade and institutions on growth. In addition, Acemoglu and Robinson (2012) argue that the political institutions only have an indirect effect on economic growth, namely through their influence on economic institutions. Where the political institutions are extractive and lack centralization, there will also be extractive economic institutions that set no incentives and opportunities concerning participation of individuals and firms in economic life. As a result, there will be little or no economic growth. Regulations, especially business regulations, as part of a country's economic institutions, set the rules for firms and thus influence the number of firms in a market, as well as their productivity and

competitiveness. If a good regulatory framework allows firms to operate efficiently and improve their productivity, the result will be higher growth. A regulatory framework that distorts the market mechanisms, on the other hand, will impede economic development.

Due to the lack of suitable data and methodological issues, however, there have been few studies analyzing the effect of (business) regulation on income. Jalilian et al. (2007) investigate the impact of regulatory quality on both a cross-section of 117 countries and a panel of 96 countries from 1980 to 2000 using the World Bank Governance Indicators and government/regulation data from the International Country Risk Guide (ICRG). The authors observe conditional convergence once a variable for government effectiveness or regulatory quality is included, all of which seem to be positively associated with economic growth. In addition, their results suggest that regulation rather than more general governance issues seem to have a larger impact on growth.

Djankov et al. (2006) addressed a similar question, using the Doing Business database by the World Bank with average annual GDP per capita growth between 1993 and 2002 as the dependent variable and argue that the impact of regulatory quality on GDP growth is very large. Specifically, an improvement from the worst to the best quartile of business regulation is associated with a 2.3 percentage point increase in average annual GDP growth, whereas for example a country's improvement from the worst to the best quartile in primary school enrollment implies an increase in growth by "only" 0.9 percentage points.

In a similar strand of literature Easton and Walker (1997), De Haan and Siermann (1998), Carlsson and Lundström (2002) and Gwartney et al. (2004) among others use the Economic Freedom Index (Gwartney et al. 2012) to study the relation between the broader concept of economic freedom and GDP growth[1]. Their results indicate that economic freedom matters for growth, but that the effect differs depending on the type of economic freedom measure (Carlsson and Lundström 2002, De Haan and Siermann 1998).

Finally, a number of studies has examined the effects of regulatory quality in financial, labor or product market regulation on the reallocation of resources, investment and productivity. Most of these studies, however, use very recent data and therefore do not capture a long-term effect.[2] The general finding of these studies is that low-quality regulation has adverse effects by

[1] For an overview of studies using the Economic Freedom Index see De Haan et al. (2005).
[2] Usually the World Bank Doing Business Indicators (World Bank 2014a), which are available from 2003, or the World Bank Governance Indicators (Kaufmann et al. 2005), available from 1995, are used.

increasing the firm's costs, reducing factor accumulation, investment and productivity, distorting the efficient allocation of resources and restricting firm entry and competition among existing firms (Eifert 2009)[3]. Especially developing countries might be prone to problems associated with excessive regulation that has been introduced by government officials to increase their rents (Jalilian et al. 2007).

Notwithstanding the relatively convincing results it is possible that a better regulatory environment does not increase growth in a direct manner, but rather through trade or better global integration of a country. If firm productivity is reduced through excessive red-tape the domestic companies will not be able to compete with foreign producers that face less burdensome regulations and trade will be reduced. On the other hand, firms may also move abroad to produce in countries with less stringent regulations, resulting in increased trade. Therefore, the effects of trade and regulation on growth cannot be examined independently, especially if one wants to investigate the effects of regulatory reform in the process of economic integration. In addition, there may be feedback effects.

Only very few studies have looked at the joint influence of trade and business regulations so far. Freund and Bolaky (2008) examine the linkages between trade, regulatory quality and income levels in 126 countries for an average of 2000-2004, arguing that distorting domestic policies may limit the positive effect of trade by restricting the reallocation of production to sectors with a comparative advantage. They use "entry regulation" from the World Bank Doing Business Indicators, because of the importance of Schumpeterian "creative destruction" for economic growth, as well as instruments such as the share of population speaking English or another major European langue or the legal origin of a country and find that regulation influences the income-effect of trade. In detail, well regulated countries profit more from trade, while countries with heavy regulation do not benefit at all.

Borrmann et al. (2006) estimate the interaction between trade, income and institutions, including business regulations in a cross-section of countries using Ordinary Least Squares (OLS) and an Instrumental Variable (IV) approach with very similar results. Their findings are

[3] For a good overview on regulation, the allocation of resources and productivity growth see Arnold et al. (2011). The effect of financial market regulation on economic growth has been of interest from the late 1990s, for example by Rajan and Zingales (1998) and Beck et al. (2005). Recent empirical studies on the effects of product market and labor regulation on economic growth, productivity, investment and innovation include Scarpetta and Tressel (2002), Scarpetta et al. (2002), Nicoletti and Scarpetta (2003), Aghion et al. (2004), Gust and Marquez (2004), Besley and Burgess (2004), Klapper et al. (2004), Botero et al. (2004), Crafts (2006), Conway et al. (2006), Micco and Pagés (2006), Klapper et al. (2006), Viviano (2008), Poschke (2010), Bourlès et al. (2010) and Buccirossi et al. (2013).

that countries with low-quality institutions (bottom 20 or 30 per cent) cannot reap the benefits of increase trade, with regulatory quality (e.g., labor market, market entry and tax system efficiency/tax level) playing a more important role than good governance. In a slightly broader context of integration, Busse and Groizard (2008) use the Doing Business Indicators to find that countries with excessive business and labor regulations cannot benefit from FDI as much as countries with relatively low regulatory burdens[4].

As previously mentioned, data restrictions have hindered research and there has not been a long-term panel data study dealing with possible linkages between trade, regulation and income so far. In addition, endogeneity issues require a suitable methodology. The commonly used IV approach has been criticized by Dollar and Kraay (2003b), who argue that the specification suffers from identification problems, because the historical and geographical instruments used in the literature usually have good explanatory power for both the institutions and the trade variable. Consequently, the studies are relatively uninformative about the partial, causal effects of trade and institutions on income. To identify whether trade or institutions drive income growth another method needs to be employed.

Based on the properties of the augmented Solow model (Solow 1956), with the addition of allowing technology to differ across countries, this paper establishes the theoretical relationship between regulation, trade and growth. Based on this theoretical relationship we estimate the impact of regulation and trade on growth, taking into account methodological issues by using the System Generalized Method of Moments (GMM) introduced by Arellano and Bover (1995) and Blundell and Bond (1998). The estimator uses lagged levels and differences of potential endogenous variables as instruments and therefore does not require external instruments. Our aim is to establish an empirical linkage between trade, regulation and economic growth in a cross-section of 106 developed and developing countries between 1970 and 2009 using an index of business regulation compiled by the Fraser Institute (Gwartney et al. 2012). We find that, although trade is also significant, regulatory quality, has a bigger and highly significant, non-linear, positive impact on economic growth. These results suggest that instead of pushing further trade liberalization, scarce resources of developing countries should be directed towards improving the regulatory framework.

