



The Information Effect of Sovereign Credit Ratings

Yu-Li Huang¹, Chi-Hsun Chou^{*2}, Tsung-Yu Hsieh³

1. *Department of Finance and Banking, Shih Chien University*

2. *Department of Finance, Tainan University of Technology*

3. *Department of Business Administration, National Yunlin University of Science and Technology*

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ABSTRACT

This paper examines the quality of sovereign credit ratings of the Big Three rating agencies, including S&P, Moody's and Fitch and checks whether the information effect of sovereign credit ratings has improved after ESMA's regulatory reforms and increased competition. When considering the whole sample, the results show sovereign ratings of Big Three rating agencies can explain default probability and default amounts and bond yield spreads. However, the information effect of sovereign ratings of Big Three rating agencies does not change after regulatory reforms and increased competition from non-Big Three rating agencies. Second, when considering high-income countries sample, part of the results shows the information effect of sovereign ratings of Big Three rating agencies worsens after regulatory reforms and when facing the competition from non-Big Three rating agencies. Third, there is no significant information effect in middle-income countries. Our results echo some recent reports from the European Union, which found that the quality of credit ratings has not significantly improved following various reform measures and increased competition among credit rating agencies (ESMA, 2021; Karimov et al., 2024).

Keywords: sovereign credit rating; regulatory reform; competition; information effect

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¹ Email : ylhuang@g2.usc.edu.tw

² Corresponding Author, Email : chouchihsun@gmail.com

³ Email :hsiehy@yuntech.edu.tw

1. Introduction

Although credit ratings play a vital role in financial markets and the literature on credit ratings is voluminous, research which specifically investigates ratings quality is limited. Rating quality is important for international financial stability, because ratings are strongly embedded in many banking and investment regulations and therefore affect the welfare of both borrowers and investors (Bae et al., 2015). The quality of ratings rests on their ability to communicate information to market participants by maintaining a stable meaning of risk classification. Low quality ratings might harm the information diffusion of ratings unless all market participants are well informed. If investors are not able to extract reliable information from ratings, this lessens their value and reduces the benefits for the financial system (Bolton et al., 2012). Additionally, low quality ratings complicate regulations and make contracting with ratings more difficult. Finally, ratings quality is at the center of the policy agenda because it is closely related to banking regulation (capital adequacy requirements in particular).

Prompted by the increased demand for external borrowing by central governments, the sovereign rating market has grown sharply over the past two decades. As investment portfolios have become increasingly diversified across national boundaries, an understanding and assessment of sovereign credit risk has become increasingly important. The quality of sovereign ratings is highly important for practitioners and governments alike. Sovereign ratings reflect a country's willingness and ability to pay its obligations (Baum, Schafer, and Stephan, 2016; Cai, Kim, and Wu, 2019). They directly affect a country's cost of borrowing and foreign direct investment flows (Cai, Kim, and Wu, 2019), and indirectly affect the cost of firms' credit via the sovereign ceiling on bank and corporate ratings (Almeida, Ferreira, and Restrepo, 2017; Arezki, Candelon, and Sy, 2011; Borensztein, Cowan, and Valenzuela, 2013; Chen, Chen, Chang, and Yang, 2016; Huang and Shen, 2015).

During the financial crisis of 2008~2009, credit ratings have been accused as an inaccurate, coarse, and delayed indicator. Recently, there have been complaints from governments about the rating agencies exacerbating market panic during crisis times with excessive downgrades on sovereign ratings and changes in rating agencies regulation are in progress around the world.⁴ They complained that the Standard & Poor's, Moody's, and Fitch Ratings were too slow to alert investors to the likely demise of Lehman Brothers in 2008. During the subsequent euro area debt crisis, certain countries were faced with abrupt bond sell-offs and higher borrowing costs following a downgrade of their credit ratings.

For the last decades, the list of critical arguments against the rating agencies has been lengthening. The most common accusations were lack of transparency, potential conflict of interest, low quality of ratings, pro-cyclical behaviour, unreliable methodology, promoting neoliberalism as the only alternative for political economy, etc.

In response, the European Commission made proposals to strengthen the regulatory and supervisory framework for rating agencies in the European Union (EU), to restore market confidence and increase investor protection. The new EU rules were introduced in three consecutive steps. The first set of rules, which entered into force at the end of 2009, established a regulatory framework for rating agencies and introduced a regulatory oversight regime, whereby rating agencies had to be registered and were supervised by national competent authorities. In addition, rating agencies were required to avoid conflicts of interest, and to have sound rating methodologies and transparent rating activities. In 2011, these rules were amended to take into account the creation of the European Securities and Markets Authority (ESMA), which supervised rating agencies registered in the EU. A further amendment was made in 2013 to reinforce the rules and address weaknesses related to sovereign debt credit ratings

In this paper, first, we want to examine the quality of sovereign credit ratings, one of the most

¹ In May 2010, after the downgrades of Greece, Spain, and Portugal's sovereign ratings, European leaders including President of the European Commission José Manuel Barroso, France's President Nicolas Sarkozy, and German's Chancellor Angela Merkel complained that the Standard & Poor's, Moody's, and Fitch Ratings were too slow to alert investors to the likely demise of Lehman Brothers in 2008.

common accusations to rating agencies. We include sovereign ratings of the Big Three rating agencies, i.e., Standard & Poor's (S&P), Moody's Investors Service (Moody's) and Fitch Ratings (Fitch), spans from 2000 to 2020. Empirically, we focus on the ability of ratings to transmit information to investors. In other words, we will check whether sovereign ratings can predict future defaults and correlate with current bond prices.

Second, this paper will investigate the effect of regulation reforms on sovereign rating quality. In the European Union, the financial crisis was followed by the deep sovereign debt crisis, so legislators and public opinion were more concerned about public finance sector. New rules were introduced in 2009 and subsequently revised in 2011 and 2013, after a series of sovereign ratings' downgrades. In 2012, the European Securities and Markets Authority (ESMA) introduced new regulations, stipulating that credit ratings must be accompanied by identifiers distinguishing between ratings issued by analysts within the EU, versus those issued in countries that qualify as endorsed jurisdictions. For the ratings to be classed as endorsed, the analyst must be located in a jurisdiction which has a comparably stringent regulatory regime to that of the EU (EC, 2011). Further, only ratings accompanied by these identifiers can be used for regulatory purposes after April 2012. This paper tries to investigate whether the new regulatory reform affects the sovereign rating quality.

Third, we investigate the effect of competition on sovereign rating quality. We try to examine whether the rating quality has changed when rating agencies face competition. Sovereign ratings category stands for 11% of revenue related to issuing ratings, which is more than 100,000,000 euro annually (EC, 2016). After the European debt crisis, the European Commission hopes to establish its own rating agency or a public rating agency. In fact, there are some rating agencies also publish sovereign ratings, including Dominion Bond Rating Services (DBRS), Scope Euro Rating Services (Scope), Japan Credit Rating Agency (JCR), Rating and Investment Information (R&I), and Dagong Global (Dagong). Amstad and Packer (2015) indicate the ratings of non-major agencies tend to correspond less with those of the major agencies. They find the rank order correlations of each of the non-major agencies with the average ratings of the Big Three are much lower than, for example, the rank-order correlation between Moody's and S&P. This paper tries to investigate whether the rating quality has changed when Big Three rating agencies face the competition from non-Big Three rating agencies. Prior literature mainly used non-sovereign ratings as sample and by considering the entry of a regulated rating agency and the corresponding effect of increased competition on the rest of the rating agencies industry (Bolton et al., 2012; Dimitrov et al., 2015; Flynn and Ghent, 2018; Behr et al., 2018). This paper uses sovereign ratings as sample and investigate whether rating quality can be improved when there are multiple agencies assign ratings to a sovereign.

Fourth, we discuss whether the sovereign rating quality differs in advanced and emerging countries. Rating studies have found that agencies apply different standards to issuers, depending on their country's development level (Cantor and Falkenstein 2001; Poon 2003; Vives 2006). Furthermore, the literature investigates the effect of the financial crisis on advanced and emerging market countries and sequentially obtains mixed results. Thus, the sovereign rating quality may also be affected by national income.

Prior literatures examine the determinants of sovereign credit ratings (Hu et al., 2002; Alexe et al., 2003; Bissoondoyal-Bheenick et al., 2005; Bennell et al., 2006; Afonso et al., 2012), the phenomena and determinants of split sovereign credit ratings (Cantor and Packer, 1996; Alsakka and ap Gwilym, 2013; Hill, Brooks and Faff, 2010; Vu, Alsakka and ap Gwilym, 2018). Some Literature indicated that sovereign ratings tend to be home bias (Öztürk, 2014; Fuchs and Gehring, 2017; Yalta and Yalta, 2018). Some literature examines whether sovereign ratings of Big Three ratings agencies can explain government bond yield spread (Sy, 2004; Afonso et al., 2012; Gande and Parsley, 2005; Ferreira and Gama, 2007; Williams et al., 2013; Kim and Wu, 2011; Christopher et al., 2012).

Different with prior literature, this paper tries to investigate the quality of sovereign ratings of Big Three rating agencies and whether the quality of sovereign ratings has changed considering the ESMA's regulatory reforms and increased competition. Both American and European regulations were aimed at limiting the oligopolistic dominance of the "Big Three" in the credit rating market. They have been in a force for a few years now, so some conclusions can be already drawn and first assessment of their effectiveness can be done.

When considering the whole sample, the results show sovereign ratings of Big Three rating agencies can explain default probability and default amounts and bond yield spreads. However, the information effect of sovereign ratings of Big Three rating agencies does not change after regulatory reforms and increased competition from non-Big Three rating agencies. Second, when considering high-income countries sample, part of the results shows the information effect of sovereign ratings of Big Three rating agencies worsens after regulatory reforms and when facing the competition from non-Big Three rating agencies. Third, there is no significant information effect in middle-income countries. Our results echo some recent reports from the European Union, which found that the quality of credit ratings has not significantly improved following various reform measures and increased competition among credit rating agencies (ESMA, 2021; Karimov et al., 2024).

This paper tries to have some contributions to the academic literatures. First, this plan uses new sovereign defaults database to examine the rating quality, i.e., the database on government debt in default developed by the Credit Rating Assessment Group (CRAG) of the Bank of Canada. There is no literature uses this CRAG database to investigate the sovereign rating quality.² The database draws on previously published datasets compiled by various public and private sector sources. It combines elements of these, together with new information, to develop comprehensive estimates of stocks of government obligations in default. These include bonds and other marketable securities as well as bank loans and official loans, valued in US dollars, for the years 1960 to 2020 on both a country-by-country and a global basis. Previous studies identify a sovereign debt crisis when a country fails to meet its principals or interest payments on the due date, or when the country postpones its obligations by rescheduling debts with less favourable terms (De Bonis et al., 1999; Detragiache and Spilimbergo, 2001; Reinhart and Rogoff, 2014). However, due to the lack of data on worldwide sovereign defaults, existing studies face three problems. First, most studies have examined sovereign debt crises in a limited group of countries (De Bonis et al., 1999; Phillips & Shi, 2019). Second, some studies only focus on external debt crises or domestic debt crises (Balteanu and Erce, 2018; Detragiache and Spilimbergo, 2001; Ishihara, 2005). Third, most studies rely on a few sources of sovereign defaults, which undermines the real size of sovereign defaults and, consequently, provides false identifications of sovereign debt crises (Laeven and Valencia, 2013, 2020; Manasse and Roubini, 2009). Previous studies use CRAG database to investigate the role of IMF-supported programs in mitigating the likelihood of sovereign default (Balima and Sy, 2021)³ and assess the role of the political environment in the timing of financial crises (Nguyen, Castro and Wood, 2020)⁴.

