Markets are smart! Structural reforms and country risk *

Christopher Findlay[†a], Silvia Sorescu[b], and Camilo Umana Dajud[c]

[a]Faculty of the Professions, University of Adelaide
[b]OECD and GEM
[c]Department of Economics, Sciences Po Paris

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Highlights:

- We use the variation of CDSs as a measure of sovereign debt risk premiums.
- We find that CDSs are not only explained by debt levels or other macroeconomic fundamentals.
- There are significant relationships between policy measures and CDSs.
- Financial markets bring forward the benefits of reform through lower CDSs.

Abstract

The level of public debt and other macroeconomic fundamentals are the main variables used in economic literature to explain the evolution of sovereign debt risk premiums. We show that the evolution of sovereign CDSs is explained not only by the evolution of these fundamentals, but also by the structural capacity of countries to grow. Introducing a set of structural capacity variables along debt-to-GDP ratio in estimations explains a much higher share of the variation in the CDS data. The results suggest that markets take into account the future benefits of structural reforms when evaluating the risk of investing on sovereign debt.

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*The views expressed in this article are those of the authors only.

†Corresponding author: christopher.findlay@adelaide.edu.au; School of Economics, University of Adelaide, Adelaide, SA 5005, Australia.

1 Introduction

Since financial stress became widespread in late 2008, risk perceptions attained unforeseeable peaks for some developed countries and thus, sovereign debt markets attracted considerably more and more attention. Further concerns related to contagion among countries had an increasing effect on risk premiums and augmented the financing cost for many economies.

Economic and political stability is closely tied to financial markets' expectations about the changes in country risk premiums. The present analysis is inspired by Cardoso and Doménech (2010), who examined the impact of structural reform capacity on countries' risk premiums, measured by the average 5-year credit default swaps (CDSs). Sovereign CDS contracts are insurance contracts in which one party buys protection against losses occurring due to a credit event of a reference entity up to the maturity of the swap. In a CDS contract, the protection buyer pays a periodic premium until the maturity date or a credit event, whichever comes first. Upon the credit event, the protection buyer receives the difference between the par and the market value of any eligible bond as compensation. CDS market prices are quoted in basis points paid annually, and are a measure of the reference entity's credit risk (the higher the spread, the greater the credit risk) (Beinstein and Scott, 2006).

Cardoso and Doménech (2010), for a sample of 16 advanced economies, found a very high and positive correlation between structural capacity aspects[1] and these measures of risk premiums. This positive relationship suggests that one of the concerns of international financial markets in the current sovereign debt crisis relates to economies' medium and long-term growth potential. Their finding draws attention to the fact that financial markets are indeed paying attention to the implementation of structural reforms in economies with large spreads. Financial markets are not choosing their victims randomly, as common belief would suggest, but do assess structural conditions for growth (Wolff, 2011). This result presents a very important message for policy-makers: strict fiscal rules and austerity alone cannot 'deliver the rewards';[2] countries with no growth perspectives are not getting their rewards from the markets, as the borrowing costs for countries that applied strict fiscal policies have not so far lowered. Clear and credible fiscal rules are a necessary, yet not a sufficient condition, for lowering countries' risk premiums. Decisive reforms are also important to address structural weaknesses of the economy, help regain market trust, and ultimately long-term sustained growth (Wolff, 2011).

[1] The authors construct a structural capacity indicator based on the information provided by the IMF in the October 2010 Regional Economic Outlook (IMF, 2010), which covers structural reforms in nine areas: labor market inefficiency, business regulations, network regulations, retail sector regulations, professional services regulations, institutions and contracts, human capital, infrastructure, and innovation. Cardoso and Doménech (2010) construct average structural capacity indicators and show that these are closely correlated with relative income per head.

[2] Stephen King, global chief economist at HSBC, interview for CNBC, available at http://www.cnbc.com/id/46144194

Our main objective for this empirical work is to offer a deeper understanding of the correlation between capacity for reform and risk premiums, by including indicators for structural capacity along with other factors that have been identified in related literature as influences upon the country risk premiums. We find that financial markets are indeed "paying attention" to country-specific factors such as the capacity for structural reform.

In the next section, we discuss the use of CDSs as a measure of the country risk premium, with reference to its differences to premiums that can be identified in government bond markets. In Section 3, we review the main determinants of the pricing of sovereign debt, as identified in related literature. We also introduce in this section structural capacity indicators. We then present in Section 4 our chosen specification for testing the impact of structural capacity variables and the results yielded by this model. Section 5 deals with possible endogeneity issues. Section 6 concludes.

2 What is the best measure for risk?

Before the onset of the current financial crisis, trading in the sovereign credit market was less extensive compared to trading in the corporate credit risk market. Liquidity in the sovereign CDS market was low as a result of the financial markets' assessment of the minimal default risk of developed countries. An absence of default of developed countries, and the belief in the low probability of such an event occurring, led to the assessment that government bonds were a proper measure for expressing the cost of financing in the case of developed countries. For this reason, in developed economies the focus had been more on identifying determinants of government bond yields and on CDS spreads for corporate debt. In turn, CDS spreads were used mostly for assessing the behavior of credit pricing and the inherent default risk for emerging markets (Fontana and Scheicher, 2010). With the onset of the financial crisis and sovereign debt crisis however, the CDS market for these countries became more appealing to investors and increasingly liquid (Dieckmann and Plank, 2011).

There is a discussion evolving around the interaction of CDSs and government bond markets. In theory, CDS and bond spreads should be roughly equal. In practice, the types of contracts experienced in the two markets have different characteristics that would make it difficult to evolve into equal spreads. Market liquidity also plays a key role in the gap between the two spreads (Coudert and Gex, 2010). Up to now, there is no conclusive evidence on the relationship between these two markets. Zhu (2004) examined the impact of the development of the credit derivatives market on the pricing of credit risk, and how CDS spreads interact with prices in the bond market. The author's analysis shows that CDSs and bonds are equally priced in the long run. This is confirmed by Coudert and Gex (2010): government bonds and CDS spreads move simultaneously in the long run. However, in the short run there are quite significant pricing discrepancies between the two markets, largely due to different responses to

changes in credit conditions; the derivatives market seems to lead the bond market to a certain extent in anticipating rating events and in price adjustment (Zhu, 2004). In countries with higher spreads, the CDS market is found to be ahead of the bond market, and these adjustments are particularly strong in the case of emerging countries (Coudert and Gex, 2010). Levy (2009) concluded that it is the relative liquidity of each of the two markets that can offer an explanation for this inconsistent pattern. More recently, Fontana and Scheicher (2010) demonstrate that the difference between CDS spreads and the spreads on the underlying government bonds was not zero in the Eurozone CDS markets during late 2010; they suggest that these deviations could be associated with the limits in arbitrage and slow-moving capital. The analysis of Coudert and Gex (2010) suggests that the lead taken by the CDS market has been exacerbated in great part by the financial turmoil in Southern Eurozone countries.

From an empirical standpoint, there are advantages of using CDS spreads rather than government bond spreads. CDS spreads provide timelier market-based information on credit pricing. The more accurate estimates of credit spreads and returns can also be attributed to the higher liquidity in the sovereign CDS market (Longstaff et al., 2011). Moreover, employing CDS spreads in the analysis avoids the difficulty in dealing with time to maturity as in the case of using interest rate spreads (Aizenman et al., 2011). Lastly, CDS yields more accurate information on "pure" credit risk as opposed to a bond, which represents several risks such as interest rate, foreign exchange rate, and credit risk (Beinstein and Scott, 2006).

We conclude that the CDS spreads are a better expression of risk perceptions and, therefore, a better proxy for the market-based default risk pricing, for both developed and emerging countries. We choose as a measure of risk the sovereign credit default swap spreads for contracts on the external debt of countries for a 5-year maturity, which is preferred because it is the most actively traded maturity for CDSs.