The remainder of this paper is structured as follows. The economic foundation based on the augmented Solow model and the resulting econometric model, including the methodology and

[4] Again, the role of financial market regulation for FDI and growth has already been investigated by a number of studies, e.g., Hermes and Lensink (2003), Durham (2004) and Alfaro et al. (2004).

the data set, are outlined in Chapter 2. The empirical results are then presented in the following Chapter 3, while in Chapter 4 we test the robustness of our results. We find that both regulation and trade are positively associated with economic growth. Chapter 5 concludes.

2 Model and Data

As economic theory provides relatively little evidence on how regulations should enter a growth model, our starting point is the augmented Solow model (Solow 1956). To account for regulation our model assumes, in line with Gundlach (2005) and that the diffusion of technology in a cross-country context depends on factors that differ across countries. It therefore combines the production function approach that focuses on increasing human and physical capital and on technological progress to enhance economic growth with the institutional approach which sees institutions as the main determinant of the availability and productivity of resources and thus the main driver of income growth (Gwartney et al. 2004). Economic growth is measured by the logarithm of GDP per capita in period t (lny_t) minus the logarithm of GDP per capita lagged by one period (lny_0).

$$lny_t - lny_0 = -\left(1 - e^{-\lambda t}\right) lny_0 + \left(1 - e^{-\lambda t}\right) lnA_t + \left(1 - e^{-\lambda t}\right) \frac{\alpha}{1 - \alpha - \beta} lns_k + \left(1 - e^{-\lambda t}\right) \frac{\beta}{1 - \alpha - \beta} lns_h - \left(1 - e^{-\lambda t}\right) \frac{\alpha + \beta}{1 - \alpha - \beta} ln(n + g + \delta) \quad (1)$$

The savings rate in this model is denoted by s_k and s_h is investment in human capital. In the last term δ is the depreciation rate, n is the growth rate of labor force and g is the rate of technological progress. Furthermore, A_{it} is the level of technology in a country i at period t. According to Gundlach (2005) this level of technology A_{it} depends on the initial level of technology A_0 and the change of technology g, which is constant across the world. Country-specific factors, such as regulations or other endowments are inc luded in the term X_{ij}.

$$A_{it} = A_0 e^{gt}\, e^{\phi_j X_{ij}} \quad (2)$$

Inserting this definition of technology into the augmented Solow model yields a model that takes into account that the determinants of technology might actually differ across countries and that differences in income might be a result of those cross-country differences in technology.

$$lny_t - lny_0 = -(1 - e^{-\lambda t}) ln\, y_0 + (1 - e^{-\lambda t})(lnA_0 + gt) + (1 - e^{-\lambda t}) \frac{\alpha}{1-\alpha-\beta} lns_k + (1 - e^{-\lambda t}) \frac{\beta}{1-\alpha-\beta} ln\, s_h - (1 - e^{-\lambda t}) \frac{\alpha+\beta}{1-\alpha-\beta} ln(n + g + \delta) + (1 - e^{-\lambda t}) \phi_j X_{ij} \quad (3)$$

In the next step, we derive a testable regression equation from the model, where lny_{it-1} is the logarithm of the initial GDP per capita (*Δ*GDPpc (t-1)) to account for convergence, s_k is the savings rate, approximated by the gross fixed capital formation as a share of GDP (InvShare), s_h the investment in human capital, calculated as average years of secondary schooling of the total population aged 15 or older (Education). The growth rate of the labor force is approximated by the population growth rate (PopGrowth). In line with Mankiw et al. (1992) we add constant of 0.05 p. a. for $g+\delta$[5]. Finally, the model includes time dummies (τ_t), country-specific fixed-effects (η_i) and an error term (ν_i). All potential determinants of technology development that differ across countries, as suggested by Gundlach (2005), are included in the vector $X_{j,it}$.

$$lny_{it} - lny_{it-1} = \alpha + \beta_1 lny_{it-1} + \beta_2 lns_{k,it} + \beta_3 ln\, s_{h,it} + \beta_4\, ln(n_{it} + g + \delta) + \phi_j X_{j,it} + \tau_t + \eta_i + \nu_i \quad (4)$$

As previously mentioned, institutions might play a role in the process of economic growth through their effect on transaction costs, but recent evidence suggests that regulation does even play a bigger role. Additionally, the degree of integration might influence the diffusion and therefore the level of technology in a country.

The regulatory channel (RegQuality) is captured by the regulation component (#5) of the Economic Freedom variable compiled by the Fraser Institute for their annual report Economic Freedom of the World (EFW) (Gwartney et al. 2012). The report provides extensive data on the different dimensions of economic freedom in five broad areas: the size of government, the legal structure and property rights, access to sound money, freedom to trade internationally, and regulation of credit and business. We only use the fifth chain-linked[6] sub-component of this

[5] Mankiw et al. (1992) derived the values for g and δ from available U.S. data. Using the capital consumption allowance and the capital-output ratio to estimate δ and average income growth per capita to approximate g, they find out that δ is about 0.03 and g is about 0.02. They also test other reasonable values and find that they have only little effect on their estimates.

[6] The chain-linked is used to ensure comparability of data throughout time even if the number of variables may have changed.

indicator as a proxy for the quality of business regulations, which again consists of a broad range of subjective and objective sub-indicators for regulation that might affect firms through labor, product and credit markets[7]. It ranges from 1 to 10, where higher scores reflect less burdensome regulation for firms and thus imply more business-friendly governance.

Criticism, however, is raised concerning the main explanatory variable RegQuality. First of all, the Economic Freedom variable is said to be a heterogenous collection of variables and not all components may have a positive influence on growth (De Haan et al. 2005). By using only the fifth component of the indicator we reduce this heterogeneity significantly. The indicator still covers a broad field of regulatory issues, but all related to business regulation and breaking down the categories further was not possible for the entire timeframe as some variables were only available in that much detail for the more recent past. Second, it includes subjective indicators, which are often criticized in literature. De Haan et al. (2005) argue that not all aspects of regulatory quality can be counted or measured. The choice is either leave out those aspects as had been done initially or rely on subjective measures of relatively high quality. Compared to many other indicators the methodology used by Gwartney et al. (2012) is transparent and reproducible.

In order to ascertain the robustness of the results we employ a second variable for regulatory quality, that is, bureaucratic quality (BurQuality) from the International Country Risk Guide (ICRG) (PRS 2011). It is available from 1984-2009 and ranges from 0, which means very low quality to 4, very high quality[8]. This variable has a slightly different focus than the EFW variable and is high if the regulatory regime is stable and risks for investors are low.

Using different variables is of particular importance since there is no general definition of "good" regulation. The Economic Freedom variable has a high score when regulation restricts economic activity as little as possible, due to the liberal attitude of the Fraser Institute. It is beyond dispute that a completely liberal approach without any regulation is not desirable in all areas of economic life. The Bureaucratic Quality indicator is used to evaluate the risks of a country, therefore its score is higher when bureaucracy is relatively stable[9]. So, depending on

[7] The use of survey data in indicators for political or economic institutions has often been criticized. Gwartney and Lawson (2003), however, argue that by using objective variables only, important dimensions will be omitted due to data limitations or measurement problems. To obtain a more thorough indicator the authors therefore include high quality survey data from the Global Competitiveness Report.