Second, we include eight rating agencies to completely investigate the sovereign rating market and prior literature focuses on sovereign ratings of Big Three rating agencies. Prior literature uses multiple rating agencies to examine whether existing home bias of sovereign ratings (Öztürk, 2014; Fuchs and Gehring, 2017; Yalta and Yalta, 2018) and this paper focuses on the sovereign rating quality.

² Reinhart (2002) examine the linkages between crises, default, and rating changes for anywhere between 46 to 62 countries. The results suggest that sovereign credit ratings systematically fail to anticipate currency crises-but do considerably better predicting defaults. Downgrades usually follow the currency crisis-possibly highlighting how currency instability increases default risk.

³ Balima and Sy (2021) studies the role of IMF-supported programs in mitigating the likelihood of subsequent sovereign defaults in borrowing countries. Using a panel of 106 developing countries from 1970 to 2016 and an entropy balancing methodology, they find that IMF-supported programs significantly reduce the likelihood of subsequent sovereign defaults.

⁴ Nguyen, Castro and Wood (2020) use the sovereign defaults database of the CRAG. They assess the role of the political environment in the timing of financial crises over a sample of 85 countries during the period 1975–2017. They consider systemic banking, currency and sovereign debt crises in addition to twin and triple crises. The results show time in office of incumbent chief executives reduces the likelihood of any type of financial crises. The incidence of twin and triple crises is lower when majority governments are in office.

Third, prior literature examines whether sovereign ratings of Big Three ratings agencies can explain government bond yield spread (Sy, 2004; Afonso et al., 2012; Gande and Parsley, 2005; Ferreira and Gama, 2007; Williams et al., 2013; Kim and Wu, 2011; Christopher et al., 2012). This paper checks whether the information effect has changed considering ESMA's regulatory reforms and increased competition. Besides, this paper considers sovereign defaults and bond yield spreads to measure the information effects of sovereign ratings.

The remainder of the current paper is organized into seven sections. Following the introduction, Section 2 describes the institutional background and regulatory reforms. Section 3 outlines the literature review. Section 4 presents the econometric model. Section 5 focuses on the data resources and the descriptive statistical analysis. This section also indicates the empirical results of the investigation. Section 6 concludes the paper.

2. Institutional background and regulatory reforms

2.1 Institutional background

Credit rating agencies are private companies that assess the default risk of bonds of all types. There are about 150 agencies operating in the rating business worldwide (White 2010; De Haan and Amtenbrink 2011). Of these, most agencies are active in a narrow national or regional market and focus solely on corporate ratings. Only a small number of agencies issue sovereign ratings. We are able to identify eight agencies that provide sovereign ratings for at least 25 sovereigns: Standard & Poor's (S&P), Moody's Investors Service (Moody's), Fitch Ratings (Fitch), Dominion Bond Rating Services (DBRS), Scope Euro Rating Services (Scope), Japan Credit Rating Agency (JCR), Rating and Investment Information (R&I) and Dagong Global (Dagong). These eight agencies are based in five countries and the company information is as shown in the Table below.

Big-Three and Non-Big-Three rating agencies

Agency	Short name	HQ locations	Founded	Sovereign ratings since	Registered in
Standard and Poor's	S&P	New York City, USA	1922	1922	EU, Japan, USA
Moody's Investors Service	Moody's	New York City, USA	1918	1918	EU, Japan, USA
Fitch Ratings	Fitch	New York City, USA; London, UK	1994	1994	EU, Japan, USA
Dominion Bond Rating Services	DBRS	Toronto, Canada	1998	1998	EU, USA
Scope Ratings	Scope	Berlin, Germany	1999	1999	EU
Japan Credit Rating Agency	JCR	Tokyo, Japan	1998	1998	EU, Japan, USA
Rating and Investment Information, Inc.	R&I	Tokyo, Japan	1998	1998	Japan
Dagong Global Credit Rating Co.	Dagong	Beijing, China	1994	2010	EU, China

2.2 Regulatory reforms

The most effective way of fighting oligopoly is to reduce barriers of entry.⁵ The recent crises exposed all weaknesses related to the rating agencies position in the financial system and made clear that system-wide reforms were needed. In the US, it led to the introduction of Dodd-Frank Act Wall Street Reform and Consumer Protection Act in 2010, which brought significant changes to the financial services industry. Improvements to the regulations of credit rating agencies were among them. In 2017, there were 10 rating agencies registered as NRSROs in the US, eight of them were US-based, one from Mexico and one from Japan.

⁵ In the US, an important barrier was removed in 2006, when the list of requirements for NRSRO designation was finally introduced. Further reforms – the Dodd-Frank Act and CRA3 in the EU – reduced any reference to the NRSRO or any other specific agencies and encouraged internal credit assessment. The main goal was to let other competitors to gain market share and reduce dominance of the “Big Three”.

In the EU, the financial crisis was followed by the deep sovereign debt crisis, so legislators and public opinion were more concerned about public finance sector. New rules were introduced in 2009 and subsequently revised in 2011 and 2013, after a series of sovereign ratings' downgrades (Bayar, 2014). In Europe, only ESMA-accredited rating agencies can issue ratings. The supervisor, ESMA, is the guardian of the Regulation Framework and in particular Regulation (EC) 1060/2009 of the European Parliament and of the Council of 16 September 2009 on Credit Rating Agencies.

EU credit rating agency regulatory initiatives aim at reducing conflicts of interest, overreliance on ratings and spillover effects, while increasing independence and soundness of rating processes and improving quality of rating methodologies and ratings (ECB, 2012). When assessing the equivalence of non-EU countries, the rules incorporate all provisions of the EU credit rating agency Regulation. The equivalence in quality of ratings and methodologies (supported by the identifiers) should help to protect financial market stability. High quality ratings lead to improved efficiency of capital markets and improve transparency and competition (ESMA, 2011b). ESMA believe that endorsing ratings from non-EU countries enables supervisory integration of the rating agencies. Greater co-operation between outside supervisors benefits the functioning of financial markets and protects investors in the EU (ESMA, 2011a). According to the EC, a rating agency operating in a non-EU country needs to conform to the EU level of supervisory expectations. The usage of rating identifiers differentiates between ratings assigned inside/outside the EU. The regulators try to ensure that, in the current framework, "users of ratings in the EU would benefit from equivalent protections in terms of a credit rating agency's integrity, transparency, good governance and reliability" (ESMA, 2017a).

All ratings for EU registered and authorised rating agencies will be published on the central European Rating Platform which will improve the visibility and comparability of credit ratings from debt instruments. The Platform will also contribute to the visibility of small and medium-sized credit rating agencies operating in the EU

3. Literature reviews

3.1 The split and bias of sovereign ratings

Prior literature investigates the determinants of sovereign ratings (Hu et al., 2002; Alexe et al., 2003; Bissoondoyal-Bheenick et al., 2005; Bennell et al., 2006; Afonso et al., 2011) and whether existing the phenomenon of split sovereign ratings and the determinants of split sovereign ratings (Cantor and Packer, 1996; Alsakka and ap Gwilym, 2012; Hill, Brooks and Faff, 2010; Vu, Alsakka and ap Gwilym, 2018; Alsakka and ap Gwilym, 2010). However, they do not examine the sovereign rating quality and which rating agency has better sovereign rating quality.

For example, Cantor and Packer (1996) emphasize the prevalence of split sovereign ratings, but they do not investigate the causes. Alsakka and ap Gwilym (2012) examine some possible causes of split sovereign ratings and use emerging markets sample. They find that rating agencies use different quantitative factors and place different weights on these factors. Hill, Brooks and Faff (2010) find that rating agencies disagree more often than they agree about the rating of a sovereign obligor, however, disagreement tends to be within one or two notches on the finer scale. They find considerable divergence of opinion in respect of ratings at the time of documented sovereign defaults.

The second strand suggest that sovereign ratings are bias toward the home country of rating agencies.⁶ For example, Fuchs and Gehring (2017) empirically investigate if there is systematic evidence for a home bias in sovereign ratings. They conclude that rating agencies assign higher ratings not only to their respective home countries but also to those countries that are economically, geopolitically and culturally aligned with them. Yalta and Yalta (2018) investigate claims of regional bias in the sovereign ratings given by the rating agencies Fitch, Moody's and S&P's by considering 99 countries categorized into eight regions plus the United States. Empirical results indicate a strong home country bias towards the United States, while there seem to be no special

⁶ The European Commission President (Reuters, 2011), the Russian Finance Minister (The Telegraph, 2015), the Chinese Finance Minister (Bloomberg, 2016), the Turkish President (Reuters, 2016) and India's chief economic advisor (The Times of India, 2017) have all alleged that the rating agencies were biased against their home countries.

biases against individual groups of countries. On the other hand, Öztürk (2014) argues that the apparently biased behavior of rating agencies can be attributable to ignorance of institutional factors in the empirical analyses, suggesting that improved quality of institutions would greatly stimulate higher credit ratings. By contrast, Amstad and Packer (2015) compare sovereign credit ratings before and after the global financial crisis and do not find support for bias against emerging market economies.

3.2 Effects of regulation and competition on rating quality

Most previous studies assessing the impact of regulatory initiatives on the quality of ratings focus on US regulations. Also, the existing empirical evidence on the effects of regulation on rating agencies considers non-sovereign ratings and takes the perspective of changing competition between rating agencies. This plan uses sovereign ratings and consider the ESMA's regulatory reforms since the European debt crisis is highly related with sovereign credit ratings.

Prior studies assessing the impact of regulatory initiatives on the quality of ratings focus on US regulations (see Behr et al., 2018; Bongaerts, Cremers, and Goetzmann, 2012; Dimitrov et al., 2015; Doherty, Kartasheva, and Phillips, 2012). In addition, most prior research addresses time periods before the EU regulatory regime was introduced. For instance, Behr et al. (2018) use a data sample between 1973 and 1982, Bongaerts et al. (2012) utilize a sample for 2002 to 2008, and Doherty et al.'s (2012) sample is from 1989 to 2000. Becker and Milbourn (2011) apply a sample from 1995 to 2006 whereas Kisgen and Strahan (2010) use the period between 2001 and 2005.

The existing empirical evidence on the effects of regulation on rating agencies considers non-sovereign ratings and takes the perspective of changing competition between rating agencies (Bae et al., 2015; Behr et al., 2018). Bolton et al. (2012) and Dimitrov et al. (2015) suggest that the overall quality of ratings drops with increased competition. Bolton et al. (2012) conclude that increased competition between rating agencies might lead to increased rating shopping and a consequent reduced wealth effect. Studying the entry of new rating agencies into structured ratings, Flynn and Ghent (2018) find that entrant rating agencies issue higher ratings than the incumbent firms, a strategy used to win business. This results in rating shopping on the part of issuers. In contrast, Doherty et al. (2012) study insurance ratings and find that the new entrant rating agencies chooses higher standards than the incumbent companies. They conclude that increased competition results in improved precision of default rate estimates. Similarly, Bae et al. (2015) cast doubt on the view that competition leads to inflated ratings in the corporate bond market.