3 Sovereign risk premium determinants

In this section, we review categories of variables that in prior research have been identified as determinants of the behavior of credit risk (identified through either CDS or government bond markets). Meanwhile, as underlined by Longstaff et al. (2011), there are a very large number of such variables.

The literature focused on establishing the main determinants of the cost of financing is not "new" (Dumicic and Rizdak, 2011). The debate has tried so far to identify whether the observed widening of spreads (CDS or government bonds) is an outcome of investors differentiating between countries' fiscal positions and macroeconomic fundamentals, or whether it is explained rather by more general factors, such as liquidity risk or international risk aversion. One of the first examples of this line of research is Edwards (1983) who analyzed the relationship between least developed countries' foreign debt and a country's default risk and showed that while lenders took into account different risk

characteristics of the borrower countries, markets did not simultaneously price correctly the risk for the countries that found themselves in debt servicing difficulties. Eichengreen and Mody (1998) tried to determine to what extent fundamental factors in comparison with the influence of the general market sentiment had an impact on the variation of bonds for a sample of developing countries. Their results showed that bonds' movements were much more influenced by the market sentiment than by country economic fundamentals.

Building on some of the most recent research (Fontana and Scheicher, 2010; Dieckmann and Planck, 2011; Longstaff et al., 2011), we focus in our analysis on the two main groups of variables that, according to Longstaff et al. (2011), aggregate the economic information relevant to investors in sovereign credit markets: global factors (including mainly global financial market variables, global risk factors, and global market liquidity factors) and local economic factors. A common finding in the empirical literature is that sovereign credit risk is driven by different global factors, which in some cases prove to be a much more important driver than the country/local specific factors. Codogno et al. (2003) and Longstaff et al. (2011) find spreads to be more associated with global factors than with local economic variables. Dooley and Hutchinson (2009) find that financial, economic, and regulatory "news" emanating from the US during the global financial crisis quickly impacted sovereign CDS spreads in emerging markets.

Longstaff et al. (2011) study sovereign CDSs of several developed and less developed economies from October 2000 to January 2010. They introduce in their analysis of CDS spreads a series of variables addressing global factors. Firstly, they include global financial market variables, with the role of taking into account the interdependencies between economies. Longstaff et al. (2011) include a number of measures from US equity and fixed income assets, based on evidence that events occurring in US financial markets have a global impact.[3] They consider the excess return on a portfolio as the equity market variable, and the change in the 5-year Constant Maturity Treasury (CMT) yield reported by the Federal Reserve as reflection of the variation in the US fixed income markets. As additional global financial market variables, they also include changes in the spreads of US investment-grade and high-yield corporate bonds.

Different measures of global risk premiums are also considered in the analysis of Longstaff et al. (2011). Firstly, they employ risk premium estimates from other global markets. Secondly, as a proxy for the variation in the equity risk premium, they use monthly changes in the earnings-price ratio for the S&P 100 index. They use as a volatility risk premium the difference between an index of volatility conveyed by S&P 500 stock index option prices and a measure of realized volatility for the S&P 100 index. They use a fourth measure through the monthly changes in the expected excess return of 5-year Treasury bonds as a proxy for changes in the term premium. They control for the spreads of other countries by calculating for each of the sovereigns in the sample the

[3]Meanwhile, the US is not one of the countries included in their sample.

average CDS spread for other countries in the same region (the regional spread), and the average CDS spread for the countries in the other regions; they regress the changes in these spreads on the other explanatory variables and use the orthogonalized residuals from these regressions as additional explanatory variables in the analysis.

Longstaff et al. (2011) include a proxy variable for global investment flow. They motivate their choice by illustrating that, when investors choose to diversify their portfolio by acquiring more foreign equity and debt securities, these associated flows can be related to valuation effects for sovereign debts because of enhanced risk sharing, local economic benefits of improved access to global sources of capital, or the improvement in the liquidity of these securities. The proxy variable is represented by the net new flows (inflows minus outflows) into mutual funds investing primarily in bonds and equity.

Manganelli and Wolswijk (2009) show that international risk aversion has an important role in determining the spreads of government bonds in the Euro area. They use as a proxy for international risk aversion the spreads of US corporate bonds over Treasury bonds. However, they also find that bond spreads are largely driven by the level of short-term interest rates set by the Eurosystem. They also show that international Hilscher and Nobusch (2010) control as well for different global factors such as changes in aggregate risk aversion, world interest rates, and aggregate liquidity. The authors include the VIX index and the US default yield spread (the spread between corporate bonds with a Moody's rate of Baa and Aaa). The authors include the 10-year US Treasury rate as a proxy for the world interest rate and the spread of US and EU interest rates to capture changes in aggregate liquidity. Dieckmann and Plank (2011) use the MSCI World Financials index[4] to capture the state of global financials.

The pricing of debt is influenced by a country's creditworthiness as reflected by its fiscal and macroeconomic position. Variables describing the state of the local economy are important determinants of sovereign credit risk. In developed countries, fiscal variables have a significant impact on risk premiums, in particular the level of public debt (e.g. Poterba and Rueben, 1999; Laubach, 2009). In European and, in particular, Euro area countries, several studies find a significant impact of government debt and public deficit on government bond spreads. Faini (2006) finds a significant effect of fiscal deficit and debt levels on the aggregate Eurozone interest rate level, as well as on sovereign bond spreads. Bernoth et al. (2004) find that fiscal fundamentals, as proxied by the budget balance or the government debt, have a significant impact on sovereign bond spreads for a pooled sample of 13 European Union countries. Bernoth and Wolff (2008) focus on the accuracy of government-reported fiscal data and find a spread-reducing impact of fiscal transparency in addition to a positive impact of deficits. In the Euro area, Hallerberg and Wolff (2008) report that government bond yields are also determined by

[4]Morgan Stanley Capital International Indices are global, regional, and national equity and fixed income market indices. They are widely used by portfolio managers and institutional investors to assess the performance of their funds against those of the underlying markets (http://glossary.reuters.com/index.php/MSCI_Indices).

institutional characteristics of the fiscal process. Credit risk is found to be an important factor in determining yield spreads (Schuknecht et al., 2008).

Attinasi et al. (2009) focus their analysis on the impact of fiscal variables on bond spreads. They use forecasted values of macroeconomic variables to capture market expectations, and show that the fiscal deficit has a significant influence on bond spreads. The authors introduce additional macroeconomic fundamentals, which include the expected economic growth rate and a proxy for expected external imbalances (the saving-investment balance of the private sector as a share of GDP). The authors also test the role of announcements, such as macroeconomic news (e.g. the announcement of bank rescue packages by governments) or government plans in terms of fiscal policy. Lara and Wolff (2011) investigate the role of numerical fiscal rules to contain sovereign bond spreads in the Euro area, using a dataset maintained by the European Commission.

Hilscher and Nobusch (2010) confirm that macroeconomic fundamentals have significant effects on spreads for a set of 31 countries over the period 1994 to 2007. The terms of trade is also an important determinant of sovereign yield spreads in emerging economies. A country's ability to pay its external debt affects its probability of default and, therefore, the spread it has to pay in international capital markets. They introduce the volatility of terms of trade, the change in terms of trade, and the number of years since the last default. These authors add two additional country-specific control variables: external debt to GDP and the ratio of reserves (including gold) to GDP. They show that countries with higher terms of trade volatilities and countries that have experienced deterioration of their terms of trade tend to have higher spreads.

Aizenman et al. (2011) develop a model of sovereign risk for 60 countries, over the period before and after the global financial crisis, based on fiscal policy variables and other economic fundamentals including the foreign interest rate, external debt, trade openness, nominal depreciation, inflation, GDP/capita, and economic growth. They find a key role of fiscal space in pricing sovereign risk, controlling for other relevant macroeconomic variables.