[8] Another variable that covers regulatory quality is provided by the Heritage Foundation (Miller and Holmes, 2014). It includes, however, less information on the different dimensions of business regulations and is only available from 1995 onwards. Using this variable would not allow us to estimate a long-term effect. The correlation, however, between the Heritage Foundation variable and our RegQuality variable is high.

[9] The correlation between the two indicators is 0.42.

one's focus the optimal regulatory framework might look different, but our results hold for both indicators. Additionally, obtaining significant coefficients on both variables provides further evidence that regulatory quality does have a positive impact on economic growth.

In addition, to ensure that it is really economic and not political institutions that drive economic growth we include two variables that characterize a country's political institutions, namely, Democracy and Autocracy from the Polity IV project (Marshall et al. 2011). Both variables range from 0 to 10, with zero being least autocratic/democratic and ten being most autocratic/democratic.

To determine the integration channel (TradeShare), we use exports and imports of goods and services (current US$) as a share of GDP lagged by one period. This has advantage of normalizing the trade variable, but avoiding the problem that an external shock might influence trade and GDP simultaneously resulting in a biased TradeShare ratio (Busse and Koeniger 2012)[10].

The sample consists of 106 countries in total out of which 80 are developing countries[11]. To reduce the influence of business cycles we use five year averages from 1970 to 2009. Unfortunately, the panel is unbalanced, mainly because data availability for the regulation variable is limited in the first periods[12].

When estimating growth regressions empirically one has to deal with endogeneity of the variables, especially omitted variable bias and potential two-way causation. Accordingly, our dependent variable ΔGDPpc and the explanatory variables InvShare, PopGrowth, TradeShare and RegQuality will probably be influenced by contemporary shocks[13]. In addition, it is unsure whether RegQuality actually influences ΔGDPpc or vice versa. On the one hand, a higher regulatory quality could increase the productivity and the efficient use of resources, resulting in higher income growth rates. On the other, it is also possible, that higher GDP growth rates entail improvements in regulatory quality through the availability of additional resources. Thus, estimators that do not take these issues into account will most likely be biased. Usually the IV approach is used to solve these problems. Finding a suitable instrument for all the endogenous

[10] Using TradeShare in period t does not significantly alter the results. The results are not reported and can be obtained from the corresponding author.
[11] Developing countries are labeled according to the World Bank classification at the beginning of the sample period, where developing economies are classified into low-income and (lower and upper) middle-income economies depending on their gross national income (GNI). See Appendix C for country list.
[12] See Appendix A for the definition of variables and their sources.
[13] They are thus treated as endogenous variables in our regression.

independent variables, especially for regulatory quality, however, proves very hard. Dollar and Kraay (2003b) also criticize the use of external instruments. Typically, historical and geographical instruments are used in the literature to instrument for the quality of institutions, but according to Dollar and Kraay (2003b) these specifications suffer from identification problems when trying to estimate both the effect of trade and institutions, because the instruments used have good explanatory power for both the institutions and the trade variable. As a result, it remains unclear what the partial, causal effects of trade and institutions on income really are.

One possible solution to this is the use of internal instruments as suggested by Arellano and Bover (1995) and Blundell and Bond (1998). The System GMM estimator uses lagged levels and differences as a set of instruments for the endogenous variables to analyze changes across countries over time while effectively dealing with reverse causality. Felbermayr (2005) adds another caveat of the traditional IV approach that is solved through the System GMM. According to Felbermayr (2005) most previous models are static cross-section regressions that assume all countries are on their respective balanced growth path, e.g., their steady state. When looking at issues of conditional convergence this is problematic if the trade share affects the countries' steady state or the speed of convergence towards the steady state is low. Consequently, the results will most likely be biased. The System GMM was also recommended for the estimation of growth equations by Bond et al. (2001). The authors argue that due to the difficulties associated with the empirical estimation of growth equations, e.g. endogenous right-hand side variables that are measured with error and omitted variables, there is no alternative to an IV approach. As previously mentioned, using outside instruments, however, is not an easy task, thus, Bond et al. (2001) suggest that it might be preferable to use the System GMM. Overall, the use of a method with internal instruments seems to be necessary to shed some light on the trade, growth and institutions/regulations nexus, which is what the System GMM does.

Of course this methodology also has its limitations. As previously mentioned, it is not free from criticism that the results are arbitrary, depending on the specification. By using the most conservative approach we ensure that the problems associated with the System GMM are mitigated.

2 Empirical Results

Following the definition of the variables and the methodology, we now turn to the empirical results. Table 1 reports the results of the Fixed Effects and the pooled OLS estimator for the complete (columns (1)-(6)) and the developing countries sample (columns (7)-(12)).

As a benchmark in column (1) we use the augmented Solow model that explains differences in GDP per capita growth rates across countries and time by the level of GDP per capita (GDPpc(t-1)) in the previous period to mitigate the endogeneity problem, the investment rate (InvShare), the population growth rate (PopGrowth) and human capital (Education). In the benchmark, we observe that the effect of GDPpc is negative and highly significant. The InvShare coefficient is positive and also significant at the 1% level, whereas PopGrowth is negative and significant in most specifications. Education on the other hand is insignificant. Column (7) repeats the exercise for developing countries only, with similar results for the control variables. In column (2) and (8) we add the regulation variable (RegQuality), which is highly significant in both cases. Adding the trade variable (TradeShare) in columns (3) and (9) does not change the significance of the other variables and only marginally alters the RegQuality coefficient. TradeShare as such is insignificant in both cases. Next, we check for a non-linear influence by using the first polynomial (columns (4) and (10)) and the logarithm (columns (5) and (11)). RegQuality Sq is negative, but insignificant in both cases, but the logarithm in columns (5) and (11) provides some evidence for non-linear effects, implying an inverse U-shaped function. The TradeShare variable, on the other hand, remains insignificant. Finally, the pooled OLS regression in columns (6) and (12) broadly confirms the results of the Fixed Effects estimation.