Using a global dataset of sovereign ratings assigned by S&P, Moody's, Fitch and DBRS during 2000-2016, Vu, Alsakka, ap Gwilym (2018) find that S&P and Moody's inflate (deflate) their ratings in response to the increase in Fitch's (DBRS's) market share in the previous year. DBRS employs a generous rating policy to succeed in this market. Imposing a regulatory pressure on rating agencies weakens their motivation to inflate ratings to win market shares.

3.3 The information effect of sovereign credit ratings

Rating signals are treated as events which trigger responses from market participants. Prior literature examines whether sovereign ratings of Big Three ratings agencies can explain government bond yield spread. This plan checks whether the information effect has changed considering ESMA's regulatory reforms and increased competition and we consider sovereign defaults and bond yield spreads to measure the information effects of sovereign ratings.

Sovereign credit signals have an effect on various asset classes including credit derivatives, bonds, equity and foreign exchange. Many studies detect significant market reactions to negative signals, while the reactions to positive signals are either muted or negligible (e.g. Sy, 2004; Afonso et al., 2012). The information value of rating agencies' credit opinions is significant even after controlling for sovereign credit spreads and country fundamentals (Cavallo et al., 2013). In addition, the effect of sovereign rating events is transferred from country to country due to strengthening global market linkages (Gande and Parsley, 2005; Ferreira and Gama, 2007), as well as from sovereign issuers to sub-sovereign issuers due to the sovereign ceiling effect (Williams et al., 2013). Sovereign credit signals also affect the international bank flows to emerging countries and the stock and bond

market correlations with their respective regional markets (Kim and Wu, 2011; Christopher et al., 2012).

The empirical results also suggested that the relative importance of capital market in terms of price discovery can vary substantially across entities. Cantor and Parker (1996) found that ratings changes give impact on bond return (yield) follow by Kaminsky and Schmukler (2002) that supported sovereign rating announcements have relationship with bond market returns. Pukthuanthong-Le et al. (2007) studies the relationship of sovereign rating changes and return of stock and bond market. They indicate that downgrades of ratings give negative impact on both bond and stock market, whereas positive returns only occur in bond market when there are upgrades announcements. Additionally, authors identified that downgrades of sovereign rating showed significant negative impact in countries which are high inflation and low current account.

4. Econometric model

This paper tries to investigate the sovereign rating quality of Big Three rating agencies and whether the sovereign rating quality has improved considering regulatory reforms and competition.

4.1 The sovereign rating quality

First, we investigate the sovereign rating quality of Big Three rating agencies. Following the empirical literature, the quality of ratings is captured by the information content of ratings (Bae et al., 2015; Becker and Milbourn, 2011; Behr et al., 2018; Dimitrov et al., 2015). The quality is examined by testing whether the market is more aligned with ratings through default prediction and bond yields.

4.1.1 Using defaults as the dependent variables

The dependent variable is the occurrence of a sovereign debt crisis. This variable is taken from the database on government debt in default developed by the Credit Rating Assessment Group (CRAG) of the Bank of Canada. Since 2014, the Bank of Canada has maintained a comprehensive database of sovereign defaults to systematically measure and aggregate the nominal value of the different types of sovereign government debt in default. The database draws on previously published datasets compiled by various public and private sector sources. It combines elements of these, together with new information, to develop comprehensive estimates of stocks of government obligations in default. These include bonds and other marketable securities as well as bank loans and official loans, valued in US dollars, for the years 1960 to 2020 on both a country-by-country and a global basis.

We include two default (*DEFAULT*) measures. First, consistent with previous literature on sovereign defaults (Reinhart and Rogoff, 2011; Cruces and Trebesch, 2013), a default (*Default*) is defined when a debt service is not paid on the due or within a specified grace period, or when payments are not made within the time frame specified under a guarantee or absent an outright payment default. However, given that the final resolution with creditors following a sovereign default can be very lengthy, we follow Reinhart and Rogoff (2011) and consider only the first year of default as a crisis year. Second, we also include the log of default amount of the country in that year (*LogAmount*) as the dependent variables. The default amount is obtained from CARG database. It combines elements of previously published data sets compiled by various public and private sector sources., together with new information, to develop estimates of stocks of government obligations in default, including bonds and other marketable securities, bank loans, and official loans in default, valued in US dollars. The model is specified as follows:

$$DEFAULT_{i,t+1} = \beta_0 + \beta_1 RATING_{Big3_{i,t}} + \beta_o Control\ Variables + \varepsilon_{i,t} \quad (1)$$

where subscripts i and t denote the default dummy variable in country i at time t . $RATING_{Big3}$ represents the average ratings assigned by Big Three rating agencies, including S&P, Moody's and Fitch. A larger rating indicates a better rating. If the coefficient of $RATING_{Big3}$ is negative and significant, suggesting that sovereign ratings of Big Three rating agencies can explain sovereign default and the better the sovereign ratings and the lower the default probability and lower default amounts.

Regarding the control variables, our baseline regressions include similar covariates as Jorra (2012). First, the macroeconomic variables are included. Real GDP growth (*GDPG*): Real GDP growth rate. External debt-to-GDP (*EDS/GNI*): Ratio of external debt stocks to GNI. Trade openness-to-GDP (*TRADE/GDP*): Sum of exports and imports of goods and services measured as a share of GDP. Current account balance-to-GDP: Sum of net exports of goods and services, net primary income, and net secondary income as a share of GDP. Inflation rate (*Inflation*): Annual percentage change of the consumer price index. Unemployment rate (Unemployment), Unemployment total (% of total labor force) (national estimate). Private credit-to-GDP (*DCPS/GDP*): Domestic credit to private sector as a share of GDP. Reserves-to-debts (Reserves/Debt): Ratio of total reserves minus gold to imports of goods and services (% of total external debt).

Besides, we include other country-specific control variables. *Rule of Law*: Rule of Law: Estimate. *LISTN*: Listed domestic companies, total. *INDV*: Industry (including construction), value added (current US\$). *MC/GDP*: Market capitalization of listed domestic companies (% of GDP). *STV*: Stocks traded, total value (current US\$). We also include year dummies (*YEAR*) and country dummies (*COUNTRY*) to control for the country and year fixed effects.

4.1.2 Using bond yield spreads as the dependent variables

Following Bae et al. (2015), Becker and Milbourn (2011) and Behr et al. (2018), we use the information content of ratings represented by linkages between ratings and bond yield spreads as a measure of rating quality. Bond yield spreads (*BSpread*), in basis points, are calculated by taking the difference between the yield to maturity of the sovereign bond subject to the rating and the yield to maturity of the comparable US benchmark bond. The selection criteria include publicly placed, unsecured, straight sovereign bonds with fixed coupon, remaining maturity between 1 and 30 years and issued in US dollars. We exclude structured notes, inflation-linked notes, hybrid or dual-currency bonds and restructured debt. Only bonds with the pricing information available are retained. We match each sovereign bond with the benchmark bond based on the closest remaining maturity and coupon amount. First, we measure government bond yield spread (*BSpread1*) by the differences between 10-year bond yield and three-month bond yield at the end of that year. Second, we measure government bond yield spread (*BSpread2*) by the differences between the average 10-year bond yields of that year and the average of three-month bond yields of that year. The model is specified as follow.

$$BSpread_{i,t+1} = \gamma_0 + \gamma_1 RATING_{Big3_{i,t}} + \gamma_o Control\ Variables + \varepsilon_{i,t} \quad (2)$$

If the coefficient of *RATING_{Big3}* is negative and significant, suggesting that sovereign ratings of Big Three rating agencies can explain government bond yield spreads and the better the sovereign ratings and the lower the yield spreads, representing that investors ask for lower risk premium.

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4.2 Whether the regulation reform has improved sovereign rating quality?

Second, we investigate whether the ESMA's regulation reforms have improved sovereign rating quality of Big Three rating agencies?

4.2.1 Using defaults as the dependent variables

The dependent variable is a dummy (*Default*) indicating the occurrence of a sovereign debt crisis. Besides, we also include the log of default amount of the country in that year (*LogAmount*) as the dependent variables. The model is specified as follows.

$$DEFAULT_{i,t+1} = \beta_0 + \beta_1 RATING_{Big3_{i,t}} + \beta_2 RATING_{Big3_{i,t}} \times D_{RegRef} + \beta_o Control Variables + \varepsilon_{i,t} \quad (3)$$

The D_{RegRef} indicator variable equals 1 after the ESMA endorsement rules took effect on 30 April 2012, and 0 otherwise. $RATING_{Big3} \times D_{RegRef}$, the key variable in this model, measures the linkage between ratings quality and ESMA's requirement for identifiers by observing the impact of rating actions upon defaults in the post-intervention period. The magnitude of rating events' impact on the default in the post-intervention period is calculated by summation of the coefficient values of $RATING_{Big3}$ and $RATING_{Big3} \times D_{RegRef}$. If the coefficient of β_1 and $\beta_1 + \beta_2$ are both significantly negative and the absolute value of magnitude of $\beta_1 + \beta_2$ is larger than β_1 , suggesting that the sovereign rating quality of Big Three rating agencies has improved after ESMA's regulatory reforms.

4.2.2 Using bond yield spreads as the dependent variables

If ESMA's aims are to be achieved, we hypothesize that the link between rating changes and bond yield spreads should strengthen after the introduction of the ESMA's reforms in April 2012. The model is specified as follows.

$$BSpread_{i,t+1} = \gamma_0 + \gamma_1 RATING_{Big3_{i,t}} + \gamma_2 RATING_{Big3_{i,t}} \times D_{RegRef} + \gamma_o Control Variables + \varepsilon_{i,t} \quad (4)$$

The coefficient γ_1 resembles the effect of comprehensive ratings of Big Three rating agencies ($RATING_{Big3}$) on yield spreads. The magnitude of rating impact of Big Three rating agencies on the bond spread in the post-identifier period is calculated by summation of the coefficient values of $RATING_{Big3}$ and $RATING_{Big3} \times D_{RegRef}$. If the coefficient of γ_1 and $\gamma_1 + \gamma_2$ are both significantly negative and the absolute value of magnitude of $\gamma_1 + \gamma_2$ is larger than γ_1 , suggesting that the sovereign rating quality of Big Three rating agencies has improved after ESMA's regulatory reforms.

4.3 Whether competition has improved sovereign rating quality?

Third, we investigate whether competition has improved sovereign rating quality of Big Three rating agencies? We consider the competition from non-Big Three rating agencies.

4.3.1 Using default as the dependent variables

In this section, we test whether a rating agency facing peer pressure will assign a more accurate sovereign rating. If so, the rating can explain default better. The dependent variable is a dummy (*Default*) indicating the occurrence of a sovereign debt crisis. Besides, we also include the log of default amount of the country in that year (*LogAmount*) as the dependent variables. The model is specified as follows.

$$DEFAULT_{i,t+1} = \beta_0 + \beta_1 RATING_{Big3_{i,t}} + \beta_2 RATING_{Big3_{i,t}} \times D_{nonBig3_{i,t}} + \beta_o Control Variables + \varepsilon_{i,t} \quad (5)$$

$D_{nonBig3}$ is a dummy and represents that the sovereign is also rated by another non-Big Three rating agency. When β_2 (the coefficient of $RATING_{Big3} \times D_{nonBig3}$) is significantly negative, suggesting that the Big Three rating agency will improve its sovereign rating quality when it faces the other non-Big Three agencies' competition.