Longstaff et al. (2011) also take into account a number of different factors that capture information about the state of the local economy: the local stock market return, percentage changes in the exchange rate of the local currency against the US dollar, and percentage changes in the US dollar value of the sovereign's holdings of foreign reserves. Some authors use credit ratings as a proxy for all available country fundamentals (e.g. Hartelius et al., 2008 for emerging markets).

Dieckmann and Planck (2011) show that a country's pre-crisis exposure to the financial system explains a large part of its CDS spread. Moreover, a deterioration of the state of the financial sector is also associated with larger CDS spreads, and this effect is more powerful when countries have a high exposure. As in Hilscher and Nobusch (2010), they employ a country's public debt as a control variable since they aim to measure if the

state of the financial system has an effect on CDS spreads above and beyond what is contained in the country's leverage. To capture the state of the local financial system, Dieckmann and Plank use the Dow Jones Total Market (DJTM)[5] Financials index.

Liquidity risk (i.e. the size and depth of the market) has also been found to be a factor. The actual measures of liquidity differ widely across studies (Attinasi et al., 2009). Trading volumes, turnover ratios, and trading intensity are used as measures of how frequently a given asset is traded in the market in a given period. For their analysis of the government bond market, Attinasi et al. (2009) include a proxy for liquidity expressed as the size of the government bond markets (i.e. the amount of gross government debt issuance). Beber et al. (2006) argue that liquidity risk is actually more relevant during economic downturns and conclude that an impact of credit risk is only relevant during more stable economic conditions.

An interesting finding comes from Haugh et al. (2009), who determine that risk aversion is a very important factor for explaining the movement in sovereign bond spreads. Nevertheless, risk aversion in itself seems to have magnified the importance of fiscal performance (measured in this case by the ratio of debt service to tax receipts and expected fiscal deficits) and the authors argue that these effects are not linear, in such a way that financial market reactions can become a very important constraint on the operation of a country's fiscal policy.

4 Model

The estimated equation is inspired by the models used in Logstaff et al. (2011) and Dieckman and Plank (2011). We add a structural capacity indicator to the traditional variables of foreign reserves and public debt.

$$CDS_{it} = Reserves_{it} + Debt_{it} + Structural\_Capacity_{it} + \epsilon_{it} \quad (1)$$

A first issue arising is that data are not available in the same periodicity. CDSs are available on a daily basis, reserves on a quarterly basis, and most of the variables used here to construct the structural capacity indicators are released annually. We transform such variables to a quarterly basis in order to have all the variables of the same periodicity. For this purpose, all the variables released on a yearly basis are converted to a quarterly basis using the cubic spline interpolation method. CDS data are transformed to a quarterly basis using a moving average function.

Following IMF (2008, 2009), we divide the structural capacity indicators into five categories, characterized as follows:

- Labor market;

[5]The Dow Jones Total Market Index is a comprehensive mirror to the global equity market. The Index family includes more than 12000 securities from 65 countries – providing near-exhaustive coverage of both developed and emerging markets (http://www.djindexes.com/totalstockmarket/).

- Business regulations;
- Institutions and contracts;
- Human capital;
- Infrastructure;
- Innovation.

Data for the structural capacity variables are drawn from different sources described in the sub-sections below. Since we are interested in estimating the impact of the capacity for structural change, we will use in our equation variables that describe the state of policy in each of the areas outlined above, rather than variables describing actual outcomes of policies implemented in such areas. We can then observe whether structural capacity does matter and which aspects transmit strong signals to financial markets. Meanwhile, the variables selected, although representative, do not offer an exhaustive picture of capacity for structural change in each area. The variables employed are drawn from different sources and a complete list of the variables used along with their brief description is given in Apendix A.

Firstly, we test each category's impact on the evolution of CDSs. In each of the following sections, we list those variables that are statistically significant when we regress them against the CDS data. Then, we group the significant variables and test their joint impact on the CDS data. Along with the indicators of the scope for structural change, we include other variables such as foreign reserves and public debt, which have, in past studies, been found to be significant determinants of CDSs. Through this approach, we will try to determine the extent to which financial markets are paying attention to structural capacity aspects versus the 'classical' public debt concerns.

The sample of countries contains 19 OECD member countries: Australia, Austria, Belgium, Canada, Denmark, Finland, Germany, Greece, Ireland, Italy, Japan, Korea, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, and the United Kingdom. This set of countries offers wide geographic and time coverage, given the availability of CDS and structural indicators data. The period for which we have available data for CDSs is 2002-2010. The set of explanatory variables was chosen so as to maximize both the coverage of countries and years.

As suggested by financial markets' reactions, when public debt augments, the CDS values increase. Tables 1a and 1b shows the results of regressing the CDS values against the public debt and foreign reserves together, using alternatively two measures of public debt: government debt as a percentage of GDP (World Bank World Development Indicators; FMI) and the level of public debt (World Bank WDI). The coefficients are significant and of the signs expected. Meanwhile, in these equations, the very low values of the goodness of fit (R-squared of 1.2%) suggest that there are other sets of factors explaining simultaneously the evolution of the CDS values.

Table 1a. The impact of public debt on CDSs

VARIABLES	(1) CDS
debt_perc	1.881***
	(0.182)
reserves	-0.000264***
	(4.79e-05)
constant	-13.59***
	(5.229)
Observations	449
Number of country_id	19

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1b. The impact of public debt on CDSs

VARIABLES	(1) CDS
publicsector_debt_level	6.39e-11***
	(0)
reserves	-0.000513***
	(0.000121)
constant	120.9***
	(3.657)
Observations	277
Number of country_id	10

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

We employ the percentage of debt to GDP in the regressions containing the structural capacity variables, as this indicator provides a good picture of the financial leverage of an economy and allows for wider country and time coverage in our dataset. We run the regressions with year-quarter fixed effects. When the structural capacity variables data present sufficient variation over the period 2002-2010, we also run the regressions introducing country fixed effects, as we are trying to take into account the country characteristics that do not vary over time and that remain unobserved in our model. The introduction of country and year-quarter fixed effects allows us thus to control for other global and local factors that we cannot specifically introduce into the equation and that might affect the evolution of the CDSs. The use of the cubic spline interpolation method in order to bring all the variables to the same time period can introduce a problem of serial correlation into the regressors. We use in the regressions the fixed

effects with autoregressive disturbances in order to account for serial correlation, as proposed in Baltagi and Wu (1999). We now turn to the results for each of the six categories of structural reform listed above. The expected and estimated signs, as well as the significance levels for each variable, are given in the table presented in Annex A.

4.1 Labor market

When taking into account aspects of labor market policies, we test variables from different data sources. Firstly, we employed selected OECD Going for Growth labor market indicators:

- LaborMarket_I (cost of labour minimum wages, percentage of median wage);
- LaborMarket_II (average tax wedge on labour (percentage of total labour compensation): at 67% of average worker earnings);
- LaborMarket_III (marginal tax wedge on labour (percentage of total labour compensation): at 100% of average worker earnings);
- LaborMarket_IV (employment protection legislation (EPL) (index scale of 0-6 from weakest to strongest protection) protection for temporary employment); and
- LaborMarket_V (employment protection legislation (EPL) (index scale of 0-6 from weakest to strongest protection) protection for collective dismissals).

We also use different variables drawn from the Fraser Institute Index of Economic Freedom:

- LaborMarket_VI (hiring and firing practices);
- LaborMarket_VII (labor force share with wages set by centralized collective bargaining);
- LaborMarket_VIII (unemployment insurance, mandated hiring costs); and
- LaborMarket_IX (use of conscripts).

