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Do sovereign-bond issuers learn from peers?☆

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ABSTRACT

This paper investigates the information spillover and learning by observing among countries in the sovereign debt markets. We find that the coupon rate of a bond offering by a borrower-country is positively associated with the average coupon rate of bonds issued by peer countries during the previous three-month period and this is significant among economically similar peers. Our results are stronger among investment-grade than speculative-grade ranked countries, and they are also more significant among countries without an IMF program than those under IMF program. We, however, fail to find evidence of learning among neighboring countries or those with a common language. Our findings suggest that although learning from peers is affected by borrower-countries' quality, sovereign bond markets learn information from their economically-similar peers, which could ensure greater price stability.

1. Introduction

Despite growing evidence on the impact of learning from peers in corporate financial decisions, there is little research on the impact of learning from peers in the sovereign debt market. Prior research in political science explores the diffusion process across cities, states, and countries and the potential learning from the experience of peers in adopting policies. There is also evidence of potential spillovers in the sovereign debt markets. Gande and Parsley (2005) argue that the 1990s have seen a fundamental change in international markets. This was driven by the rise in economic links between countries supported by the rapid expansion of Internet networks, which made it easier for investors to invest across countries. Beirne and Fratzscher (2013) find evidence for a herding contagion across countries. Researchers have also developed models on cross-country links based on countries learning about the impact of economic policies and exogenous shocks (Rojas, 2016; Meseguer, 2006). In this paper, we directly explore international linkages by asking whether borrower countries in the sovereign bond market learn about market conditions from peer countries in setting their coupon rates. We also investigate whether this information spillover is differentially affected by the level of uncertainty about the quality of peers and whether the spillover effects vary over our sample period.

The sovereign bond markets are particularly important in studying cross-country links and information spillovers across countries. Gande and Parsley (2005) note that sovereign debt serves as a benchmark for all other market rates, and it is perhaps the best channel to communicate information across countries. Notar (2020) argues that governments work closely with investment banks to place their sovereign bonds. Investment banks submit a technical proposal in which they provide an assessment of market conditions, the structure of the transaction, and the appetite for the issuance. Most importantly, investment banks usually include a detailed analysis of recent bond issues by comparable issuers. Governments are thus likely to learn from bonds issued by peer countries about the potential impact of political risk, default risk, liquidity risk, and market conditions on the determination of the coupon rate of their bond issuance.

Sovereign bonds are also an important and strategic asset class in institutional investor portfolios. The International County/City Management Association (ICMA) estimates that as of August 2020, sovereign bonds represent around 50 % of the global bond markets, $63.7tn out of $128.3tn. The volume of bonds issued by major low- and middle-income countries has increased by 11 times between 1991 and 2016 (Gaillard, 2020). The success of a sovereign bond issuance has become a key milestone for borrower countries as it demonstrates the credibility of

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their economic and monetary policies (Chatterjee and Eyigungor, 2015). The coupon rate of a sovereign bond is influenced by the credit risk rating of the issuing government, and its economic indicators (Belke and Rees, 2014). The process of issuing sovereign bonds usually starts with issuers and their investment banks determining whether market conditions are favorable for debt issuance. Economic agents will evaluate their deals relative to the term structure of interest rates at a minimum, and keeping bond maturity in mind (DeLong and DeYoung, 2007).[1] They may also look at outstanding bonds of peer countries, taking into consideration the issuer's rating, maturity and volume. Such Learning-by-observing is driven by the possibility of information spillovers into the public sphere, sovereign bonds issued by different countries usually have common investors, and are connected and subject to such information spillovers (Glover and Richards-Shubik, 2014).

Political science literature emphasizes that policymakers use "shortcuts" when they have limited time and resources, and may rely on previous experiences from other jurisdictions (Weyland, 2004). The process of issuing sovereign bonds can sometimes differ markedly from the process followed by corporate bond markets with the rather extensive roadshows to price the bond. Policymakers observe and learn from the experiences of other governments (Shipan and Volden, 2008; Meseguer, 2006). Andone and Scheubel (2019) show, for example, that Asian countries learn from the success of their peers' experience in deciding whether to enter in an IMF arrangement.