4.3.2 Using bond yield spreads as the dependent variables

This section uses government bond yield spreads to examine the effect of competition on rating quality. The model is specified as follow.

$$BSpread_{i,t+1} = \beta_0 + \beta_1 RATING_{Big3,i,t} + \beta_2 RATING_{Big3,i,t} \times D_{nonBig3,i,t} + \beta_o Control\ Variables + \varepsilon_{i,t} \quad (6)$$

When the coefficient of $RATING_{Big3} \times D_{nonBig3}$ is significantly negative, suggesting that the Big Three rating agency will improve its sovereign rating quality when it faces the other non-Big Three agency's competition.

5. Empirical results

5.1 Data and basic statistics

First, the data of default occurrences and default amounts is obtained from Credit Rating Assessment Group (CRAG) of the Bank of Canada. Next, the data of government bond yield to maturity is obtained from Datastream database. Third, we collect the long-term foreign-currency sovereign issuer ratings from each rating agency's website. Fourth, the macroeconomic variables are collected from the World Bank database and other country-specific variables are collected from the Datastream database. Table 1 presents the names, definitions, and sources of the variables.

Table 1 Variable definitions and data resources

Variable names	Definitions	Resources
<i>Default</i>	A default (<i>Default</i>) is defined when a debt service is not paid on the due or within a specified grace period, or when payments are not made within the time frame specified under a guarantee or absent an outright payment default. However, given that the final resolution with creditors following a sovereign default can be very lengthy, we follow Reinhart and Rogoff (2011) and consider only the first year of default as a crisis year.	Credit Rating Assessment Group (CRAG) of the Bank of Canada
<i>Log Amount</i>	The log of default amount of the country in that year (<i>LogAmount</i>).	
<i>BSpread1</i>	Bond yield spreads (<i>BSpread1</i>), in basis points, are calculated by taking the difference between the yield to maturity of the sovereign bond subject to the rating and the yield to maturity of the comparable US benchmark bond. we measure government bond yield spread by the differences between 10-year bond yield and three-month bond yield at the end of that year.	DataStream database
<i>BSpread2</i>	Bond yield spreads (<i>BSpread2</i>) measure government bond yield spread by the differences between the average 10-year bond yields of that year and the average of three-month bond yields of that year.	
<i>RATING_{Big3}</i>	We convert the long-term alphanumeric ratings into 22 numerical ratings. (AAA (Aaa) = 22, AA+ (Aa1) = 21, AA (Aa2) = 20, ..., CC (Ca) = 3, C = 2 and D(SD) = 1). We use the average numerical ratings of the big three rating agencies: Standard & Poor's (S&P), Moody's Investors Service (Moody's) and Fitch Ratings (Fitch).	Big three rating agencies' websites
<i>RATING_{nonBig3}</i>	We convert the long-term alphanumeric ratings into 22 numerical ratings. (AAA (Aaa) = 22, AA+ (Aa1) = 21, AA (Aa2) = 20, ..., CC (Ca) = 3, C = 2 and D(SD) = 1). We use the average numerical ratings of the five agencies are Dominion Bond Rating Services (DBRS), Scope Euro Rating Services (Scope), Japan Credit Rating Agency (JCR), Rating and Investment Information (R&I), and Dagong Global (Dagong).	Rating agencies' websites
<i>GDPG</i>	GDP growth (annual %)	
<i>CAB/GDP</i>	Current account balance (% of GDP)	World bank database
<i>TRADE/GDP</i>	Sum of exports and imports of goods and services measured as a share of GDP (% of GDP)	

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<i>EDS/GNI</i>	External debt stocks (% of GNI)	
<i>Inflation</i>	Inflation, GDP deflator (annual %)	
<i>Unemployment</i>	Unemployment, total (% of total labor force) (national estimate)	
<i>Reserves/Debt</i>	Total reserves (% of total external debt)	
<i>DCPS/GDP</i>	Domestic credit to private sector (% of GDP)	
<i>Rule of Law</i>	Rule of Law: Estimate	
<i>LISTN</i>	Listed domestic companies, total	
<i>INDV</i>	Industry (including construction), value added (current US\$)	DataStream database
<i>MC/GDP</i>	Market capitalization of listed domestic companies (% of GDP)	
<i>STV</i>	Stocks traded, total value (current US\$)	

Table 2 illustrates the numbers of sovereign ratings of each rating agencies. Big Three rating agencies assign more sovereign ratings than non-Big Three rating agencies.

Table 2 The numbers of sovereign credit ratings of each rating agencies

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
S&P	83	86	89	95	101	103	107	111	115	114	117	119	119	119	118	119	118	119	121	122	120
Moody's	95	96	95	96	97	98	100	104	105	104	108	110	115	118	121	123	125	128	128	133	133
Fitch	68	70	77	82	86	91	96	100	100	100	103	104	100	101	103	108	109	104	104	106	106
DBRS	0	0	1	1	1	1	4	6	7	7	11	19	23	27	29	31	35	37	35	35	36
JCR	11	13	15	15	15	16	17	18	18	18	18	18	18	18	18	32	32	33	32	35	34
R&I	23	29	29	30	31	32	32	33	37	37	39	39	41	40	41	41	42	42	42	42	42
Dagong	0	0	0	0	0	0	0	0	0	0	0	2	38	92	93	94	94	91	91	0	0
Scope	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	34	30	16

Table 3 presents the average scores of sovereign ratings of each rating agencies at each year. The patterns are different between Big Three agencies and non-Big Three rating agencies. For Big Three rating agencies, using the univariate results, the year 2008 seems to be a watershed that divides the ratings into two groups. Prior to 2008, the average of sovereign ratings is stable and reaches its peak in 2007. Post-2008, the average ratings are decreasing. This range is consistent with the claim that a more stringent rating standard occurs after the crisis. However, the average ratings of non-Big Three agencies show a stable trend even post 2008.

Table 3 The average level of sovereign ratings of each rating agencies at each year

YEAR	S&P	Moody's	Fitch	Big Three	DBRS	JCR	R&I	Dagong	Scope	non-Big Three
2000	14.86	14.14	15.28	14.03		18.73	15.96			16.79
2001	14.72	14.22	15.03	14.13		19.23	16.86			17.26
2002	14.65	14.64	14.83	14.20	22.00	18.40	16.66			17.18
2003	14.58	14.85	14.65	14.16	22.00	18.60	16.57			17.11
2004	14.36	14.82	14.66	13.92	22.00	18.73	16.94			17.42
2005	14.54	14.85	14.55	13.96	22.00	18.50	17.25			17.61
2006	14.47	14.99	14.40	13.91	15.75	18.82	17.63			17.74
2007	14.60	14.91	14.52	13.97	14.00	18.67	18.00			17.63
2008	14.25	14.82	14.28	13.77	13.57	18.67	18.00			17.59
2009	14.29	14.80	14.34	13.87	13.71	18.72	17.92			17.50
2010	14.22	14.60	14.16	13.72	15.73	18.61	17.33			16.93
2011	13.94	14.17	13.91	13.46	17.95	18.67	17.18	15.00		16.96
2012	13.70	13.80	13.68	13.32	18.43	18.50	16.63	14.95		15.77
2013	13.61	13.56	13.55	13.18	17.44	18.56	17.00	14.39		14.57

2014	13.52	13.50	13.49	13.19	17.52	18.56	16.68	14.24		14.46
2015	13.36	13.36	13.30	12.98	17.45	18.44	16.56	14.14		14.45
2016	13.26	13.06	13.23	12.80	17.71	18.47	16.71	14.04		14.41
2017	13.24	12.85	13.53	12.89	17.86	18.52	16.76	14.07	17.28	14.54
2018	13.17	12.81	13.51	12.84	18.20	18.59	16.93	14.08	17.21	14.64
2019	13.22	12.64	13.40	12.72	18.17	18.63	17.19		17.13	16.95
2020	12.93	12.47	13.04	12.37	18.11	18.74	17.38		16.13	17.13
ALL	13.92	13.90	13.99	13.45	17.60	18.61	17.07	14.21	17.05	15.88

Table 4 is the mean test. The results show the Big Three agencies' average sovereign ratings are significantly lower than non-Big Three rating agencies, which are 15.68 and 16.00, respectively. The S&P average sovereign ratings are significantly lower than the other rating agencies, except Dagong. S&P's average rating is higher than Dagong for 0.247 notches. The average rating notch is lower than JCR for 0.83 notch, R&I for 0.43 notch,

DBRS for 0.282 notch and Scope for 0.17 notch. The notch gaps are smaller between S&P and another two Big Three rating agencies, i.e., Moody's and Fitch. However, the average rating notch is still lower than Moody's for 0.44 notch and Fitch for 0.61 notch, respectively. The results are similar for Moody's. Moody's average sovereign ratings are significantly lower than DBRS (0.419), JCR (0.753), R&I (0.467) and Scope (0.563). The exception is Dagong. Moody's average rating is higher than Dagong for 0.232 notches. The notch gap is insignificant between Moody's and Fitch, although Moody's average rating notch is still higher than Fitch for 0.019 notches. The results are similar for Fitch. Fitch's average sovereign ratings are significantly lower than DBRS (0.320), JCR (0.823), R&I (0.452) and Scope (0.205). The exception is Dagong. Fitch's average rating is higher than Dagong for 0.272 notches.

Table 4 The mean test

Rating agency	Rating agency	Obs.	Mean	Mean	Diff	t-value
S&P	Moody's	2054	14.25	14.30	-.044*	-1.874
	Fitch	1819	14.42	14.48	-.061***	-3.128
	DBRS	344	17.32	17.60	-.282***	-5.834
	JCR	441	17.79	18.62	-.830***	-12.843
	R&I	752	16.71	17.14	-.430***	-9.885
	Dagong	534	14.60	14.36	.247***	2.664
	Scope	112	16.88	17.05	-.170*	-1.648
Moody's	Fitch	1775	14.58	14.57	.019	.749
	DBRS	341	17.18	17.60	-.419***	-6.815
	JCR	438	17.87	18.62	-.753***	-10.156
	R&I	745	16.63	17.10	-.467***	-10.033
	Dagong	556	14.75	14.52	.232***	2.686
	Scope	112	16.49	17.05	-.563***	-5.992
Fitch	DBRS	341	17.28	17.60	-.320***	-6.748
	JCR	429	17.81	18.63	-.823***	-12.431
	R&I	736	16.63	17.09	-.452***	-10.922
	Dagong	497	14.79	14.52	.272***	2.647
	Scope	112	16.85	17.05	-.205**	-2.221
Big Three	Non-Big Three	1194	15.68	16.00	-.314***	-7.090

Table 5 illustrates the summary statistics for all of the variables.