LaborMarket_X (Labor freedom) is drawn from the Heritage Foundation database.

The coefficients for the variables LaborMarket_III, LaborMarket_VI, LaborMarket_VIII, and LaborMarket_X are significant and robust in the different econometric specifications. It is interesting to see that some of the variables that seem to have an important negative impact on the evolution of CDSs are variables relating to wage setting on the labor market (LaborMarket_III). The coefficient on LaborMarket_VIII, related to unemployment insurance, is also significant and with a negative coefficient. The value of the R-squared increases considerably with the introduction of these additional variables. The coefficient on public debt is negative and significant.

Table 2. The joint impact of debt and labor market aspects on CDSs

VARIABLES	(1) CDS
debt_perc	-0.631***
	(0.112)
reserves	0.000139***
	(3.07e-05)
LaborMarket_I	0.188
	(0.345)
LaborMarket_II	-0.0793
	(0.379)
LaborMarket_III	0.784*
	(0.446)
LaborMarket_IV	0
	(0)
LaborMarket_V	0
	(0)
LaborMarket_VI	-1.911***
	(0.648)
LaborMarket_VII	-0.150
	(0.932)
LaborMarket_VIII	-2.508***
	(0.725)
LaborMarket_IX	-2.904***
	(0.548)
LaborMarket_X	0.315*
	(0.187)
constant	13.53*
	(6.953)
Observations	104
Number of country_id	11

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.2 Business regulations

We employ various variables from the Fraser Institute Index of Economic Freedom as proxies for business regulation aspects:

- BusinessReg_I (price controls);
- BusinessReg_II (administrative conditions/entry of new business);
- BusinessReg_III (time with government bureaucracy);
- BusinessReg_IV (starting a new business);
- BusinessReg_V (irregular payments).

Once the level of government debt is accounted for in the specification, the coefficients are significant for BusinessReg_IV and BusinessReg_V. The coefficient of debt is positive, yet not significant.

Table 3. The joint impact of debt and business regulation aspects on CDSs

VARIABLES	(1) CDS
debt_perc	0.0644
	(0.106)
reserves	-1.73e-05
	(2.37e-05)
BusinessReg_I	-0.225
	(0.556)
BusinessReg_II	-1.174
	(1.005)
BusinessReg_III	0.0962
	(0.550)
BusinessReg_IV	8.609***
	(1.166)
BusinessReg_V	-4.503***
	(1.090)
constant	-23.30***
	(4.994)
Observations	343
Number of country_id	19

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

4.3 Institutions and contracts

When testing for institutional aspects, we employ the following variables from the Fraser Institute Index of Economic Freedom:

- Inst_I (judiciary independence);
- Inst_II (impartial courts);
- Inst_III (protection of intellectual property);
- Inst_IV (law and order).

Inst_V (property rights) is drawn from the Heritage Foundation database.

The variables that prove robust to the different econometric specifications are Inst_II, Inst_IV, and Inst_V, of which Inst_II and Inst_V have a negative impact on the CDS evolution. In this case, the coefficient for debt is positive and significant.

Table 4. The joint impact of debt and institutions and contracts aspects on CDSs

VARIABLES	(1) CDS
debt_perc	0.197*
	(0.116)
reserves	-7.29e-05***
	(2.54e-05)
Inst_I	0.374
	(1.169)
Inst_II	-3.182**
	(1.243)
Inst_III	1.824
	(1.327)
Inst_IV	7.318***
	(1.691)
Inst_V	-0.348*
	(0.189)
constant	-21.13***
	(4.225)
Observations	315
Number of country_id	19

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.4 Human capital

The following human capital indicators are regressed against CDS data (all are drawn from the World Bank's World Development Indicators):

- HumanCap_I (local availability of specialized research and training services) from the Global Competitiveness Report of the World Economic Forum;
- HumanCap_II (public spending on education, total, % of government expenditure);
- HumanCap_III (public spending on education, total, % of government expenditure);
- HumanCap_IV (pupil-teacher ratio, secondary);
- HumanCap_V (expenditure per student, primary, % of GDP per capita);
- HumanCap_VI (expenditure per student, secondary, % of GDP per capita); and
- HumanCap_VII (expenditure per student, tertiary, % of GDP per capita).

When we control for public spending on education as an aggregate, we find that the coefficients for the variables HumanCap_I, HumanCap_II, and HumanCap_IV are significant, pointing to a strong impact of human capital indicators on the CDS evolution. We also tried to take into account the disaggregated spending on education, by introducing HumanCap_V, HumanCap_VI, and HumanCap_VII as alternatives to HumanCap_II, but less robust results were obtained. The coefficient on public debt is negative and significant.

Table 5. The joint impact of debt and human capital aspects on CDSs

VARIABLES	(1) CDS
debt_perc	-0.402***
	(0.0889)
reserves	3.34e-05**
	(1.56e-05)
HumanCap_I	-2.093*
	(1.168)
HumanCap_II	-5.365***
	(1.704)
HumanCap_IV	3.067***
	(0.807)
constant	39.95***
	(6.339)
Observations	74
Number of country_id	8

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.5 Infrastructure

In regards to infrastructure, existing research for policy-related variables, led us to consider the following sectoral regulation indicators drawn from the OECD Going for Growth database:

- Infrastr_I (sectoral regulation in airlines);
- Infrastr_II (sectoral regulation in rail);
- Infrastr_III (sectoral regulation in the road sector);
- Infrastr_IV (sectoral regulation in electricity);
- Infrastr_V (sectoral regulation in the gas sector);
- Infrastr_VI (sectoral regulation in the telecommunications sector); and
- Infrastr_VII (sectoral regulation in the postal sector).

The indices scale is 0-6 from the least to the most restrictive sector and manages to capture the state of regulation in each of the enumerated sectors.

When regressing these variables simultaneously on the CDS values, Infrastr_III, and Infrastr_IV are significant. Extensive regulation in the road transport and electricity sectors translates into a negative signal according to the financial markets. The coefficient on public debt is negative and significant.

Table 6. The joint impact of debt and infrastructure sector policies on CDSs

	(1)
VARIABLES	CDS
debt_perc	-0.381***
	(0.0634)
reserves	6.57e-05***
	(1.36e-05)
Infrastr_I	-0.0575
	(0.0955)
Infrastr_II	-0.0199
	(0.112)
Infrastr_III	0.148**
	(0.0583)
Infrastr_IV	0.304
	(0.196)
Infrastr_V	0.0431
	(0.134)
Infrastr_VI	0.219
	(0.250)
Infrastr_VII	0.0974
	(0.103)
constant	11.98***
	(2.783)
Observations	227
Number of country_id	18

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.6 Innovation

Lastly, we also employ proxies for innovation policy drawn from the World Economic Forum of the Global Competitiveness Report in order to assess the possible impact of such aspects on the evolution of CDSs:

- Innov_I (capacity to innovate);

- Innov_II (company spending on R&D);
- Innov_III (university-industry collaboration in R&D);
- Innov_IV (government procurement of advanced technology products).

The variables providing the most significant results are Innov_II and Innov_IV. Increased values for the capacity to innovate and government procurement of advanced technology products seem to be associated with lower values of the CDSs. The coefficient for debt is positive and not significant.

Table 7. The joint impact of debt and innovation policies on CDSs

VARIABLES	(1) CDS
debt_perc	0.0835
	(0.104)
reserves	-3.35e-05
	(2.48e-05)
Innov_I	-0.553
	(1.410)
Innov_II	3.976*
	(2.059)
Innov_III	-2.183
	(1.791)
Innov_IV	-2.826*
	(1.522)
constant	22.93***
	(4.852)
Observations	297
Number of country_id	19

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Across all the specifications testing the impact of the individual structural capacity dimensions, the areas that seem to explain most of the variation in the CDSs are labor market and infrastructure, followed by innovation.