Using global data on all U.S. dollar denominated sovereign bond issuance, we examine whether a borrower-country "learns-by-observing" the information that spills over from sovereign bond issuance of peer countries in setting their own coupon rates. The diffusion of information through previously issued peer countries' sovereign bonds offerings would spill through a causal process that isolates cause-and-effect relationships, and helps the borrower-country succeed in its sovereign bond offering.

We find that the coupon rate of a sovereign bond issue is positively correlated with the average coupon rate of bonds issued by peer countries over the same maturity. The coefficient on peer-country coupons is significant and positive for peer countries with similar economic conditions as proxied by the same rating or level of GDP per Capita. Our results are consistent with those of Alter and Beyer (2014) who show evidence on the association between changes in Spanish sovereign CDS and Italian sovereign CDS. Similarly, they are consistent with Gande and Parsley (2005) who argue that a common (differential) information spillover suggests that an improvement in the credit rating of a country is followed by a lower (higher) interest-rate spreads for all other countries.

A natural question that arises is whether the peer-company spillover effect simply reflects a correlation that arises because the bonds have a similar rating. Our tests disentangle this effect by specifying as our base peer group all the countries that issue bonds with the same maturity as the focal bond. The peer group of countries when using this metric, therefore, does not control for similar rating or wealth. Any information spillovers are then independent of the rating and wealth effect. Moreover, we use alternate peer-groups that issue bonds with the same rating and belong to countries with similar GDP to control for potential correlations that arise from similar ratings and wealth effects. We further address the identification problem by examining a subset of bonds issued by firms that go through a ratings shock[2] and find similar results.

In other cross-sectional results, we find that peer coupon rates have a larger impact in affecting the coupon rate of a sovereign bond issuance in high-quality groups than in low-quality groups. In particular, we find that the coupon rate of borrower-countries is positively associated with the average coupon rate of peers among investment grade countries, and this is more significant than the positive association among speculative grade countries. In other words, political and macroeconomic uncertainties affect investors' risk aversion and the sovereign financing premia (Pastor and Veronesi, 2012, 2013; Pouzo and Presno, 2016), thus altering the potential benefits of diffusion of information and learning from peers.

We also test our predictions using the differential effect of IMF program as a measure of the quality of borrower-countries. Several countries in our sample are under an IMF program and are thus subject to very stringent constraints and rules, and have less flexibility in setting their policies. Given the constraints and rules, we argue that countries under an IMF program have limited potential to react to market conditions. Consistently, we find that both borrower-countries with or without an IMF program learn from their peers. However, countries that are not under an IMF program learn more from their peers than those that are under an IMF program.

We extend our work along several fronts. To test the impact of uncertainty on learning, we use the global economic policy uncertainty index from 1997 to 2021 as in Baker et al. (2016) as an additional control variable. We find that learning from peers is lower in periods of higher uncertainty especially following the 2008–2009 subprime crisis. Given that the signal-to-noise ratio is lower during periods of uncertainty, it is not surprising that it is more difficult to learn from peers. In a further extension of this rationale, we test whether learning is higher in one group of countries compared to others. We study the impact of cultural similarity (common language) and physical proximity (common border) on the learning process. We do not find significant associations across culturally and geographically close countries, perhaps attesting to the international nature of the sovereign bond markets.

Finally, we control for endogeneity, and examine whether a change in the rating of country affect the learning exercise. We argue that the peer group, defined on countries with the same maturity and ratings, now matches a different set of countries and bond issues. The shift of the peer group is thus exogenous to the ratings shock. We nonetheless find that coupon on bond issues are positively associated with the average coupon rate of the peer group countries. Our results thus remain robust after controlling for potential endogeneity in the determination of the coupon rate.

The contributions of our research are three-fold. This is the first paper that examines learning by observing in the context of sovereign bond issuance. It complements the extensive literature on spillovers in the sovereign bond markets (Gande and Parsley, 2005; Alter and Beyer, 2014), or on learning from stock market returns (Foucault and Fresard, 2014). It also adds to the evidence that policymakers learn by observing other jurisdictions, whether it is in trade policy, healthcare, taxes, and energy policies (Elkins and Simmons, 2005; Simmons et al., 2006; Meseguer, 2006; Berry and Berry, 2018). Our paper shows that peers' coupon rate matters in determining the coupon rate of a sovereign bond at issuance and confirms prior evidence on the spillover of interest rate levels across countries (Anaraki, 2021). Our results also suggest that both internal factors as well as the average coupon rate of peer countries during the recent period matter. This enriches our understanding of the global factors that affect sovereign debt markets that can lead to price stability, an important factor in maintaining financial market stability.