Table 5 The basic statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
<i>Default</i>	4,557	0.452	0.498	0.000	1.000
<i>LogAmount</i>	4,557	0.897	1.280	0.000	5.495
<i>BSpread1</i>	854	3.236	3.666	-4.230	35.468
<i>BSpread2</i>	856	3.268	3.552	-4.210	23.956
<i>RATING_{Big3}</i>	2,723	13.449	5.287	1.000	22.000
<i>RATING_{nonBig3}</i>	1,224	15.866	5.002	1.000	22.000
<i>GDPG</i>	4,449	3.226	5.733	-62.076	123.140
<i>CAB/GDP</i>	3,791	-2.374	14.847	-73.047	311.761
<i>DCPS/GDP</i>	3,489	50.392	44.055	0.000	304.575
<i>TRADE/GDP</i>	3,967	90.800	58.708	0.785	863.195
<i>Inflation</i>	4,447	7.430	44.249	-30.200	2630.123
<i>Unemployment</i>	4,114	8.254	6.246	0.100	37.250
<i>EDS/GNI</i>	2,620	54.770	47.124	0.141	610.452
<i>Reserve/Debt</i>	2,354	71.256	228.646	0.009	3840.105
<i>Rule of Law</i>	4,036	-0.023	0.996	-2.606	2.130
<i>LISTN</i>	1,737	4.967	1.673	0.000	8.886
<i>INDV</i>	4,160	22.465	2.627	13.755	29.348
<i>MC/GDP</i>	1,581	67.454	120.476	0.009	1768.803
<i>STV</i>	1,658	22.894	3.841	10.309	31.486

Table 6 is the correlation coefficient matrix. The results show the correlation between sovereign ratings of Big Three and non-Big Three rating agencies and default probability (amounts) are significantly negative, suggesting that higher rating level and lower default probability (amounts). Besides, the correlation between sovereign ratings of Big Three and non-Big Three rating agencies and bond yield spreads are also significantly negative, suggesting that higher rating level and lower bond yield spread.

Table 6 Correlation coefficient matrix

		<i>Default</i>	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
<i>LogAmount</i>	(1)	0.692																	
<i>BSpread1</i>	(2)	0.492	0.426																
<i>BSpread2</i>	(3)	0.529	0.418	0.957															
<i>RATING_{Big3}</i>	(4)	-0.437	-0.371	-0.514	-0.590														
<i>RATING_{nonBig3}</i>	(5)	-0.460	-0.487	-0.517	-0.581	0.894													
<i>GDPG</i>	(6)	-0.188	-0.089	-0.399	-0.426	0.286	0.229												
<i>CAB/GDP</i>	(7)	-0.157	-0.277	-0.593	-0.548	0.340	0.421	0.392											
<i>DCPS/GDP</i>	(8)	-0.178	-0.178	-0.267	-0.293	0.624	0.669	0.193	0.147										
<i>TRADE/GDP</i>	(9)	-0.173	-0.284	-0.373	-0.380	0.110	0.097	-0.062	0.280	-0.044									
<i>Inflation</i>	(10)	0.264	0.258	0.483	0.532	-0.360	-0.332	-0.126	-0.239	-0.080	-0.183								
<i>Rule of Law</i>	(11)	-0.066	-0.149	0.025	0.038	-0.010	0.114	-0.132	-0.277	0.341	-0.080	0.149							
<i>Unemployment</i>	(12)	-0.012	-0.118	0.116	0.140	0.007	0.109	-0.318	-0.249	0.532	-0.054	0.231	0.606						
<i>INDV</i>	(13)	-0.282	-0.201	-0.234	-0.265	0.647	0.629	0.356	0.295	0.372	-0.416	-0.093	-0.114	-0.255					
<i>MC/GDP</i>	(14)	-0.054	-0.164	0.039	0.053	0.109	0.257	-0.095	-0.112	0.527	-0.063	0.120	0.554	0.818	-0.155				
<i>STV</i>	(15)	-0.151	-0.187	-0.137	-0.138	0.469	0.578	0.371	0.357	0.470	-0.421	0.114	0.165	0.083	0.777	0.253			
<i>LISTN</i>	(16)	-0.254	-0.263	-0.371	-0.376	0.343	0.500	0.493	0.405	0.366	-0.097	-0.073	0.347	-0.101	0.561	0.123	0.691		
<i>EDS/GNI</i>	(17)	0.132	-0.058	0.121	0.145	-0.356	-0.335	-0.408	-0.110	-0.200	0.658	0.025	0.059	0.103	-0.577	-0.132	-0.547	-0.331	
<i>Reserves/Debt</i>	(18)	-0.217	-0.139	-0.454	-0.489	0.634	0.599	0.603	0.620	0.472	-0.030	-0.213	-0.202	-0.264	0.586	-0.098	0.541	0.530	-0.462

5.2 Empirical results

5.2.1 Can sovereign ratings explain default probability and bond yield spread?

Table 7 reports the results of explanatory ability of sovereign ratings on default probability and amounts. In specifications (1) and (2) we use the dummy variable *Default* as the dependent variables and in specifications (3) and (4), we use the log of default amount of the country in that year (*LogAmount*) as the dependent variables. We consider the average sovereign rating levels of Big Three rating agencies, including S&P, Moody's and Fitch.

In Panel A, when considering the whole sample, the results show the coefficients of *RATING_{Big3}* are significantly negative in specifications (1) and (2), suggesting that the better Big Three agencies' sovereign ratings and the lower default probability of that country. The coefficients of *RATING_{Big3}* are also significantly negative in specifications (3) and (4), suggesting that the better Big Three agencies' sovereign ratings and the lower default amounts of that country.

In Panels B and C, we separate the sample into high-income and middle-income countries. The results are similar for high-income countries. The coefficients of *RATING_{Big3}* are still significantly negative for all specifications, suggesting that sovereign ratings of Big Three rating agencies can explain government default probability and default amounts. However, the results are different for middle-income countries. The coefficients of *RATING_{Big3}* are insignificant in specifications (1), (2) and (4) and only significantly negative in specification (3), suggesting that sovereign ratings of Big Three rating agencies cannot explain government default probability and default amounts in middle-income countries.

Table 8 reports the results of whether sovereign ratings can explain government bond yield spreads. In specifications (1) and (2), we measure government bond yield spreads by the differences between 10-year bond yield and three-month bond yield at the end of that year. In specifications (3) and (4), we measure government bond yield spreads by the differences between the average 10-year bond yields of that year and the average of three-month bond yields of that year.

In Panel A, when considering the whole sample, the results show the coefficients of *RATING_{Big3}* are significantly negative in all specifications, suggesting that the better sovereign ratings of Big Three rating agencies and the lower bond yield spreads. In Panels B and C, when we separating the sample into high-income and middle-income countries, the results are similar for high-income countries. The coefficients of *RATING_{Big3}* are still significantly negative in all specifications. The results suggest that sovereign ratings of Big Three rating agencies can explain government bond yield spreads. However, the results are different for middle-income countries. The coefficients of *RATING_{Big3}* are insignificant in specifications (1), (2) and (4), suggesting that sovereign ratings of Big Three rating agencies cannot explain government bond yield spreads in middle-income countries.

Table 7 Can sovereign ratings explain government default?

	<i>Panel A The whole sample</i>				<i>Panel B High-income countries sample</i>				<i>Panel C Middle-income countries sample</i>			
	(1) <i>Default</i>	(2) <i>Default</i>	(3) <i>LogAmount</i>	(4) <i>LogAmount</i>	(1) <i>Default</i>	(2) <i>Default</i>	(3) <i>LogAmount</i>	(4) <i>LogAmount</i>	(1) <i>Default</i>	(2) <i>Default</i>	(3) <i>LogAmount</i>	(4) <i>LogAmount</i>
<i>RATING_{Big3}</i>	-0.416** (-2.56)	-0.634* (-1.66)	-0.099*** (-3.97)	-0.088* (-1.89)	-0.307*** (-4.86)	-0.788*** (-3.69)	-0.071** (-2.03)	-0.116** (-2.09)	-0.199 (-0.76)	-0.701 (-1.40)	-0.098** (-2.54)	0.012 (0.18)
<i>GDPG</i>	-0.037 (-0.48)	-0.119 (-1.44)	-0.014*** (-2.94)	-0.004 (-0.39)	0.032 (0.48)	0.163*** (3.19)	-0.018* (-1.71)	-0.025* (-1.86)	-0.009 (-0.09)	-0.223 (-1.61)	-0.005 (-0.50)	0.014 (1.00)
<i>CAB/GDP</i>	-0.043 (-0.91)	-0.155* (-1.89)	0.006 (1.32)	0.002 (0.32)	0.022 (1.01)	0.002 (0.03)	0.002 (0.72)	-0.004 (-0.68)	-0.084* (-1.86)	0.065 (0.65)	0.004 (0.53)	-0.000 (-0.00)
<i>DCPS/GDP</i>	0.053* (1.96)	0.103** (2.43)	0.005*** (2.94)	0.006** (2.47)	0.019** (2.21)	0.017** (2.07)	0.002** (2.16)	0.002* (1.93)	0.034 (1.09)	0.188** (2.45)	0.009** (2.39)	0.011 (1.52)
<i>TRADE/GDP</i>	0.013 (0.61)	-0.035 (-1.41)	-0.000 (-0.01)	-0.002 (-1.26)	-0.013 (-1.43)	0.043*** (2.78)	-0.000 (-0.33)	0.001 (0.56)	0.025 (1.21)	-0.075 (-1.38)	-0.005 (-1.45)	-0.014*** (-2.70)
<i>Inflation</i>	0.021 (0.58)	0.016 (0.24)	0.000 (0.06)	-0.001 (-0.10)	-0.062** (-2.41)	0.052 (0.48)	-0.001 (-0.29)	0.002 (0.38)	0.017 (0.41)	-0.010 (-0.15)	0.001 (0.27)	-0.004 (-0.28)
<i>Rule of Law</i>	-1.117 (-0.91)	-3.407 (-1.13)	-0.101 (-0.77)	-0.421* (-1.86)	-1.092 (-1.30)	-0.270 (-0.12)	0.129 (1.55)	0.038 (0.30)	-1.859 (-1.44)	-4.110 (-1.32)	-0.383* (-1.76)	-1.281*** (-3.21)
<i>Unemployment</i>	0.007 (0.11)	-0.067 (-0.38)	-0.020* (-1.93)	-0.016 (-1.11)	-0.143 (-1.08)	-0.258** (-2.02)	0.006 (0.52)	0.003 (0.18)	0.029 (0.28)	-0.259 (-0.57)	-0.054*** (-2.78)	-0.077** (-2.02)
<i>INDV</i>		-3.378 (-1.26)		-0.164 (-0.82)		-0.788 (-0.58)		0.205 (1.09)		-3.208 (-1.06)		-0.071 (-0.26)
<i>MC/GDP</i>		-0.035** (-2.28)		0.000 (0.19)		-0.090*** (-3.23)		0.000 (0.22)		-0.040* (-1.86)		0.001 (0.32)
<i>STV</i>		0.965 (1.51)		-0.055 (-1.13)		1.331** (1.97)		-0.081 (-1.54)		1.429** (2.14)		-0.032 (-0.46)
<i>LISTN</i>		-5.261*** (-3.87)		-0.078 (-0.92)		2.309* (1.68)		-0.051 (-0.96)		-7.314*** (-3.46)		-0.174 (-0.94)
<i>EDS/GNI</i>									0.043** (2.53)	0.018 (0.40)	0.003 (1.13)	0.007** (2.08)
<i>Reserves/Debt</i>									0.001 (0.65)	-0.038*** (-2.97)	0.000*** (2.58)	-0.001 (-0.38)
<i>Constant</i>	1.601 (0.69)	94.985 (1.48)	1.423*** (4.12)	10.541** (2.28)	4.279** (2.39)	-15.171 (-0.91)	1.121 (1.40)	-0.579 (-0.18)	-4.708 (-1.33)	96.164 (1.23)	2.147*** (3.21)	8.114 (1.28)
<i>YEAR</i>	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
<i>COUNTRY</i>	YES	YES	YES	YES	NO	NO	YES	YES	YES	YES	YES	YES
Observations	1883	996	1883	996	803	536	803	536	922	428	922	428
adj. R-square	0.344	0.302	0.303	0.242	0.098	0.087	0.072	0.164	0.303	0.305	0.292	0.305

*, **, and *** denote significance at the 10%, 5%, and 1% levels respectively.