Table 1: Regulation and Economic Growth, Pooled OLS and Fixed Effects Estimation

	Dependent Variable: ΔGDpc											
Independent Variables	Complete Sample						Developing Countries					
	FE					OLS	FE					OLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ln GDPpc (t-1)	-0.00355**	-0.0241***	-0.0249***	-0.0229***	-0.0248***	-0.0155***	-0.0195**	-0.0376***	-0.0374***	-0.0390***	-0.0386***	-0.0260***
	(-2.490)	(-3.609)	(-3.708)	(-3.266)	(-3.703)	(-3.993)	(-2.088)	(-3.597)	(-3.639)	(-3.721)	(-3.713)	(-4.390)
ln InvShare	0.230***	0.213***	0.207***	0.208***	0.208***	0.217***	0.238***	0.217***	0.218***	0.222***	0.220***	0.239***
	(12.05)	(10.11)	(9.250)	(9.164)	(9.262)	(14.81)	(10.74)	(8.855)	(8.812)	(9.004)	(8.935)	(13.89)
PopGrowth	-0.0155	-0.151**	-0.153**	-0.138**	-0.149**	-0.184***	0.0157	-0.145*	-0.147*	-0.156*	-0.153*	-0.230***
	(-0.292)	(-2.512)	(-2.473)	(-2.159)	(-2.404)	(-5.069)	(0.235)	(-1.810)	(-1.782)	(-1.861)	(-1.837)	(-5.032)
ln Education	-0.00454	0.00246	0.00228	0.00221	0.00291	-0.00604	-9.16e-05	0.00110	0.00117	0.00748	0.00375	-0.00286
	(-0.396)	(0.174)	(0.156)	(0.152)	(0.201)	(-0.755)	(-0.00719)	(0.0675)	(0.0716)	(0.492)	(0.232)	(-0.307)
TradeShare			0.0116	0.00996	0.0103	-0.00473			-0.00341	-0.00395	-0.00466	-0.0349***
			(0.997)	(0.813)	(0.862)	(-0.594)			(-0.199)	(-0.228)	(-0.268)	(-3.041)
RegQuality		0.0386***	0.0379***	0.122**		0.0341***		0.0418***	0.0422***	0.152*		0.0456***
		(3.940)	(3.900)	(1.990)		(8.034)		(3.632)	(3.644)	(1.857)		(8.047)
RegQualitySq				-0.00746						-0.0103		
				(-1.548)						(-1.504)		
ln RegQuality					0.215***						0.227***	
					(3.557)						(3.338)	
Observations	660	602	597	597	597	597	493	435	434	434	434	434
Countries	106	106	106	106	106	106	80	80	80	80	80	80
R^2 (overall)						0.369						0.418
R^2 (within)	0.314	0.338	0.345	0.361	0.357		0.375	0.390	0.389	0.405	0.399	

Notes: t-values in parentheses, significance at the 10, 5, and 1 percent level is denoted by *, **, and *** respectively.

As previously mentioned, the Fixed Effects estimator does not adequately deal with the problems that occur when estimating growth regressions, e.g., endogeneity due to omitted variables, measurement error and reverse causality. In addition, Nickell (1981) identified that the coefficients of a regression might be biased in dynamic panel data models, where T is small. In case the lagged dependent variable is used as an explanatory variable, the demeaning process of the Fixed Effects estimation causes the regressor to be correlated with the error term. While it is not entirely clear how large T needs to be for this effect to vanish, it seems self-evident that the eight periods we use represent a small T. Therefore, we re-run the regressions from Table 1 using the System GMM estimator, which does not suffer from the Nickell bias and deals with endogeneity using internal instruments. The results are reported in Table 2.

Despite its advantages, the System GMM estimator is not free from drawbacks. Specifically, it is often criticized for being sensitive to specification, in particular to an arbitrary setting of laglimits. In addition, the proliferation of instruments is an issue that might bias the results. Roodman (2009) describes how in the System GMM the Hansen test of instrument validity can be weakened if the number of instruments overfits the endogenous variables. In this case, even though the Hansen test does not indicate overidentification, there are too many instruments and the results are biased "towards those from non-instrumenting estimators". Roodman (2009) argues that, even though the Hansen test seems valid and the number of instruments does not exceed the number of N (countries), applying this rule of thumb can still result in an overfitting bias and fail to produce valid results. This might pose a problem, especially when the number of countries is reduced for the developing countries sample. To reduce the instrument count Roodman (2009) suggest restricting the lags instead of using all available instruments and collapsing the instrument matrix into smaller sets, through the combination of instruments. To avoid this bias we therefore collapse the instrument matrix for the endogenous variables and limit the number of lags used to two[14]. This way we ensure that the instrument count is linear in T, and thus mitigate the problem of an overfitting bias.

Again, we estimate a benchmark based on the augmented Solow model, already including the RegQuality and then add the TradeShare variable. Due to issues with second order

[14] The results for RegQuality hold for different lag limits, whereas TradeShare is less robust. See Appendix D for additional results.

autocorrelation in residuals, reflected in the p-value of the Arellano-Bond test, we had to include an additional lag for GDPpc. In general, the results confirm the findings of the FE estimation. The net effect of income levels (GDPpc) is negative, InvShare is positive and significant in three out of four regressions for the complete sample (columns (1) to (4)), but only in one for the developing countries sample (columns (5) to (8)). PopGrowth and Education have the expected signs, but are insignificant. TradeShare on the other hand is significant in all regressions, as is RegQuality in all different specifications, except for RegQualitySq in the complete sample. These results indicate, that both trade and regulation matter for growth. Neither the Sargan/Hansen Test for joint validity of instruments[15], nor the Arrelano-Bond test for first- and second-order correlation in differences (AR(1) and AR(2)) suggest any econometric problems.

In term of economic significance an increase in RegQuality by one standard deviation (0.155) is associated with an increase in ΔGDPpc of 5.5 percentage points over the five year period (column 4). The effect is slightly larger (5.9 percentage points) for the developing countries sample. The influence of TradeShare on ΔGDPpc on the other hand is smaller. Here, an increase by one standard deviation (0.24) leads to an increase in ΔGDPpc of about 2.5 percentage points over the five year period for both developed and developing countries (column 8).

[15] We reject Ho: the instruments are valid if the p-value of the Hansen Test is below 0.1. A value of 0.0866 (column (6)) would indicate, that the instruments used are not valid. Since we continue to use the functional form logarithm and the value is just below the threshold, we do not deal with this issue any further.

Table 2: Regulation and Economic Growth, System GMM Estimation

	Dependent Variable: Δ GDP Per Capita							
Independent Variables	**Complete Sample**				**Developing Countries**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln GDPpc (t-1)	0.284***	0.183*	0.205**	0.187*	0.281**	0.190*	0.254**	0.194*
	(2.668)	(1.758)	(1.984)	(1.813)	(2.430)	(1.747)	(2.037)	(1.819)
ln GDPpc (t-2)	-0.295***	-0.233**	-0.246**	-0.234**	-0.295***	-0.261**	-0.315**	-0.268**
	(-2.795)	(-2.049)	(-2.228)	(-2.066)	(-2.712)	(-2.243)	(-2.426)	(-2.327)
ln InvShare	0.102	0.176*	0.165*	0.165*	0.0963	0.160*	0.155	0.154
	(1.126)	(1.895)	(1.770)	(1.776)	(1.051)	(1.651)	(1.562)	(1.607)
PopGrowth	-0.0939	-0.299	-0.315	-0.334	-0.165	-0.343	-0.352	-0.379
	(-0.620)	(-1.403)	(-1.579)	(-1.617)	(-0.887)	(-1.464)	(-1.530)	(-1.598)
ln Education	-0.00677	0.0282	0.0174	0.0173	-0.0293	0.00547	0.0159	0.0113
	(-0.179)	(0.680)	(0.394)	(0.416)	(-0.701)	(0.111)	(0.357)	(0.231)
TradeShare		0.123**	0.115**	0.106*		0.124*	0.113*	0.103*
		(2.164)	(2.360)	(1.948)		(1.950)	(1.820)	(1.650)
RegQuality	0.0581**	0.0569**	0.142		0.0773**	0.0628*	0.292*	
	(2.295)	(2.300)	(1.494)		(2.360)	(1.807)	(1.784)	
RegQualitySq			-0.00831				-0.0253*	
			(-1.117)				(-1.742)	
ln RegQuality				0.371**				0.386**
				(2.522)				(2.109)
Observations	538	534	534	534	395	394	394	394
Countries	106	106	106	106	80	80	80	80
Hansen Test (p-value)	0.451	0.477	0.461	0.472	0.216	0.0866	0.289	0.133
# of Instruments	22	23	24	23	22	23	24	23
AR 2 (p-value)	0.393	0.697	0.455	0.530	0.477	0.726	0.224	0.576
AR 1 (p-value)	0.00231	0.00544	0.00379	0.00363	0.00387	0.00709	0.00692	0.00608