4.7 All structural capacity variables included

The specifications in this section include all the variables that were the most statistically significant to the different econometric specifications estimated in the previous

sections by individual structural capacity areas. The variables that were robust to the different econometric specifications are: LaborMarket_III, LaborMarket_VI, LaborMarket_VIII, LaborMarket_IX, BusinessReg_IV, BusinessReg_V, Inst_II, Inst_IV, Inst_V, HumanCap_I, HumanCap_II, Infrastr_III, Infrastr_IV, Innov_II, and Innov_IV .

When testing these variables jointly in the regression, some of the variables have a significant impact (and the direction of the impact conforms to expectations) on the evolution of CDSs and seem robust to the different econometric techniques, and these include some of the labor market variables (LaborMarket_VI, LaborMarket_VIII, and LaborMarket_IX), human capital (HumanCap_II), infrastructure sector regulation (Infrastr_IV), and innovation (Innov_IV).

Table 8. Regression with the public debt and the jointly significant variables

VARIABLES	(1) CDS
reserves	4.81e-05**
	(1.83e-05)
debt_perc	-0.328***
	(0.0956)
LaborMarket_III	-0.102
	(0.170)
LaborMarket_VI	1.717***
	(0.588)
LaborMarket_VIII	-0.818
	(0.560)
LaborMarket_IX	-0.883**
	(0.386)
BusinessReg_IV	5.979***
	(1.989)
BusinessReg_V	-0.496
	(0.885)
Inst_II	-0.0367
	(1.117)
Inst_IV	0
	(0)
Inst_V	-0.224
	(0.203)
HumanCap_I	2.176*
	(1.231)
HumanCap_II	-3.427***
	(0.999)
Infrastr_III	0.122
	(0.0856)
Infrastr_IV	0.405
	(0.249)
Innov_II	0.626
	(1.236)
Innov_IV	-4.225***
	(1.210)
constant	12.96
	(22.99)
	20
Observations	116
Number of country_id	14

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The coefficient of public debt in this equation, which includes the set of significant structural variables, is negative and significant. This result is contrary to that from the traditional model in which higher debt is associated with a higher risk spread (compared to Table 1a and 1b). It also shows an ambiguous effect of debt on CDSs when structural variables are taken into account. Our interpretation is that higher levels of public debt are not associated with higher CDS values when the borrowing country has a set of structural policies in place that contribute to growth and the capacity to repay. Markets, in other words, are smart – they are taking into consideration the capacity of states to grow in the mid and long run when they are evaluating the risk of a sovereign default. However, this result also means that the econometric work may be affected by an endogeneity problem. Structural capacity reforms translating into positive signals in the financial market can feed back into the possibility for countries to borrow at lower rates and thus have greater capacity to support the implementation of such structural reforms. We further address this issue in Section 5.

Meanwhile, the year-quarter fixed effects are different in the specification accounting only for public debt versus the specification that includes the structural capacity variables (Tables 1a, 1b and, 8) as they are dependent on the time fixed effects accounted for and this has an impact on the R-squared value in the sense that it would not allow for an adequate comparison of the explanatory power of both regressions. In order to fully compare the explanatory power of the structural variables and, respectively, the explanatory power of public debt in the CDS trend, we run the two specifications without the year-quarter fixed effects. We first test the impact of the jointly significant structural capacity variables on CDSs without introducing debt, and then test the impact of public debt, without including time fixed effects, as some of these are dropped due to collinearity issues. We can thus observe that the explanatory power (i.e the R-squared) of the jointly significant structural variables is much higher than explanatory power of the debt-to-GDP ratio and reserves separately. Moreover, the measure of goodness of fit when introducing the debt and the structural capacity variables without time fixed effects is much greater than when introducing debt alone, and is closer to 57% rather than 3.5%. The traditional model certainly suffers from bias due to omitted variables.

Table 9a. Regression without year-quarter fixed effects a

VARIABLES	(1) CDS
reserves	-0.000210***
	(6.00e-05)
debt_perc	1.105***
	(0.161)
constant	1.006
	(3.682)
Observations	449
Number of country_id	19

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9b. Regression without year-quarter fixed effects b

VARIABLES	(1) CDS
reserves	4.37e-05**
	(1.67e-05)
debt_perc	-0.284***
	(0.0862)
LaborMarket_III	-0.217
	(0.149)
LaborMarket_VI	1.166**
	(0.535)
LaborMarket_VIII	-0.923**
	(0.443)
LaborMarket_IX	-0.646*
	(0.370)
BusinessReg_IV	8.369***
	(1.600)
BusinessReg_V	-0.499
	(0.826)
Inst_II	0.540
	(0.964)
Inst_IV	0
	(0)
Inst_V	-0.290
	(0.194)
HumanCap_I	2.432**
	(1.202)
HumanCap_II	-3.587***
	(0.942)
Infrastr_III	0.172**
	(0.0739)
Infrastr_IV	0.415*
	(0.231)
Innov_II	0.525
	(1.100)
Innov_IV	-4.607***
	(1.083)
constant	-5.671***
	(1.033)
Observations	116
Number of country_id	14

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9c. Regression without year-quarter fixed effects c

VARIABLES	(1) CDS
LaborMarket_III	-0.513***
	(0.117)
LaborMarket_VI	0.964*
	(0.552)
LaborMarket_VIII	-0.920**
	(0.415)
LaborMarket_IX	-0.678*
	(0.362)
BusinessReg_IV	5.067***
	(1.253)
BusinessReg_V	-0.880
	(0.807)
Inst_II	0.404
	(0.760)
Inst_IV	0
	(0)
Inst_V	0.0113
	(0.154)
HumanCap_I	3.461***
	(1.207)
HumanCap_II	-2.532***
	(0.873)
Infrastr_III	-0.0269
	(0.0163)
Infrastr_IV	0.633***
	(0.229)
Innov_II	-0.608
	(0.993)
Innov_IV	-4.300***
	(1.078)
constant	3.035***
	(0.946)
Observations	124
Number of country_id	14

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5 Endogeneity issues

As discussed in the previous section, the relationship between CDSs and the structural capacity variables could be affected by endogeneity. One option to control for endogeneity is to introduce in the regressions the structural capacity variables with a time lag. This makes sense, as we can think that owing to a medium and longer term setting of implementation, the state of policy variables might not be considered simultaneously by financial markets.

Nevertheless, it remains difficult to introduce the appropriate time lags for two reasons. First, it is challenging to simultaneously identify the appropriate lag for each of the structural capacity variables. Since we are looking at different areas of structural capacity, it is highly likely that such policy signals exert differentiated effects on growth and are picked up by the markets with different lags. The effects of their implementation on the growth perspectives will not be visible within the same time framework and will surely differ across our sample of countries. Second, owing to data limitations, we do not have the possibility to go too far back in time. Doing so would reduce the number of observations by too great an extent.

As a check, we introduce the same structural capacity variables as in the final regression (containing all the selected individual structural capacity variables), with a one-year time lag. We can observe that there are only a few changes at the level of the significance of the structural capacity variables. The coefficient for public debt remains negative, yet is not significant here. It is interesting to note that the explanatory power of this specification is much higher than the one with the structural capacity variables not lagged (the R-squared has a value of 24.5% here).