Table 8 Can sovereign ratings explain bond yield spread?

	<i>Panel A The whole sample</i>				<i>Panel B High-income countries sample</i>				<i>Panel C Middle-income countries sample</i>			
	(1) <i>Spread1</i>	(2) <i>Spread1</i>	(3) <i>Spread2</i>	(4) <i>Spread2</i>	(1) <i>Spread1</i>	(2) <i>Spread1</i>	(3) <i>Spread2</i>	(4) <i>Spread2</i>	(1) <i>Spread1</i>	(2) <i>Spread1</i>	(3) <i>Spread2</i>	(4) <i>Spread2</i>
<i>RATING</i> _{Big3}	-0.467** (-2.01)	-0.744** (-2.16)	-0.438*** (-3.04)	-0.633*** (-3.38)	-0.698** (-2.21)	-1.086*** (-2.61)	-0.571*** (-3.08)	-0.826*** (-3.75)	-0.247 (-1.00)	-0.019 (-0.06)	-0.409** (-2.22)	-0.291 (-1.25)
<i>GDPG</i>	-0.179** (-2.11)	-0.201** (-2.34)	-0.176*** (-3.26)	-0.198*** (-3.57)	-0.135 (-1.33)	-0.156* (-1.76)	-0.107** (-1.97)	-0.117*** (-2.69)	-0.121** (-2.32)	-0.167*** (-3.04)	-0.225*** (-4.36)	-0.268*** (-4.72)
<i>CAB/GDP</i>	-0.070** (-2.14)	-0.135*** (-2.69)	-0.026 (-0.99)	-0.075** (-2.28)	-0.033 (-0.81)	-0.118** (-2.29)	0.009 (0.29)	-0.054** (-2.12)	-0.127* (-1.93)	-0.311** (-2.37)	-0.094 (-1.63)	-0.251** (-2.16)
<i>DCPS/GDP</i>	0.016*** (3.07)	0.025*** (2.75)	0.014*** (2.81)	0.019** (2.26)	0.017*** (3.12)	0.027*** (2.80)	0.016*** (2.72)	0.022*** (2.84)	0.033 (1.15)	0.001 (0.03)	0.020 (0.81)	-0.009 (-0.31)
<i>TRADE/GDP</i>	-0.008 (-1.11)	0.002 (0.25)	-0.009 (-1.27)	-0.001 (-0.16)	-0.008* (-1.74)	-0.001 (-0.18)	-0.010** (-2.24)	-0.005 (-1.24)	0.011 (0.40)	0.019 (0.67)	0.007 (0.27)	0.017 (0.55)
<i>Inflation</i>	0.005 (0.15)	0.081* (1.77)	0.030 (0.73)	0.102* (1.88)	-0.062 (-1.16)	0.003 (0.07)	-0.003 (-0.07)	0.046 (1.00)	0.093* (1.94)	0.206*** (3.60)	0.100** (1.97)	0.187** (2.47)
<i>Rule of Law</i>	1.428 (1.25)	0.878 (0.69)	1.295 (1.22)	0.770 (0.70)	2.883** (2.39)	3.597** (2.77)	1.896** (2.49)	2.398*** (3.29)	-0.380 (-0.18)	-3.331* (-1.84)	0.802 (0.33)	-2.083 (-1.01)
<i>Unemployment</i>	-0.011 (-0.13)	-0.046 (-0.44)	0.057 (1.18)	0.054 (1.09)	-0.125 (-1.02)	-0.179 (-1.20)	-0.028 (-0.62)	-0.047 (-0.81)	0.139 (1.00)	0.200* (1.96)	0.187 (1.15)	0.237** (2.20)
<i>INDV</i>		1.385 (1.30)		1.250 (1.39)		1.851* (1.74)		1.362 (1.45)		0.849 (0.83)		1.346 (1.28)
<i>MC/GDP</i>		0.001 (1.24)		0.000 (0.16)		-0.000 (-0.02)		-0.000 (-0.65)		-0.007 (-0.76)		-0.007 (-0.55)
<i>STV</i>		-0.585** (-2.06)		-0.346 (-1.57)		-0.428** (-2.10)		-0.239* (-1.82)		0.447 (0.81)		0.621 (1.02)
<i>LISTN</i>		0.356 (1.30)		0.127 (0.47)		0.516 (1.17)		0.363 (1.05)		-1.147 (-1.00)		-1.764 (-1.47)
<i>Constant</i>	7.578* (1.75)	-9.538 (-0.38)	7.370*** (2.73)	-12.227 (-0.49)	10.860* (1.88)	-23.767 (-0.99)	9.701*** (3.01)	-18.275 (-0.76)	8.116** (2.60)	-20.447 (-0.67)	10.332*** (3.45)	-30.481 (-1.03)
<i>YEAR</i>	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
<i>COUNTRY</i>	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	738	578	739	578	509	373	510	373	229	205	229	205
adj. R-square	0.685	0.693	0.723	0.732	0.688	0.693	0.744	0.743	0.651	0.738	0.703	0.769

*, **, and *** denote significance at the 10%, 5%, and 1% levels respectively

5.2.2 Effect of regulatory reforms

Table 9 reports the effect of regulatory reforms on the relationship between sovereign ratings and defaults. In Panel A, when considering the whole sample, the coefficients of $RATING_{Big3}$ are significantly negative. The coefficients of $RATING_{Big3} \times D_{RegRef}$ are significantly positive in specifications (1) and (3). However, when we add more control variables, the coefficients of $RATING_{Big3} \times D_{RegRef}$ become insignificant in specifications (2) and (4), suggesting that explanatory ability of sovereign ratings of Big Three rating agencies on default probabilities and amounts does not significantly change after the regulatory reforms.

In Panel B, part of the results of high-income countries sample show the explanatory ability of sovereign ratings of Big Three rating agencies on default probabilities decreases after regulatory reforms. In Panel C, the results show the explanatory ability of sovereign ratings of Big Three rating agencies on default probability and default amounts does not significantly change after the regulatory reforms for middle-income countries.

Table 10 reports the effect of regulatory reforms on the relationship between sovereign ratings and bond yield spread. In Panel A, when considering the whole sample, the results show the effect of sovereign ratings on bond yield spread does not change after regulatory reforms for Big three rating agencies.

In Panel B, when considering high-income countries sample, the results are different with the whole sample. The coefficients of $RATING_{Big3} \times D_{RegRef}$ are significantly positive in $BSpread1$ specifications, suggesting the information effect of sovereign ratings of Big Three rating agencies on bond yield spread decreases after regulatory reforms. In Panel C, when considering middle-income countries sample, the results suggest the effect of sovereign ratings on bond yield spread does not change after regulatory reforms.

5.2.3 Effect of competition

Table 11 reports the effect of non-Big Three agencies' competition on the relationship between sovereign ratings of Big Three rating agencies and default probability and amounts. Panel A considers the whole sample and find all the coefficients of $RATING_{Big3} \times D_{nonBig3}$ are insignificant, suggesting that explanatory ability of sovereign ratings of Big Three rating agencies on default probability and amount does not change when Big Three agencies face non-Big Three agencies' competition.

In Panel B and C, the results of high-income countries and middle-income countries sample are similar with the whole sample. The results suggest that the explanatory ability of sovereign ratings of Big Three rating agencies on default probabilities and amounts does not change when facing the competition from non-Big Three rating agencies.

Table 12 reports the effect of competition on the relationship between sovereign ratings of Big Three rating agencies and bond yield spreads. In Panel A, when considering the whole sample, the results show the coefficients of $RATING_{Big3} \times D_{nonBig3}$ are all insignificant, suggesting the effect of sovereign ratings of Big Three rating agencies on bond yield spreads does not change when Big Three rating agencies face the competition form non-Big Three rating agencies. In Panel B, when considering high-income countries sample, the results show the coefficients of $RATING_{Big3} \times D_{nonBig3}$ are significantly positive for all specifications, suggesting the effect of sovereign ratings of Big Three rating agencies on bond yield spread decreases when Big Three rating agencies face the competition form non-Big Three rating agencies. In Panel C, when considering middle-income countries sample, the results show the coefficients of $RATING_{Big3} \times D_{nonBig3}$ are significantly negative in specifications (2) and (4), suggesting the effect of sovereign ratings of Big Three rating agencies on bond yield spreads increases when Big Three rating agencies face the competition form non-Big Three rating agencies.

Table 9 Does the ability of sovereign ratings explaining default improve after regulatory reforms?