Notes: Significance at the 10, 5, and 1 percent level is denoted by *, **, and *** respectively. Estimation based on two-step System GMM estimator with robust standard errors; corresponding z-values are reported in parentheses. Constant terms and time dummies are always included but not reported. Hansen Test is the Hansen-test of overidentifying restrictions. AR (1) and AR (2) are the Arellano-Bond-test that first and second order autocorrelation in residuals is 0.

It may be argued that there is a systematic difference in the influence of RegQuality on ΔGDPpc for the best and worst regulated countries, for example, that a certain level of RegQuality is necessary for it to exert any effect on economic growth. In order to account for threshold effects we include a dummy for the top 50% of countries with the best regulatory quality and one for the countries with the biggest improvement over time[16]. That dummy is then interacted with the RegQuality variable and takes its value if the country belongs to the best 50% of regulated countries and zero otherwise. Columns (1) to (4) of Table 3 present the results for the best regulated 50% of countries in 2009 and the most improved countries during the entire period (1970-2009) , while columns (5) to (8) present the worst regulated 50%[17]. For the complete as well as the developing countries sample there is little change in the coefficients of the control

[16] We used two different dummies Top50Reg09 for the best 50% in 2009 and Top50Reg70-09 for the most improved countries between 1970 and 2009.

[17] We tried different threshold levels, but for both the complete as well as the developing countries sample the top 50% perform best.

variables and the TradeShare variable is also significant[18]. In addition, the RegQuality coefficient remains significant. The interaction term for the top 50% itself is negative, albeit only significant for the best regulated countries in 2009 (columns (1) and (3)) and not for the most improved ones. This implies that countries that already have high-quality regulations benefit less from additional improvement. Repeating the estimation for the bottom 50% confirms these findings. The interaction term is now positive, which indicates that countries with worse regulation benefit more. One could argue that there are decreasing returns to regulation. This argument makes sense, since the improvement of regulation is easier and with larger potential effects in countries where regulatory quality is relatively bad. It makes a difference, for example, whether the duration to enter a market is reduced from 200 to 100 days or from 20 to ten.

[18] An interaction term for the countries with the highest or lowest TradeShare is not robustly significant, independent of the cutoff level. The results are not reported, but can be obtained from the corresponding author.

Table 3: Regulation and Economic Growth, 50% Best and Worst Regulated Countries

	Dependent Variable: Δ GDP Per Capita								
Independent Variables	**Complete Sample**		**Developing Countries**			**Complete Sample**		**Developing Countries**	
	(1)	(2)	(3)	(4)		(5)	(6)	(7)	(8)
ln GDPpc (t-1)	0.202*	0.178*	0.199*	0.174*	ln GDPpc (t-1)	0.201*	0.194*	0.213*	0.183*
	(1.860)	(1.752)	(1.841)	(1.739)		(1.816)	(1.882)	(1.931)	(1.879)
ln GDPpc (t-2)	-0.246**	-0.225**	-0.277**	-0.249**	ln GDPpc (t-2)	-0.244**	-0.242**	-0.285**	-0.257**
	(-2.080)	(-2.063)	(-2.350)	(-2.277)		(-2.040)	(-2.135)	(-2.394)	(-2.388)
ln InvShare	0.154	0.185**	0.162*	0.177*	ln InvShare	0.156	0.155*	0.154	0.174*
	(1.580)	(2.026)	(1.709)	(1.892)		(1.591)	(1.651)	(1.582)	(1.907)
PopGrowth	-0.371*	-0.325	-0.376*	-0.407	PopGrowth	-0.387*	-0.332	-0.367	-0.386
	(-1.819)	(-1.576)	(-1.650)	(-1.491)		(-1.879)	(-1.579)	(-1.601)	(-1.336)
ln Education	0.0313	0.0374	0.0333	0.0238	ln Education	0.0357	0.0178	0.0238	0.0199
	(0.696)	(0.888)	(0.627)	(0.470)		0.201*	0.194*	0.213*	0.183*
TradeShare	0.130**	0.117**	0.129*	0.109*	TradeShare	0.130**	0.117**	0.129*	0.109*
	(2.302)	(2.399)	(1.951)	(1.902)		(2.302)	(2.399)	(1.951)	(1.902)
ln RegQuality	0.410***	0.284**	0.383**	0.362*	ln RegQuality	0.410***	0.284**	0.383**	0.362*
	(2.766)	(2.093)	(2.165)	(1.878)		(2.766)	(2.093)	(2.165)	(1.878)
Top50%Reg09	-0.0478**		-0.0529**		Bottom50%Reg09	0.0645**		0.0516*	
	(-2.028)		(-2.001)			(2.528)		(1.781)	
Top50%Reg70-09		-0.0168		-0.0269	Bottom50%Reg70-09		-0.0169		0.0166
		(-0.845)		(-0.910)			(-0.997)		(0.495)
Observations	534	534	394	394		534	534	394	394
Countries	106	106	80	80		106	106	80	80
Hansen Test (p-value)	0.166	0.237	0.263	0.107		0.291	0.438	0.199	0.101
# of Instruments	24	26	24	24		24	24	24	24
AR 2 (p-value)	0.592	0.552	0.633	0.604		0.618	0.487	0.607	0.588
AR 1 (p-value)	0.00504	0.00426	0.00839	0.00559		0.00560	0.00325	0.00841	0.00502

Notes: See Table 2

To sum up, one can say that both RegQuality and TradeShare have a positive association with GDPpc growth rates. The effect of regulatory quality is of considerable size, whereas the effect of trade is smaller in economic terms. Apparently, a good regulatory environment facilitates the creation and expansion of domestic private businesses and attracts investment from abroad (e.g. as foreign direct investment) resulting in higher economic growth. It also potentially increases the productivity of existing firms and facilitates business by correcting for or even removing market failures that are perceived as serious obstacles by potential investors and existing firms alike. For firms to even start investing the country needs to provide a certain quality of regulation, e.g. ensure that there is a functioning market. Then, firms are set up, investments are completed, ideally resulting in job creation and higher income. Obviously, if countries already have qualitatively good regulations, additional improvements will be harder to execute and thus not have an equally large effect.