Table 10. Regression with all the lagged jointly significant variables

VARIABLES	(1) CDS
reserves	4.72e-05**
	(2.21e-05)
debt_perc	-0.143
	(0.103)
lag1_LaborMarket_III	-0.273
	(0.187)
lag1_LaborMarket_VI	-1.442**
	(0.643)
lag1_LaborMarket_VIII	-0.801
	(0.550)
lag1_LaborMarket_IX	-0.679
	(0.467)
lag1_BusinessReg_IV	1.795
	(2.405)
lag1_BusinessReg_V	-2.346**
	(0.974)
lag1_Inst_II	0.236
	(1.297)
lag1_Inst_IV	0
	(0)
lag1_Inst_V	0.192
	(0.245)
lag1_HumanCap_I	7.218***
	(1.333)
lag1_HumanCap_II	-0.484
	(1.150)
lag1_Infrastr_III	-0.0486
	(0.0964)
lag1_Infrastr_IV	0.387
	(0.257)
lag1_Innov_II	-6.226***
	(1.397)
lag1_Innov_IV	5.778***
	(1.298)
constant	-11.23**
	(4.636)
Observations	123
Number of country_id	15

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6 Best predictors

Another alternative for choosing the variables is looking merely at their ability to explain the evolution of CDSs. In this section, we analyze therefore which of the variables should be included in an optimal model for the prediction of their behavior. However, finding the optimal subset can rapidly become extremely computationally demanding. In fact, finding the optimal subset was proven to be NP-hard [Furnival and Wilson (1974)]. In order to find which variables should be included in an optimal model, we use the Leap and Bounds Algorithm proposed by Furnival and Wilson (1974). The algorithm allows us to choose a subset of optimal models. The optimality of a model is given by the minimization of the residual sum of squares.

The algorithm gives us the optimal model for each possible number of predictors. Table 11 shows the variables included in the regression models including up to 15 explanatory variables. The results show that in the optimal models containing up to seven explanatory variables, none of the usual variables used to explain the evolution of CDS should be included.

It still needs to be defined among these models which one should be considered to be the best model. In this area, there is no consensus and numerous information criteria have been proposed. For this reason, we apply to the optimal models the most commonly used information criteria: Adjusted R-square, Mallow's C, Akaike's information criterion, Akaike's corrected information criterion (AICC), and the Bayesian information criterion (BIC).

Table 12 shows the results of different information criteria applied to the optimal models obtained using the Furnival and Wilson algorithm. The best obtained value for each criterion is presented in bold. The optimal model, among the optimal models for each number of regressors in terms of the residual sum of squares, according the largest number of criteria (AICC, BIC, and Mallow's C) is model number 7.

Model number 7, as it is reported in Table 11, contains variables from almost every area examined in this paper (business regulations, innovation, infrastructure, human Capital) but none of the traditional variables used to explain CDSs: the importance of debt in relative terms and the level of reserves.

The optimal models, according to the remaining information criteria, are models 13 and 14. While these two models do include the percentage of debt as one of the explanatory variables, they also include indicators from every other area considered in this paper except the level of reserves.

Table 10. Optimal prediction models

NUMBER OF PREDICTORS	VARIABLES
1	LaborMarket_IX
2	HumanCap_IV Inst_II
3	HumanCap_IV Infrastr_V Inst_II
4	BusinessReg_IV HumanCap_IV Inst_II LaborMarket_IX
5	BusinessReg_IV HumanCap_IV LaborMarket_VIII Inst_IV Inst_II
6	BusinessReg_IV Innov_I HumanCap_IV BusinessReg_II Inst_IV Infrastr_II
7	BusinessReg_IV Innov_I HumanCap_IV BusinessReg_II HumanCap_I Inst_IV Infrastr_II
8	BusinessReg_IV debt_perc Innov_I HumanCap_IV LaborMarket_V BusinessReg_II LaborMarket_II LaborMarket_X
9	BusinessReg_IV Innov_I HumanCap_IV BusinessReg_II BusinessReg_III LaborMarket_I LaborMarket_III Inst_I LaborMarket_II
10	BusinessReg_IV Innov_I HumanCap_IV BusinessReg_II Infrastr_VI Inst_IV LaborMarket_I LaborMarket_III Inst_V LaborMarket_X
11	BusinessReg_IV Infrastr_III Innov_I HumanCap_IV LaborMarket_V BusinessReg_II reserves Infrastr_V Inst_IV LaborMarket_I Inst_V
12	BusinessReg_IV debt_perc Innov_I HumanCap_IV BusinessReg_II Infrastr_VI Inst_IV LaborMarket_I LaborMarket_III Inst_V LaborMarket_X Innov_III
13	BusinessReg_IV debt_perc Innov_I HumanCap_IV LaborMarket_V BusinessReg_II Infrastr_VI Inst_IV LaborMarket_I LaborMarket_III Inst_V Infrastr_II LaborMarket_X
14	BusinessReg_IV Infrastr_III debt_perc Innov_I HumanCap_IV LaborMarket_V BusinessReg_II Infrastr_VI Infrastr_V Inst_IV LaborMarket_I LaborMarket_III Inst_V LaborMarket_X
15	BusinessReg_IV Infrastr_III debt_perc Innov_I HumanCap_IV LaborMarket_V BusinessReg_II Infrastr_IV Infrastr_VI Inst_IV LaborMarket_I LaborMarket_III Infrastr_I Inst_V LaborMarket_X

Table 12. Optimal prediction models selection criteria

NUMBER OF PREDICTORS	R2ADJ	C	AIC	AICC	BIC
1	.5638157	88.75954	469.2579	656.9449	473.6372
2	.7143549	37.18563	442.2798	630.2354	448.8487
3	.7957596	10.38617	421.0839	609.3838	429.8425
4	.8142614	5.188087	415.7435	604.4672	426.6918
5	.8271526	2.007863	411.9051	601.136	425.0431
6	.841979	-1.649744	406.8769	596.7031	422.2045
7	.8500579	**-3.033695**	404.2851	**594.7993**	**421.8023**
8	.8515425	-2.300481	404.4804	595.7803	424.1873
9	.85532	-2.244628	403.6112	595.8	425.5078
10	.8589039	-2.090504	402.7665	595.9531	426.8527
11	.8628762	-2.010924	401.6707	595.9706	427.9465
12	.8652776	-1.438804	401.2709	596.8061	429.7364
13	.868676	-1.120732	**400.3275**	597.2274	430.9827
14	**.8687629**	.146103	401.0022	599.4042	433.847
15	.8681391	1.605801	402.0082	602.0581	437.0427
16	.8685384	2.788009	402.4747	604.3278	439.6988
17	.8682395	4.155564	403.2637	607.0854	442.6775
18	.8674474	5.64503	404.2698	610.2363	445.8732
19	.8675175	6.911756	404.8154	613.1153	448.6085
20	.8670273	8.315406	405.6086	616.4434	451.5913
21	.8648797	10.10761	407.1828	620.7684	455.3552
22	.8636315	11.66777	408.2724	624.8406	458.6345
23	.8616643	13.3775	409.6647	629.4645	462.2164
24	.8591675	15.18327	411.2549	634.5547	465.9962
25	.8583122	16.60745	412.0247	639.1141	468.9557
26	.8554148	18.45251	413.6898	644.8815	472.8105
27	.852125	20.34681	415.4603	651.0935	476.7706
28	.848699	22.23279	417.2119	657.6546	480.7118
29	.8453553	24.06576	418.8462	664.499	484.5358
30	.8410859	26.03761	420.7844	672.0842	488.6637
31	.8364992	28.02158	422.7491	680.174	492.8181
32	.8316169	30.0087	424.7208	688.7949	496.9794
33	.8263803	32.00431	426.7112	698.011	501.1594
34	.8208054	34.00001	428.7017	707.8636	505.3396
35	.814832329	36	430.7017	718.4301	509.5293

7 Conclusions

Our most important result shows that, for the period 2002-2010, the evolution of CDSs is explained not only by the evolution of public debt, but that there also other factors that matter and that financial markets are 'paying attention' to factors such as a country's capacity for structural reform. The introduction of a set of structural capacity variables along the debt-to-GDP ratio explains a much higher share of the variation in the CDS data.