	<i>Panel A The whole sample</i>				<i>Panel B High-income countries sample</i>				<i>Panel C Middle-income countries sample</i>			
	(1) <i>Default</i>	(2) <i>Default</i>	(3) <i>LogAmount</i>	(4) <i>LogAmount</i>	(1) <i>Default</i>	(2) <i>Default</i>	(3) <i>LogAmount</i>	(4) <i>LogAmount</i>	(1) <i>Default</i>	(2) <i>Default</i>	(3) <i>LogAmount</i>	(4) <i>LogAmount</i>
<i>RATING_{Big3}</i>	-0.565*** (-2.92)	-0.707 (-1.48)	-0.108*** (-4.25)	-0.100** (-2.13)	-0.427*** (-6.09)	-1.329*** (-6.21)	-0.072* (-1.77)	-0.116* (-1.65)	-0.382 (-1.28)	-0.699 (-1.18)	-0.102** (-2.64)	0.033 (0.58)
<i>RATING_{Big3} × D_{RegRef}</i>	0.293* (1.68)	0.122 (0.40)	0.020*** (2.65)	0.022 (1.52)	0.239*** (3.06)	0.721*** (2.94)	0.001 (0.11)	-0.000 (-0.01)	0.278 (1.37)	-0.003 (-0.01)	0.007 (0.32)	-0.026 (-0.66)
<i>GDPG</i>	-0.018 (-0.23)	-0.121 (-1.45)	-0.014*** (-2.82)	-0.007 (-0.66)	0.043 (0.63)	0.210*** (2.92)	-0.018* (-1.74)	-0.025* (-2.02)	-0.005 (-0.06)	-0.223* (-1.65)	-0.005 (-0.50)	0.016 (1.32)
<i>CAB/GDP</i>	-0.047 (-0.96)	-0.159* (-1.93)	0.006 (1.40)	0.003 (0.41)	0.025 (1.19)	-0.007 (-0.07)	0.003 (0.68)	-0.004 (-0.58)	-0.092* (-1.89)	0.065 (0.64)	0.004 (0.51)	0.001 (0.10)
<i>DCPS/GDP</i>	0.053** (2.04)	0.105** (2.41)	0.005*** (3.17)	0.006*** (2.61)	0.023*** (2.62)	0.032*** (2.78)	0.002** (2.08)	0.002* (1.70)	0.032 (1.05)	0.188** (2.46)	0.009** (2.34)	0.011 (1.57)
<i>TRADE/GDP</i>	0.011 (0.53)	-0.036 (-1.43)	-0.000 (-0.39)	-0.002 (-1.36)	-0.011 (-1.42)	0.052** (2.48)	-0.000 (-0.33)	0.001 (0.54)	0.027 (1.31)	-0.075 (-1.27)	-0.005 (-1.45)	-0.015*** (-2.82)
<i>Inflation</i>	0.021 (0.53)	0.007 (0.11)	-0.000 (-0.10)	-0.001 (-0.15)	-0.074*** (-2.82)	0.016 (0.09)	-0.001 (-0.28)	0.002 (0.33)	0.014 (0.34)	-0.010 (-0.13)	0.001 (0.27)	-0.004 (-0.28)
<i>Rule of Law</i>	-0.912 (-0.82)	-3.402 (-1.12)	-0.128 (-0.97)	-0.472** (-2.05)	-1.208 (-1.44)	-1.477 (-0.64)	0.125 (1.30)	0.038 (0.26)	-1.638 (-1.38)	-4.113 (-1.30)	-0.381* (-1.74)	-1.284*** (-3.19)
<i>Unemployment</i>	0.010 (0.14)	-0.045 (-0.22)	-0.020** (-2.03)	-0.015 (-1.02)	-0.111 (-0.83)	-0.199* (-1.67)	0.005 (0.48)	0.003 (0.18)	0.036 (0.34)	-0.260 (-0.53)	-0.055*** (-2.80)	-0.079** (-2.04)
<i>INDV</i>		-2.889 (-1.10)		-0.084 (-0.45)		-0.752 (-0.56)		0.205 (1.02)		-3.221 (-1.02)		-0.111 (-0.46)
<i>MC/GDP</i>		-0.035** (-2.26)		0.000 (0.27)		-0.095*** (-2.64)		0.000 (0.22)		-0.040* (-1.84)		0.001 (0.36)
<i>STV</i>		1.001 (1.61)		-0.051 (-1.06)		1.585** (1.97)		-0.081 (-1.63)		1.429** (2.15)		-0.042 (-0.53)
<i>LISTN</i>		-5.272*** (-3.87)		-0.080 (-0.98)		2.109 (1.55)		-0.051 (-0.90)		-7.315*** (-3.33)		-0.185 (-0.97)
<i>EDS/GNI</i>									0.040*** (2.83)	0.019 (0.40)	0.003 (1.15)	0.008** (2.11)
<i>Reserves/Debt</i>									0.002 (1.03)	-0.038*** (-3.15)	0.000** (2.29)	-0.001 (-0.58)
<i>Constant</i>	3.454 (1.36)	83.510 (1.35)	1.606*** (4.66)	8.614** (1.96)	5.683*** (2.72)	-12.710 (-0.76)	1.143 (1.20)	-0.577 (-0.16)	-2.770 (-0.83)	96.449 (1.13)	2.197*** (3.34)	9.183 (1.56)
<i>YEAR</i>	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
<i>COUNTRY</i>	YES	YES	YES	YES	NO	NO	YES	YES	YES	YES	YES	YES
Observations	1883	996	1883	996	803	536	803	536	922	428	922	428
adj. R-square	0.309	0.288	0.304	0.245	0.099	0.111	0.074	0.172	0.299	0.305	0.293	0.307

*, **, and *** denote significance at the 10%, 5%, and 1% levels respectively.

Table 10 Does the ability of sovereign ratings explaining bond yield spread improve after regulatory reforms?

	<i>Panel A The whole sample</i>				<i>Panel B High-income countries sample</i>				<i>Panel C Middle-income countries sample</i>			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	<i>Spread1</i>	<i>Spread1</i>	<i>Spread2</i>	<i>Spread2</i>	<i>Spread1</i>	<i>Spread1</i>	<i>Spread2</i>	<i>Spread2</i>	<i>Spread1</i>	<i>Spread1</i>	<i>Spread2</i>	<i>Spread2</i>
$RATING_{Big3}$	-0.465*	-0.777**	-0.411***	-0.629***	-1.053**	-1.551***	-0.626***	-0.911***	-0.218	-0.021	-0.406***	-0.295
	(-1.81)	(-2.10)	(-2.76)	(-3.36)	(-2.35)	(-3.69)	(-3.16)	(-5.82)	(-0.96)	(-0.07)	(-2.91)	(-1.30)
$RATING_{Big3} \times D_{RegRef}$	-0.005	0.102	-0.087	-0.015	0.442**	0.601***	0.069	0.110	-0.071	0.011	-0.007	0.021
	(-0.06)	(1.06)	(-1.59)	(-0.32)	(2.19)	(3.74)	(1.11)	(1.48)	(-0.39)	(0.08)	(-0.03)	(0.14)
$GDPG$	-0.179**	-0.203**	-0.172***	-0.198***	-0.105	-0.098**	-0.102*	-0.106**	-0.121**	-0.167***	-0.225***	-0.267***
	(-2.05)	(-2.41)	(-3.13)	(-3.55)	(-1.54)	(-2.49)	(-2.01)	(-2.61)	(-2.37)	(-3.09)	(-4.42)	(-5.01)
CAB/GDP	-0.071**	-0.126***	-0.034	-0.077**	0.055	-0.023	0.023	-0.037	-0.125*	-0.310**	-0.094	-0.249*
	(-2.26)	(-2.76)	(-1.31)	(-2.30)	(1.44)	(-0.96)	(0.89)	(-1.51)	(-1.86)	(-2.31)	(-1.60)	(-2.14)
$DCPS/GDP$	0.016***	0.026**	0.014***	0.019**	0.025**	0.036***	0.017***	0.023***	0.037	0.001	0.020	-0.009
	(2.86)	(2.57)	(2.77)	(2.25)	(2.52)	(3.45)	(2.74)	(3.36)	(1.21)	(0.02)	(0.69)	(-0.31)
$TRADE/GDP$	-0.008	0.003	-0.009	-0.001	-0.000	0.007	-0.009	-0.004	0.008	0.019	0.007	0.017
	(-1.11)	(0.33)	(-1.25)	(-0.17)	(-0.04)	(0.94)	(-1.65)	(-1.00)	(0.27)	(0.67)	(0.24)	(0.57)
$Inflation$	0.006	0.067	0.048	0.104*	-0.079	0.025	-0.006	0.050	0.096**	0.206***	0.101**	0.186**
	(0.15)	(1.36)	(1.21)	(1.91)	(-1.25)	(0.79)	(-0.14)	(1.17)	(2.11)	(3.51)	(2.05)	(2.41)
$Rule\ of\ Law$	1.437	0.553	1.457	0.817	1.818**	1.807**	1.730**	2.071**	-0.623	-3.308*	0.780	-2.037
	(1.34)	(0.49)	(1.41)	(0.72)	(2.40)	(2.06)	(2.34)	(2.54)	(-0.29)	(-1.70)	(0.31)	(-0.91)
$Unemployment$	-0.012	-0.034	0.055	0.052	-0.181*	-0.219***	-0.037	-0.055	0.130	0.202*	0.186	0.241**
	(-0.13)	(-0.39)	(1.09)	(1.05)	(-1.81)	(-2.72)	(-0.91)	(-1.15)	(0.88)	(1.89)	(1.16)	(2.34)
$INDV$		1.551		1.226		1.420		1.284		0.844		1.337
		(1.34)		(1.41)		(1.65)		(1.35)		(0.80)		(1.21)
MC/GDP		0.001		0.000		-0.000		-0.000		-0.007		-0.007
		(1.41)		(0.12)		(-0.34)		(-0.71)		(-0.76)		(-0.55)
STV		-0.603**		-0.344		-0.099		-0.179		0.445		0.618
		(-2.09)		(-1.55)		(-0.46)		(-1.50)		(0.80)		(1.01)
$LISTN$		0.331		0.130		-0.039		0.262		-1.119		-1.710
		(1.27)		(0.48)		(-0.07)		(0.70)		(-0.90)		(-1.35)
$Constant$	7.534	-12.098	6.618**	-11.861	19.523**	-5.711	11.044***	-14.977	7.747**	-20.441	10.298***	-30.469
	(1.51)	(-0.46)	(2.36)	(-0.49)	(2.09)	(-0.23)	(3.02)	(-0.59)	(2.65)	(-0.67)	(3.81)	(-1.02)
$YEAR$	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
$COUNTRY$	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	738	578	739	578	509	373	510	373	229	205	229	205
adj. R-square	0.685	0.693	0.726	0.732	0.727	0.761	0.746	0.750	0.655	0.739	0.705	0.769

*, **, and *** denote significance at the 10%, 5%, and 1% levels respectively.

Table 11 Does the ability of sovereign ratings explaining default improve facing competition from non-Big three agencies?