4 Robustness

In a next step, we check the robustness of the results, by using different periods, samples and additional variables (Table 4). First, we exclude the first three periods, since data availability was limited for the regulatory quality variable. Columns (1) and (2) present the results for the shorter timeframe between 1985 and 2009. Again, there is only very little change in the controls. GDPpc and InvShare are both highly significant, while PopGrowth and Education are not. TradeShare on the other hand is not significant, neither for the complete, nor for the developing countries sample, whereas RegQuality is still highly significant, with a coefficient that is higher compared to the sample period from 1970. This result suggests that the changes in regulation in more recent periods were more important for income growth. Possibly, the process of globalization/internationalization makes regulatory quality more relevant when firms can move abroad if they find the regulatory framework hostile to their activity and new sources of income such as foreign investors have many countries to choose from.

Central and Eastern European Countries (CEEC) are excluded from the sample in column (3). The countries in this specific group have experienced major changes in regulatory quality after the collapse of the Iron Curtain in 1989-1990 and increases in GDP per capita growth rates. It is conceivable that the results in Tables 1 through 3 are driven by exactly this process only and regulation does not have a significant effect on the remaining sample. For this reduced sample, the coefficients for the control variables are similar to the ones in the baseline specification, but

the coefficient for the RegQuality variable decreases strongly, indicating that the improvement in regulation in the CEE countries might indeed be one major driver of increased GDP growth. This is still only one part of the story. The size of the RegQuality coefficient may be reduced, but it is still significant at the 5% level, which means that regulatory quality is also a driver of economic growth in non-CEE countries.

Next, we split the sample in income groups according to the World Bank classification[19]. The results are presented in columns (4) to (7). Surprisingly, there is no significant impact of regulatory quality on GDP growth for low-income countries. Education, on the other hand, is significant and positive only for this income group. One possible explanation is that the least developed countries have other issues that are more important than regulation, such as the provision of the most basic (political) institutions or education. Another possibility is that the implementation of regulation is problematic in low-income countries, so that de jure regulatory quality is not bad, but when it comes to de facto regulation, there are issues that prevent firms from benefiting from improvements in regulation, such as corruption. In contrast, the middle-income countries benefit from improved regulation, as do high-income countries. The TradeShare coefficient is insignificant in all sub-samples, but the high-income sample, where it is highly significant. This result suggests, that it is mostly the high-income countries that benefit from trade liberalization or increased trade volumes. Reducing the sample by a sizeable amount leads to potential issues with overidentification. Limiting the number of lags even further, however, only marginally alters the results, except for the fact that RegQuality is not significant for high-income countries any more[20].

Then, to verify that the results are not driven by some factor that is specific to our main independent variable RegQuality we use a different variable for regulatory quality, bureaucratic quality (BurQuality) from the ICRG to the baseline regression (PRS 2011)[21]. This reduces our sample size to 95 countries (69 developing ones) and the timeframe under investigation to 1985 to 2009 (columns (8) and (9)). Despite having a different focus than the EFW indicator[22] the

[19] According to this classification countries with an annual income lower than 1,045 US$ are low-income countries. Lower-middle-income countries have an income between 1,046 and 4,125 US$ and upper-middle-income countries lie between 4,126 and 12,745 US$. Finally, all countries with an annual income higher than 12,745 US$ are classified as high-income countries.

[20] Results not reported, but can be obtained upon request.

[21] Another variable that covers regulatory quality is provided by the Heritage Foundation (Miller and Holmes, 2014). It includes, however, less information on the different dimensions of business regulations and is only available from 1995 onwards. Using this variable would not allow us to estimate a long-term effect. The correlation, however, between the Heritage Foundation variable and our RegQuality variable is high.

[22] RegQuality is targeted at economic freedom and therefore high, when regulation maximizes economic freedom, whereas BurQual is high when regulation minimizes risks of investment in a country.

variable turns out to be significant for the complete as well as the developing countries sample. The TradeShare variable is also positive when entered with the BurQuality variable. Surprisingly, Education is negative and significant for the complete sample. This could be related to the different sample and to the fact that in the observation period of the indicator countries with relative low levels of education have experienced high income growth rates, e.g. China, while the industrialized countries such as the US with high levels of education have had to deal with lower income growth.

Altogether, there is no evidence that the results are driven by the specific regulation variable and they seem robust throughout different country groups, time-frames and estimation methods.

Finally, to ensure that the RegQuality variable does indeed capture the effect of economic, but not political institutions instead, we include different measures of political institutions together with the RegQuality and the TradeShare variable. Democracy in columns (10) and (12) and Autocracy in columns (11) and (13) are from the Polity IV project (Marshall et al. 2011). Both variables range from 0 to 10, with zero being least autocratic/democratic and ten being most autocratic/democratic. As would be expected, the Democracy coefficient is positive, but insignificant, whereas the Autocracy coefficient is negative and significant in the complete sample. This is in line with De Haan and Siermann (1995) who find that the relationship between democracy and growth is indeed not robust. More importantly, the RegQuality variable is still significant, albeit with a strongly reduced coefficient. Apparently, the Democracy and the RegQuality variable contain some common features that influence growth.

In terms of political institutions it seems that a democratic regime does not matter for growth, but a strongly autocratic regime somewhat impedes economic development. More importantly, RegQuality retains is statistical significance, even though its economic significance is reduced with either one of the political institutions variables. Apparently, economic institutions have a bigger impact on income growth rates than political institutions. There is, however, the possibility that more democratic countries simply reform more and put a stronger emphasis on regulatory quality and increase growth through better regulations (Eifert 2009, De Haan et al. 2005). In addition, Acemoglu and Robinson (2012) argue, that the economic institutions of a country, including the regulatory framework, depend on the political institutions. The results in columns (10) to (13) support this hypothesis. This would imply that political institutions are an indirect determinant of economic growth, through economic institutions.