The effect of public debt on CDSs when the structural capacity variables are taken into account is negative and significant when all the structural capacity variables are added, but not significant when controlling for endogeneity. It is not just the debt-to-GDP level that influences the CDS trend, but also the use of such debt in relation to structural capacity reforms and the returns to investment in structural capacity areas sustained through the level of debt.

A further important implication is that financial markets do take account of the state of structural reform. With respect to the arguments regarding the response to debt crises, for example, the usual response is that microeconomic reform 'takes too long'. Yet these results show that financial markets will recognize reform of that type in the risk premiums that are paid, which will facilitate the refinancing required. We infer that the significance of such reforms in the package of responses should be given greater weight. An opportunity is lost if this is not done.

The caveat to keep in mind is that this analysis is not exhaustive. We cannot be sure of capturing all of the aspects that are important in terms of structural capacity areas and we are also using mostly proxy variables for our selected areas. Moreover, we are only capturing marginal effects for each of these variables and thus missing out on the impacts of different interactions between variables, i.e how structural policy reform should be packaged. Further work should therefore aim at covering more structural capacity aspects, through better measures/indicators, and possibly, attempting to identify which types or forms of policy reform packages could be prioritized.

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Appendix A. Variables description with expected and estimated signs

		Individual Regression			All variables Regression	
Variable	**Description**	**Expected Sign**	**Actual Sign**	**Significance Level**	**Actual Sign**	**Significance Level**
debt_perc	Percentage of total public debt over gdp	Positive	Postive	5	Negative	1
reserves	Foreign currency reserves	Negative	Negative	5	Positive	1
generalgovtpublicsectordebtus	Public sector debt level	Positive	Positive	10		
LaborMarket_I	Cost of labour, percentage of median wage	Positive	Postive	Not significant at 10%		
LaborMarket_II	Average tax wedge on labour (Percentage of total labour compensation): At 67% of average worker earnings	Positive	Negative	Not significant at 10%		
LaborMarket_III	Marginal tax wedge on labor (Percentage of total labour compensation): At 100% of average worker earnings	Positive	Positive	5	Postive	Not significant at 10%
LaborMarket_VI	Hiring and firing practices	Negative	Negative	5	Positive	1
LaborMarket_VII	bargaining	Negatve	Postive	Not significant at 10%		
LaborMarket_VIII	Unemployment insurance, mandated hiring costs	Negative	Negative	5	Negative	5
LaborMarket_IX	Use of conscripts	Negative	Negative	1	Negative	1
LaborMarket_X	Labor Freedom	Negative	Positive	Not significant at 10%		
BusinessReg_I	Price controls	Negative	Negative	Not significant at 10%		
BusinessReg_II	Administrative conditions/entry of new business	Negative	Negative	Not significant at 10%		
BusinessReg_III	Time with government bureaucracy	Negative	Negative	Not significant at 10%		
BusinessReg_IV	Starting a new business	Negative	Positive	1		
BusinessReg_V	Irregular payments	Negative	Negative	1	Negative	Not significant at 10%
Inst_I	Judiciary independence	Negative	Postive	Not significant at 10%		
Inst_II	Impartial courts	Negative	Negative	5	Positve	Not significant at 10%
Inst_III	Protection of intellectual property	Negative	Negative	Not significant at 10%		
Inst_IV	Law and order	Negative	Positive	1		
Inst_V	Property rights	Negative	Negative	10	Positive	Not significant at 10%
HumanCap_I	services	Negative	Negative	Not significant at 10%		
HumanCap_II	Public spending on education, total, % of GDP	Negative	Negative	5	Negative	Not significant at 10%
HumanCap_III	expenditure	Negative	Positive	1		
HumanCap_IV	Pupil-teacher ratio, secondary	Negative	Positive	Not significant at 10%		
HumanCap_V	Expenditure per student, primary, % of GDP per capita	Negative	Positive	Not significant at 10%		
HumanCap_VI	Expenditure per student, secondary, % of GDP per capita	Negative	Negative	Not significant at 10%		
HumanCap_VII	Expenditure per student, tertiary, % of GDP per capita	Negative	Negative	10	Negative	1
Infrastr_I	Sectoral regulation in airlines	Positive	Negative	Not significant at 10%		
Infrastr_II	Sectoral regulation in rail	Positive	Negative	Not significant at 10%		

Infrastr_III	Sectoral regulation in the road sector	Positive	Positive	5	Negative	Not significant at 10%
Infrastr_IV	Sectoral regulation in electricity	Positive	Positive	Not significant at 10%		
Infrastr_V	Sectoral regulation in the gas sector	Positive	Positive	Not significant at 10%		
Infrastr_VI	Sectoral regulation in the telecommunications sector	Positive	Positive	Not significant at 10%		
Infrastr_VII	Sectoral regulation in the post sector	Positive	Positive	Not significant at 10%		
Innov_I	Capacity to innovate	Negative	Negative	Not significant at 10%		
Innov_II	company spending on R&D	Negative	Postive	10		
Innov_III	University-industry collaboration in R&D	Negative	Negative	Not significant at 10%		
Innov_IV	Government procurement of advanced technology products	Negative	Negative	10	Negative	1

Appendix B. Detailed description of variables

Variable ID	Variable name	Source	Detailed description
LaborMarket_I	Cost of labour Minimum wages, Percentage of median wage	OECD Going for growth	
LaborMarket_II	Average tax wedge on labour (Percentage of total labour compensation): At 67% of average worker earnings	OECD Going for growth	
LaborMarket_III	Marginal tax wedge on labour (Percentage of total labour compensation): At 100% of average worker earnings	OECD Going for growth	
LaborMarket_IV	Protection for temporary employment	OECD Going for growth	Index scale of 0-6 from weakest to strongest protection
LaborMarket_V	Protection for collective dismissals	OECD Going for growth	Index scale of 0-6 from weakest to strongest protection
LaborMarket_VI	Hiring and firing practices	Fraser Institute Index of Economic Freedom	This sub-component is based on the Global Competitiveness Report's question: "The hiring and firing of workers is impeded by regulations (= 1) or flexibly determined by employers (= 7).
LaborMarket_VII	Labour force share with wages set by centralized collective bargaining	Fraser Institute Index of Economic Freedom	This sub-component is based on the Global Competitiveness Report's question: "Wages in your country are set by a centralized bargaining process (= 1) or up to each individual company (= 7)."
LaborMarket_VIII	Unemployment insurance, Mandated hiring costs	Fraser Institute Index of Economic Freedom	This sub-component is based on the World Bank's Doing Business data on the cost of the requirements for advance notice, severance payments, and penalties due when dismissing a redundant worker. The formula used to calculate the zero-to-10 ratings was: (Vmax − Vi) / (Vmax − Vmin) multiplied by 10. Vi represents the dismissal cost (measured in weeks of wages). The values for Vmax and Vmin were set at 108 weeks (1.5 standard deviations above average) and zero weeks, respectively. Countries with values outside of the Vmax and Vmin range received ratings of either zero or 10, accordingly.
LaborMarket_IX	Use of conscripts	Fraser Institute Index of Economic Freedom	Data on the use and duration of military conscription were used to construct rating intervals. Countries with longer conscription periods received lower ratings. A rating of 10 was assigned to countries without military conscription. When length of conscription was six