	<i>Panel A The whole sample</i>				<i>Panel B High-income countries sample</i>				<i>Panel C Middle-income countries sample</i>			
	(1) <i>Default</i>	(2) <i>Default</i>	(3) <i>LogAmount</i>	(4) <i>LogAmount</i>	(1) <i>Default</i>	(2) <i>Default</i>	(3) <i>LogAmount</i>	(4) <i>LogAmount</i>	(1) <i>Default</i>	(2) <i>Default</i>	(3) <i>LogAmount</i>	(4) <i>LogAmount</i>
<i>RATING_{Big3}</i>	-0.495** (-2.53)	-0.716 (-1.62)	-0.103*** (-4.04)	-0.092* (-1.93)	-0.643*** (-4.46)	-1.092*** (-3.05)	-0.074** (-2.02)	-0.121** (-2.07)	-0.285 (-1.01)	-0.814 (-1.57)	-0.102** (-2.55)	0.012 (0.18)
<i>RATING_{Big3} × D_{nonBig3}</i>	0.077 (1.25)	0.105 (1.38)	0.007* (1.92)	0.007 (1.47)	0.351*** (2.98)	0.430 (1.08)	0.003 (1.03)	0.005 (0.93)	0.087 (1.36)	0.141 (1.25)	0.009 (0.96)	-0.001 (-0.09)
<i>GDPG</i>	-0.031 (-0.39)	-0.109 (-1.25)	-0.013*** (-2.80)	-0.004 (-0.37)	0.034 (0.44)	0.164** (2.25)	-0.017* (-1.69)	-0.025* (-1.89)	-0.012 (-0.12)	-0.228 (-1.59)	-0.005 (-0.49)	0.014 (0.99)
<i>CAB/GDP</i>	-0.047 (-0.99)	-0.144* (-1.84)	0.006 (1.31)	0.003 (0.35)	0.031 (1.10)	0.085 (0.66)	0.003 (0.74)	-0.003 (-0.55)	-0.095** (-1.97)	0.047 (0.54)	0.004 (0.48)	0.000 (0.00)
<i>DCPS/GDP</i>	0.051** (2.00)	0.099** (2.40)	0.005*** (3.00)	0.006** (2.43)	0.026** (2.44)	0.027* (1.82)	0.002** (2.12)	0.002* (1.89)	0.032 (1.08)	0.188** (2.36)	0.009** (2.34)	0.011 (1.52)
<i>TRADE/GDP</i>	0.010 (0.48)	-0.035 (-1.46)	-0.000 (-0.15)	-0.002 (-1.34)	-0.011* (-1.72)	0.034** (2.05)	-0.000 (-0.43)	0.001 (0.55)	0.022 (1.06)	-0.084 (-1.33)	-0.005 (-1.47)	-0.014*** (-2.69)
<i>Inflation</i>	0.022 (0.59)	0.014 (0.19)	0.001 (0.15)	-0.001 (-0.06)	0.006 (0.11)	0.232 (1.04)	-0.000 (-0.11)	0.003 (0.44)	0.018 (0.42)	-0.008 (-0.12)	0.001 (0.28)	-0.004 (-0.28)
<i>Rule of Law</i>	-0.873 (-0.70)	-2.584 (-0.83)	-0.088 (-0.67)	-0.396* (-1.80)	-1.115 (-1.02)	-0.483 (-0.25)	0.146* (1.94)	0.072 (0.65)	-1.473 (-1.10)	-2.216 (-0.65)	-0.384* (-1.74)	-1.283*** (-3.13)
<i>Unemployment</i>	0.010 (0.16)	-0.060 (-0.33)	-0.018* (-1.82)	-0.015 (-1.04)	-0.174 (-1.25)	-0.215* (-1.80)	0.006 (0.60)	0.003 (0.23)	0.038 (0.38)	-0.206 (-0.45)	-0.053*** (-2.73)	-0.078** (-2.03)
<i>INDV</i>		-3.968 (-1.49)		-0.166 (-0.83)		-0.817 (-0.56)		0.210 (1.12)		-3.971 (-1.36)		-0.069 (-0.26)
<i>MC/GDP</i>		-0.035** (-2.36)		0.000 (0.07)		-0.094*** (-3.61)		0.000 (0.10)		-0.045** (-2.05)		0.001 (0.33)
<i>STV</i>		0.926 (1.45)		-0.058 (-1.17)		1.182* (1.78)		-0.085 (-1.57)		1.416** (2.12)		-0.032 (-0.45)
<i>LISTN</i>		-5.169*** (-3.84)		-0.085 (-1.02)		2.088* (1.78)		-0.056 (-1.07)		-6.857*** (-3.51)		-0.173 (-0.93)
<i>EDS/GNI</i>									0.045*** (2.65)	0.027 (0.56)	0.003 (1.12)	0.007** (2.07)
<i>Reserves/Debt</i>									0.001 (0.97)	-0.037*** (-2.73)	0.000** (2.50)	-0.001 (-0.38)
<i>Constant</i>	2.849 (0.98)	110.365* (1.71)	1.491*** (4.18)	10.710** (2.34)	4.995*** (2.86)	-9.924 (-0.51)	1.071 (1.40)	-0.602 (-0.19)	-3.491 (-0.92)	113.661 (1.50)	2.198*** (3.21)	8.056 (1.30)
<i>YEAR</i>	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
<i>COUNTRY</i>	YES	YES	YES	YES	NO	NO	YES	YES	YES	YES	YES	YES
Observations	1883	996	1883	996	803	536	803	536	922	428	922	428
adj. R-square	0.319	0.289	0.303	0.242	0.102	0.198	0.087	0.173	0.312	0.333	0.307	0.312

*, **, and *** denote significance at the 10%, 5%, and 1% levels respectively.

Table 12 Does the ability of sovereign ratings explaining yield spread improve facing competition from non-Big three agencies?

	<i>Panel A The whole sample</i>				<i>Panel B High-income countries sample</i>				<i>Panel C Middle-income countries sample</i>			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
	<i>Spread1</i>	<i>Spread1</i>	<i>Spread2</i>	<i>Spread2</i>	<i>Spread1</i>	<i>Spread1</i>	<i>Spread2</i>	<i>Spread2</i>	<i>Spread1</i>	<i>Spread1</i>	<i>Spread2</i>	<i>Spread2</i>
$RATING_{Big3}$	-0.473**	-0.754**	-0.446***	-0.648***	-0.717**	-1.137**	-0.592***	-0.879***	-0.247	0.043	-0.409**	-0.234
	(-2.05)	(-2.15)	(-3.10)	(-3.38)	(-2.28)	(-2.74)	(-3.23)	(-4.07)	(-0.99)	(0.15)	(-2.13)	(-1.07)
$RATING_{Big3} \times D_{nonBig3}$	0.021	0.015	0.024	0.021	0.033**	0.046*	0.037**	0.048**	-0.033	-0.166**	-0.052	-0.154*
	(1.00)	(0.56)	(1.15)	(0.80)	(1.98)	(1.76)	(2.23)	(1.96)	(-0.36)	(-2.23)	(-0.65)	(-1.88)
<i>GDPG</i>	-0.176**	-0.200**	-0.171***	-0.196***	-0.128	-0.150*	-0.099*	-0.110***	-0.120**	-0.167***	-0.224***	-0.267***
	(-2.08)	(-2.34)	(-3.22)	(-3.55)	(-1.29)	(-1.77)	(-1.93)	(-2.78)	(-2.29)	(-3.05)	(-4.31)	(-4.95)
<i>CAB/GDP</i>	-0.072**	-0.134***	-0.028	-0.075**	-0.032	-0.114**	0.010	-0.050*	-0.121	-0.306**	-0.084	-0.247*
	(-2.20)	(-2.71)	(-1.06)	(-2.30)	(-0.80)	(-2.28)	(0.32)	(-1.93)	(-1.61)	(-2.30)	(-1.22)	(-2.10)
<i>DCPS/GDP</i>	0.017***	0.026***	0.015***	0.019**	0.018***	0.028***	0.017***	0.024***	0.033	-0.002	0.019	-0.012
	(3.20)	(2.81)	(2.92)	(2.39)	(3.29)	(3.14)	(2.84)	(3.34)	(1.13)	(-0.08)	(0.79)	(-0.43)
<i>TRADE/GDP</i>	-0.008	0.002	-0.009	-0.001	-0.008	-0.000	-0.010**	-0.004	0.013	0.027	0.010	0.025
	(-1.16)	(0.24)	(-1.31)	(-0.18)	(-1.64)	(-0.03)	(-2.08)	(-1.04)	(0.50)	(0.95)	(0.41)	(0.80)
<i>Inflation</i>	0.010	0.082*	0.035	0.104*	-0.058	0.003	0.002	0.046	0.087*	0.198***	0.091*	0.179**
	(0.31)	(1.81)	(0.92)	(1.91)	(-1.14)	(0.07)	(0.05)	(0.93)	(1.69)	(3.61)	(1.69)	(2.34)
<i>Rule of Law</i>	1.434	0.862	1.302	0.747	3.093**	3.829***	2.131***	2.639***	-0.068	-2.249	1.305	-1.079
	(1.23)	(0.67)	(1.22)	(0.67)	(2.43)	(2.72)	(2.69)	(3.30)	(-0.03)	(-1.56)	(0.66)	(-0.73)
<i>Unemployment</i>	-0.005	-0.044	0.065	0.057	-0.116	-0.175	-0.018	-0.043	0.127	0.172*	0.167	0.212**
	(-0.06)	(-0.43)	(1.35)	(1.21)	(-0.95)	(-1.20)	(-0.40)	(-0.85)	(0.91)	(1.72)	(1.02)	(2.06)
<i>INDV</i>		1.422		1.302		2.081*		1.601		1.256		1.724*
		(1.31)		(1.43)		(1.83)		(1.64)		(1.27)		(1.71)
<i>MC/GDP</i>		0.001		0.000		-0.000		-0.000		-0.006		-0.005
		(1.24)		(0.18)		(-0.03)		(-0.63)		(-0.64)		(-0.45)
<i>STV</i>		-0.595**		-0.359		-0.422**		-0.234*		0.625		0.786
		(-2.04)		(-1.60)		(-2.08)		(-1.79)		(1.21)		(1.33)
<i>LISTN</i>		0.334		0.095		0.462		0.307		-0.933		-1.566
		(1.26)		(0.37)		(1.06)		(0.91)		(-0.99)		(-1.52)
<i>Constant</i>	7.241*	-10.148	6.983***	-13.090	10.186*	-29.705	8.945***	-24.437	8.647***	-35.351	11.187***	-44.314
	(1.70)	(-0.40)	(2.60)	(-0.52)	(1.84)	(-1.17)	(2.98)	(-1.00)	(2.70)	(-1.17)	(3.83)	(-1.50)
<i>YEAR</i>	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
<i>COUNTRY</i>	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	738	578	739	578	509	373	510	373	229	205	229	205
adj. R-square	0.820	0.834	0.865	0.873	0.781	0.809	0.847	0.856	0.755	0.803	0.786	0.817

*, **, and *** denote significance at the 10%, 5%, and 1% levels respectively

6. Conclusion

Prior literature uses nine rating agencies to examine whether existing home bias of sovereign ratings (Öztürk, 2014; Fuchs and Gehring, 2017; Yalta and Yalta, 2018) and this paper focuses on the sovereign rating quality. This paper uses new sovereign defaults database to examine the rating quality, i.e., the database on government debt in default developed by the Credit Rating Assessment Group (CRAG) of the Bank of Canada. This paper also examines whether sovereign ratings of Big Three ratings agencies can explain government bond yield spread. This paper checks whether the information effect has changed considering ESMA's regulatory reforms and increased competition. Besides, this paper considers sovereign defaults and bond yield spreads to measure the information effects of sovereign ratings.

When considering the whole sample, the results show sovereign ratings of Big Three rating agencies can explain default probability and default amounts and bond yield spreads. However, the information effect of sovereign ratings of Big Three rating agencies does not change after regulatory reforms and increased competition from non-Big Three rating agencies. Second, when considering high-income countries sample, part of the results shows the information effect of sovereign ratings of Big Three rating agencies worsens after regulatory reforms and when facing the competition from non-Big Three rating agencies. Third, there is no significant information effect in middle-income countries.

Our results echo some recent reports from the European Union, which found that the quality of credit ratings has not significantly improved following various reform measures and increased competition among credit rating agencies. Following the 2008 Global Financial Crisis, the European Union (EU) implemented regulatory reforms aimed at enhancing the quality of credit ratings and fostering competition among credit rating agencies. Despite these efforts, recent analyses suggest that significant challenges persist. A 2024 study by the European Central Bank examined asset-backed securities issued between 1998 and 2018. The findings indicated that while regulatory changes have mitigated certain conflicts of interest, the issue of rating shopping remains prevalent. This ongoing practice continues to undermine the reliability of credit ratings, particularly for higher-quality securities. Besides, ESMA also noted that the regulation's impact on enhancing competition and addressing conflicts of interest was limited. High fees and frequent increases imposed by some rating agencies suggest that effective competition is lacking in specific market segments. These developments suggest that, despite the EU's regulatory reforms, significant obstacles remain in improving the quality of credit ratings and fostering effective competition among rating agencies within the EU. Continuous efforts are underway to address these challenges and enhance the credibility of credit assessments within the EU.

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