Table 4: Regulation and Economic Growth, Robustness

	Dependent Variable: Δ GDP Per Capita												
	1985 - 2009		Other Country Samples					Bureaucratic Quality		Policy Variables			
Independent Variables	Complete	Developing	No CEE Countries	Low-income	Lower middle-income	Upper middle-income	High-income	Complete	Developing	Complete		Developing	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
ln GDPpc (t-1)	0.482***	0.483***	0.433***	0.179	0.0526	0.0296	0.328**	0.125	0.227**	0.330***	0.596***	0.263***	0.517***
	(4.861)	(4.081)	(3.882)	(0.926)	(0.894)	(0.222)	(2.424)	(1.157)	(1.989)	(3.603)	(5.490)	(2.950)	(4.970)
ln GDPpc (t-2)	-0.545***	-0.583***	-0.463***	-0.347	-0.265***	-0.0470	-0.423***	-0.120	-0.248*	-0.384***	-0.678***	-0.338***	-0.613***
	(-4.947)	(-4.842)	(-4.087)	(-1.618)	(-3.431)	(-0.285)	(-2.659)	(-0.982)	(-1.835)	(-4.105)	(-5.856)	(-3.819)	(-5.559)
ln InvShare	0.278***	0.260***	0.371***	0.250***	0.264***	0.500***	0.277***	0.237**	0.116	0.363***	0.257***	0.357***	0.267***
	(4.094)	(4.563)	(6.455)	(5.241)	(3.308)	(5.908)	(2.853)	(2.033)	(0.777)	(7.714)	(4.933)	(7.898)	(4.819)
PopGrowth	-0.285	-0.345	-0.317*	0.00410	-0.453**	0.00355	-0.264	-0.393	-0.625	-0.263*	-0.315**	-0.280*	-0.334**
	(-1.453)	(-1.544)	(-1.780)	(0.0440)	(-2.350)	(0.0106)	(-1.249)	(-1.410)	(-1.618)	(-1.772)	(-2.102)	(-1.769)	(-1.976)
ln Education	0.00490	-0.00711	-0.00274	0.0542**	-0.126	0.0102	0.0618	-0.156*	-0.208	0.0558	0.0508	0.0671	0.0354
	(0.0617)	(-0.0819)	(-0.0383)	(2.098)	(-1.363)	(0.203)	(1.010)	(-1.831)	(-1.365)	(1.223)	(0.931)	(1.536)	(0.623)
TradeShare	0.0714	0.140	0.0105	-0.0783	-0.0605	0.00789	0.145***	0.184**	0.247*	-0.0149	-0.00239	-0.0289	0.0152
	(0.865)	(1.235)	(0.192)	(-1.445)	(-0.728)	(0.134)	(4.535)	(2.087)	(1.896)	(-0.318)	(-0.0503)	(-0.660)	(0.316)
ln RegQuality	0.596***	0.586***	0.241**	0.229	0.583***	0.361***	0.251**			0.0424***	0.0848***	0.0451**	0.0854***
	(3.582)	(3.119)	(2.395)	(1.236)	(3.471)	(2.652)	(2.114)			(2.843)	(3.253)	(2.513)	(3.057)
ln BurQuality								0.142**	0.135*				
								(2.124)	(1.676)				
Democracy										0.00410		0.00247	
										(0.963)		(0.543)	
Autocracy											-0.0141*		-0.0111
											(-1.780)		(-1.519)
Observations	365	269	487	134	149	98	153	405	288	482	514	354	365
Countries	106	80	91	26	30	21	29	95	69	106	106	80	80
Hansen Test (p-value)	0.573	0.757	0.471	0.764	0.675	0.995	0.693	0.627	0.556	0.235	0.573	0.168	0.442
# of Instruments	15	15	23	22	23	22	23	19	19	33	33	33	33
AR 1 (p-value)	0.0135	0.0234	0.00335	0.0387	0.0850	0.0101	0.0198	0.00784	0.00858	0.00362	0.00776	0.00543	0.0110
AR 2 (p-value)	0.157	0.151	0.113	0.667	0.517	0.231	0.814	0.243	0.377	0.157	0.392	0.243	0.459

Notes: See Table 2

5 Conclusion

Despite its potential for improvement, the quality of business regulation and its impact on economic growth have been subject to very little research. Even less research has been conducted about the joint impact of integration and regulation despite potential interlinkages. In addition, previous empirical research has been suffering from various problems, such as the use of problematic instruments with the IV approach or the failure to take the dynamic setting of growth regressions into account. This suggests the use of a relatively new method, the System GMM estimation. This method, however, is not without caveats. It drastically suffers from the use of too many instruments and the explanatory power of conventional tests is also reduced in the case of an overidentification problem. We take all these issues into account, by using the System GMM with a collapsed instrument matrix that significantly reduces the number of instruments. When comparing the results to the standard FE or the pooled OLS estimator, we find a very similar pattern, supporting our hypothesis.

Our results suggest that regulatory quality is a highly significant and robust determinant of economic growth. Moreover, the effect seems to be non-linear, suggesting that there might be decreasing returns to regulatory improvement. Countries that already have had a relatively high improvement in regulatory quality will benefit less than countries that have had little. In addition least developed countries do not seem to benefit from improved regulation. Apparently, there are other factors that play a more prominent role for economic growth in the poorest countries, such as education. The integration channel also seems to be significant, albeit less robust and mostly relevant for high-income countries. There is also no clear evidence of a direct effect of political institutions on changes in income, although the effect might be indirect in the sense that countries with better political institutions will simply reform more and have better business regulation.

As a policy implication, these findings indicate that a stronger focus of policy makers on the regulatory quality of a country is likely to result in enhanced growth prospects. While trade liberalization has been on the agenda for many years now, regulation has only gained importance more recently. Especially in countries, in which the political institutions are non-extractive and there is sufficient centralization, regulatory reforms can be a major source of

economic growth[23]. They are often initiated by determined policymakers and government officials, even in countries that seem to lack resources for reform. In only seven years, between 2004 and 2011, Mozambique for example managed to reduce the number of days to start a business from 153 to only 13 (World Bank, 2014a). It is therefore particularly interesting to observe that the improvement of business regulation does indeed have a positive effect on economic growth.

Of course these results do not allow for precise policy implications for a specific country. Even though the indicators for good regulatory quality are standardized there is no "one size fits" all regulation. What works well for one country does not need to be welfare improving for the other and practical policy implications need to be formulated taking into account country characteristics and needs. One also has to distinguish between de facto and de jure regulation. Even if an indicator significantly (e.g. days to start a business decrease) improves it does not necessarily mean that firms really face a less burdensome regulatory framework. Corruption and unofficial rules may be bigger impediments to business activities than official business regulation, especially in developing countries. This is, however, that needs to be dealt with on a more regional basis, taking into account the specific environment and challenges of countries.

In general, this study is in line with a small set of literature that argues that trade and economic institutions might be an important determinant of income growth. Despite its drawbacks our study has successfully established this link and, to be more specific, business regulations seems to have a bigger and more robust association with economic development than trade. In addition, while trade benefits high-income countries, it is the middle-income countries that gain from improved regulatory quality. Consequently, regulatory reform should be on the agenda especially for developing countries. For least-developed countries, the story is, again, different. This country-group benefits from more education and investment, but changes in regulation do not have direct impact on growth. Apparently, other issues need to be tackled before this country-group can benefit from improved regulation.

[23] According to Acemoglu and Robinson (2012) reform towards non-extractive economic institutions that are conductive to growth needs to be accompanied by reforms in political institutions. Where those are extractive, economic reform will not be sustainable.