			months or less, countries were given a rating of 5. When length of conscription was more than six months but not more than 12 months, countries were rated at 3. When length of conscription was more than 12 months but not more than 18 months, countries were assigned a rating of 1. When conscription periods exceeded 18 months, countries were rated zero.
LaborMarket_X	Labour freedom	Heritage Foundation	The labor freedom component is a quantitative measure that considers various aspects of the legal and regulatory framework of a country's labor market, including regulations concerning minimum wages, laws inhibiting layoffs, severance requirements, and measurable regulatory restraints on hiring and hours worked. The index is on a scale of 0 to 100, with 100 being the best score.
BusinessReg_I	Price controls	Fraser Institute Index of Economic Freedom	The more widespread the use of price controls, the lower the rating. Countries were given a rating of 10 if no price controls or marketing boards were present. When price controls were limited to industries where economies of scale may reduce the effectiveness of competition (e.g., power generation), a country was given a rating of 8. When price controls were applied in only a few other industries, such as agriculture, a country was given a rating of 6. When price controls were levied on energy, agriculture, and many other staple products that are widely purchased by house-holds, a rating of 4 was given. When price controls applied to a significant number of products in both agriculture and manufacturing, the rating was 2. A rating of zero was given when there was widespread use of price controls throughout various sectors of the economy.
BusinessReg_II	Administrative Conditions/Entry of New Business	Fraser Institute Index of Economic Freedom	This sub-component is based on the Global Competitiveness Report's question: "Complying with administrative requirements (permits, regulations,

			reporting) issued by the government in your country is (1 = burdensome, 7 = not burdensome)."
BusinessReg_III	Time with government bureaucracy	Fraser Institute Index of Economic Freedom	This sub-component is based on the Global Competitiveness Report's question: "Standards on product/service quality, energy and other regulations (outside environmental regulations) in your country are: (1 = Lax or nonexistent, 7 = among the world's most stringent)."
BusinessReg_IV	Starting a new business	Fraser Institute Index of Economic Freedom	This sub-component is based on the World Bank's Doing Business data on the amount of time and money it takes to start a new limited liability business (LLC). Countries where it takes longer or is more costly to start a new business are given lower ratings. Zero-to-10 ratings were constructed for three different variables: (1) time (measured in days) necessary to comply with regulations when starting a limited liability company; (2) money costs of the fees paid to regulatory authorities (measured as a share of per-capita income); and (3) minimum capital requirements, i.e., funds that must be deposited into company bank account (measured as a share of per-capita income). These three ratings were then averaged to arrive at the final rating for this sub-component. The formula used to calculate the zero-to-10 ratings was: (Vmax − Vi) / (Vmax − Vmin) multiplied by 10. Vi represents the variable value. The values for Vmax and Vmin were set at 104 days, 317%, and 1,017% (1.5 standard deviations above average) and 0 days, 0%, and 0%, respectively. Countries with values outside of the Vmax and Vmin range received ratings of either zero or 10, accordingly.
BusinessReg_V	Irregular payments	Fraser Institute Index of Economic Freedom	This sub-component is based on the Global Competitiveness Report's question: "In your industry, how commonly would you estimate that firms make undocumented extra payments or bribes connected with the following: A–Import and export permits; B–Connection

			to public utilities (e.g., telephone or electricity); C–Annual tax payments; D–Awarding of public contracts (investment projects); E–Getting favorable judicial decisions. Common (= 1) Never occur (= 7).”
Inst_I	Judiciary independence	Fraser Institute Index of Economic Freedom	This component is from the Global Competitiveness Report’s survey question: “Is the judiciary in your country independent from political influences of members of government, citizens, or firms? No—heavily influenced (= 1) or Yes—entirely independent (= 7).” The question’s wording has varied slightly over the years. All variables from the Global Competitiveness Report were converted from the original 1-to-7 scale to a 0-to-10 scale using this formula: EFWi = ((GCRi − 1)/6) × 10.
Inst_II	Impartial courts	Fraser Institute Index of Economic Freedom	This component is from the Global Competitiveness Report’s survey question: “The legal framework in your country for private businesses to settle disputes and challenge the legality of government actions and/or regulations is inefficient and subject to manipulation (= 1) or is efficient and follows a clear, neutral process (=7).”
Inst_III	Protection of intellectual property	Fraser Institute Index of Economic Freedom	Index goes from not protected by law (= 1) or are clearly defined and well protected by law (= 7).
Inst_IV	Law and Order	Fraser Institute Index of Economic Freedom	Integrity of the legal system: This component is based on the International Country Risk Guide’s Political Risk Component I for Law and Order: “Two measures comprising one risk component. Each sub-component equals half of the total. The ‘law’ sub-component assesses the strength and impartiality of the legal system, and the ‘order’ sub-component assesses popular observance of the law.”
Inst_V	Property rights	Heritage Foundation	The property rights component is an assessment of the ability of individuals to accumulate private property, secured by clear laws that are fully enforced by the state. It measures the degree to which a country’s laws protect private property

			rights and the degree to which its government enforces those laws. It also assesses the likelihood that private property will be expropriated and analyzes the independence of the judiciary, the existence of corruption within the judiciary, and the ability of individuals and businesses to enforce contracts.
HumanCap_I	Local availability of specialized research and training services	Global Competitiveness Report World Economic Forum	Local availability of specialized research and training services – index on a scale from 0 to 7 (with 7 representing the highest performance) based on the answer to the question: „In your country, specialized research and training services are (1 = not available, 7 = available from world-class local institutions)".
HumanCap_II	Public spending on education, total, % of GDP	World Development Indicators	
HumanCap_III	Public spending on education, total, % of government expenditure	World Development Indicators	
HumanCap_IV	Pupil-teacher ratio, secondary	World Development Indicators	
HumanCap_V	Expenditure per student, primary, % of GDP per capita	World Development Indicators	
HumanCap_VI	Expenditure per student, secondary, % of GDP per capita	World Development Indicators	
HumanCap_VII	Expenditure per student, tertiary, % of GDP per capita	World Development Indicators	
Infrastr_I	Sectoral regulation in airlines	OECD Going for growth	The index scale is 0-6 from least to most restrictive regulation
Infrastr_II	Sectoral regulation in rail	OECD Going for growth	The index scale is 0-6 from least to most restrictive regulation
Infrastr_III	Sectoral regulation in road sector	OECD Going for growth	The index scale is 0-6 from least to most restrictive regulation
Infrastr_IV	Sectoral regulation in electricity	OECD Going for growth	The index scale is 0-6 from least to most restrictive regulation
Infrastr_V	Sectoral regulation in gas sector	OECD Going for growth	The index scale is 0-6 from least to most restrictive regulation
Infrastr_VI	Sectoral regulation in the telecommunications sector	OECD Going for growth	The index scale is 0-6 from least to most restrictive regulation
Infrastr_VII	Sectoral regulation in the post sector	OECD Going for growth	The index scale is 0-6 from least to most restrictive regulation
Innov_I	Capacity to innovation	Global Competitiveness Report World Economic Forum	index on a scale from 0 to 7 (with 7 representing the highest performance) based on the answer to the question: In your country, how do companies obtain technology? [1 = exclusively from

			licensing or imitating foreign companies; 7 = by conducting formal research and pioneering their own new products and processes]
Innov_II	Company spending on R&D	Global Competitiveness Report World Economic Forum	index on a scale from 0 to 7 (with 7 representing the highest performance) based on the answer to the question: To what extent do companies in your country spend on R&D? [1 = do not spend on R&D; 7 = spend heavily on R&D]
Innov_III	University-industry collaboration in R&D	Global Competitiveness Report World Economic Forum	index on a scale from 0 to 7 (with 7 representing the highest performance) based on the answer to the question: To what extent do business and universities collaborate on research and development (R&D) in your country? [1 = do not collaborate at all; 7 = collaborate extensively]
Innov_IV	Government procurement of advanced technology products	Global Competitiveness Report World Economic Forum	index on a scale from 0 to 7 (with 7 representing the highest performance) based on the answer to the question: Do government procurement decisions foster technological innovation in your country? [1 = no, not at all; 7 = yes, extremely effectively]