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Appendix A: Definition of Variables and Data Sources

Variable	Definition	Data Source
GDPpc	Real gross domestic product per capita (constant 2000 US$, in logs)	World Bank (2014b)
InvShare	Gross fixed capital formation (% of GDP) (in logs)	World Bank (2014b)
PopGrowth	Growth rate of total population	World Bank (2014b)
Education	Average years of secondary schooling in the population of age 15 and over	Barro and Lee (2010)
TradeShare	Sum of imports and exports of goods and services (current US$) divided by total GDP (current US$) lagged 5 year	World Bank (2014b)
RegQuality	Regulation component (#5) of the Economic Freedom variable, chain-linked	Gwartney et al. (2012)
BurQuality	ICRG: Bureaucratic Quality	PRS (2011)
Democracy	Institutionalized Democracy	Marshall et al. (2011)
Autocracy	Institutionalized Autocracy	Marshall et al. (2011)

Appendix B: Descriptive Statistics

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Full Sample					
Δ GDP Per Capita	673	.0812263	0.1063859	-.5921292	.5175729
GDPpc	779	7095.241	2983.529	109.4873	54128.65
InvShare	769	22.5518	4.463652	3.500661	63.99796
PopGrowth	848	.0644073	0.0315418	-.1975905	.6943439
Education	848	1.961114	0.6361452	.0311	7.4761
TradeShare	765	.784651	0.1931644	.0809318	4.876048
TradeShare (logs)	765	4.204453	0.2425342	2.091022	6.189505
RegQuality	680	5.737472	0.816032	2.4732	8.762972
RegQuality (logs)	680	1.722598	0.1550824	0.9055129	2.170535
BurQuality	470	2.360786	0.4946534	0	4
Democracy	750	3.984067	2.276186	0	10
Autocracy	774	2.548945	2.088053.	0	10
Developing Countries Only					
Δ GDP Per Capita	500	.0753661	0.1181106	-.5957971	.5175729
GDPpc	580	2273.492	762.6961	109.4873	14998.7
InvShare	571	22.33698	4.752257	3.500661	63.99796
PopGrowth	640	.0688767	0.0237764	-.0743971	.2476582
Education	640	1.575448	0.571493	.0311	5.073
TradeShare	566	.7490721	0.1847749	.0809318	2.464955
TradeShare (logs)	566	4.170376	0.2632802	2.091022	5.507344
RegQuality	477	5.496532	0.8125643	2.4732	8.762972
RegQuality (logs)	477	1.677991	0.1650027	0.9055129	2.170535
BurQuality	341	1.864383	0.5667812	0	4
Democracy	565	2.831947	2.328383	0	10
Autocracy	586	2.958845	2.378415	0	10
Best 50% in Regulatory Quality in 2009					
Δ GDP Per Capita	342	.0915676	0.1031296	-.5105658	.4882154
GDPpc	396	11082.4	4023.807	169.6122	54128.65
InvShare	390	23.95263	4.671872	4.840231	66.50823
PopGrowth	432	.0578187	0.0376704	-.1975905	.6943439
Education	432	2.380912	0.7051689	.0979	5.2611
TradeShare	388	.9650218	0.2339022	.1343315	4.876048
TradeShare (logs)	388	4.419428	0.221485	2.597725	6.189505
RegQuality	358	6.265241	0.8728232	2.4732	8.762972
RegQuality (logs)	358	1.820012	0.1495346	.09055129	2.170535
BurQuality	226	2.862116	0.451195	0	4
Democracy	374	4.28563	2.255161	0	10
Autocracy	386	2.097723	1.766791	0	10
Worst 50% in Regulatory Quality in 2009					
Δ GDP Per Capita	328	.0699863	0.1101806	-.5921292	.5175729
GDPpc	379	2942.961	1183.877	109.4873	24700.53
InvShare	375	21.03918	4.262406	3.500661	46.08743
PopGrowth	408	.072496	0.0237739	-.0743971	.193428
Education	408	1.511853	0.5534636	.0311	7.4761
TradeShare	373	.5909098	0.1386056	.0809318	1.423217
TradeShare (logs)	373	3.973412	0.2636648	2.091022	4.95809
RegQuality	318	5.143663	0.7324224	2.4732	7.277523
RegQuality (logs)	318	1.613285	0.1581019	0.9055129	1.98479
BurQuality	222	1.798257	0.5435208	0	4
Democracy	372	3.025269	2.276939	0	10
Autocracy	382	3.033944	2.382247	0	10

Appendix C: Country Sample

Albania, Algeria, Argentina, Armenia, **Australia, Austria, Bahrain,** Bangladesh, Barbados, **Belgium,** Benin, Bolivia, Botswana, Brazil, Bulgaria, Burundi, Cameroon, **Canada,** Central African Republic, Chile, China, Colombia, Costa Rica, Cote d'Ivoire, Croatia, Cyprus, Czech Republic**, Denmark,** Dominican Republic, Ecuador, El Salvador, Estonia, Fiji, **Finland, France,** Gabon, **Germany,** Ghana, Greece, Guatemala, Guyana, Haiti, Honduras, Hungary**, Iceland,** India, Indonesia, **Ireland, Israel, Italy,** Jamaica, **Japan,** Jordan, Kenya, **Kuwait,** Latvia, Lithuania, **Luxembourg**, Malaysia, Mali, Mauritius, Mexico, Mongolia, Morocco, Mozambique, Namibia, Nepal, **Netherlands, New Zealand,** Nicaragua, Niger, **Norway,** Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Russian Federation, Senegal, Sierra Leone**, Singapore,** Slovak Republic, Slovenia, South Africa, **Spain,** Sri Lanka, **Sweden, Switzerland,** Syrian Arab Republic, Tanzania, Thailand, Togo, Tunisia, Turkey, Uganda, Ukraine, **United Arab Emirate**s, **United Kingdom**, **United States**, Uruguay, Zambia, Zimbabwe

Note: Developed countries in **bold,** CEE countries in italic.

Appendix D: Further robustness checks

	Dependent Variable: Δ GDP Per Capita					
Independent Variables	Collapsed instrument matrix, lags limited to one		Not collapsed instrument matrix, lags limited to two		Not collapsed instrument matrix, no laglimit	
	Complete	Developing	Complete	Developing	Complete	Developing
	(1)	(2)	(3)	(4)	(5)	(6)
ln GDPpc (t-1)	0.444***	0.509***	0.109*	0.0731	-0.0392	-0.0776**
	(3.478)	(3.979)	(1.718)	(1.122)	(-0.912)	(-2.007)
ln GDPpc (t-2)	-0.479***	-0.512***	-0.146**	-0.132*	-0.00967	-0.0406
	(-3.650)	(-3.353)	(-2.230)	(-1.960)	(-0.207)	(-0.769)
ln InvShare	0.394***	0.419***	0.218***	0.232***	0.360***	0.351***
	(4.555)	(4.794)	(3.500)	(3.843)	(7.444)	(8.343)
ln PopGrowth	0.0467	-0.229	-0.325**	-0.335***	-0.396**	-0.425***
	(0.190)	(-1.133)	(-2.152)	(-3.232)	(-2.314)	(-3.388)
ln Education	0.0487	-0.0800	0.00962	0.00216	0.0240	0.0391
	(0.701)	(-1.045)	(0.312)	(0.101)	(0.533)	(1.290)
ln TradeShare	0.0937	-0.0370	0.0245	0.00675	0.0728*	0.0192
	(0.932)	(-0.316)	(0.674)	(0.144)	(1.784)	(0.426)
ln RegQual	0.422***	0.519***	0.412***	0.472***	0.407***	0.453***
	(2.687)	(3.044)	(3.017)	(2.876)	(2.905)	(3.224)
Observations	534	394	534	394	534	394
Countries	106	80	106	80	106	80
Hansen Test (p-value)	0.211	0.126	0.548	0.642	0.998	1
# of Instruments	5	7	59	61	139	141
AR 1 (p-value)	0.0385	0.0175	0.000276	0.000638	0.0106	0.00619
AR 2 (p-value)	0.132	0.115	0.238	0.259	0.167	0.217

Notes: See Table 2.