Second, our research also shows that the quality of peers is important for learning. Prior research in corporate finance has provided some evidence that suggests that learning from peers is not homogeneous (Leary

[1] Under the efficient markets hypothesis, market investors determine yields on financial assets from the expected future path of short-term interest rates (Woodford, 2007). A normative argument is that through their short-term interventions, monetary policymakers control demand by setting investors' expectations of future short-term interest rates. They thus influence the term structure, which embodies the market's anticipations of future events (e.g., Levin et al., 1999; Sack and Wieland, 2000), and then borrow at a coupon rate that is consistent with those expectations.

[2] We thank an anonymous referee for this suggestion.

and Roberts, 2014). Our results show that government choices are positively correlated with the quality of peer groups. Governments learn from high-quality peers in a facilitated and a structured environment, which ultimately improves their judgement.

Our focus on bond issuance extends current empirical research on sovereign bond markets. It adds to the literature on the effect of macro-fundamentals and shows that when accessing sovereign debt markets, governments learn from the external conditions under which a sovereign bond offering takes place. Our findings imply that governments are likely to converge to international standards and incorporate in their sovereign debt contracts features that facilitate their access to international capital markets, and may ultimately mitigate some systemic risks (Gelos et al., 2003).

The remainder of the paper is as follows. In the next section, we present a review of the literature and hypotheses. In Section 3, we present the data and methodology and discuss our empirical findings in Section 4. In Sections 5 and 6, we explore extensions and robustness tests, respectively. Section 7 concludes.

2. Review of literature and hypotheses

There is evidence that policymakers learn from other successful countries in matters pertaining to trade liberalization, privatization, and the decision to enter IMF agreements (Meseguer, 2006). Governments compete over scarce resources, and respond similarly in setting their tax policies (Wilson and Wildasin, 2004), and in deregulating their economies (Sinn, 2003). Even if they operate autonomously, governments learn from the information spilled over by the policies adopted by peer countries (Besley and Case, 1995), especially from observing successful strategies (Eckardt and Kerber, 2005).

Sovereign debt markets are also similarly affected by external factors (Calvo et al., 1996; González-Rozada and Yeyati, 2008; Belke and Rees, 2014; Izumi, 2020) and are subject to potential information spillovers (Arellano et al., 2012; Glover and Richards-Shubik, 2014; Kirschenmann et al., 2020). Sovereign bonds market rates represent a key channel to communicate information across countries (Gande and Parsley, 2005). As such, government work closely with their investment banks to understand investors' appetite using a comprehensive assessment including information about previous issuances (Notar, 2020). Therefore, governments are likely to learn from the information embedded in peer bonds' issuance about the impact of political risk, default risk, liquidity risk, and market conditions, on the coupon. For example, a drop in interest rates in developed countries results in greater liquidity would result in portfolio rebalancing that is likely to lead to lower yields in emerging economies (Belke and Verheyen, 2014). Tsang et al. (2021) show evidence of return and volatility spillovers across the sovereign bond markets between the US and ASEAN4 economies. The debt market is also subject to international transmission and spillovers of monetary shocks across countries globally (Miniane and Rogers, 2003; Koźluk and Mehrotra, 2009; Anaraki, 2021) or within interdependent economic and monetary zones (Kalemli-Ozcan et al., 2010; Beirne and Fratzscher, 2013).

Prior research suggests that financing costs are positively associated with the level of asymmetric information (Myers and Majluf, 1984; Lambert et al., 2012), which could be reduced by information from peers that face similar economic factors (Admati and Pfleiderer, 2000). Economic agents are likely to observe their peers and learn from their mistakes and successes (Merlo and Schotter, 2003). At the sovereign level, learning-by-observing is driven by information generated outside the borrower country that spills over into the public sphere. Alter and Beyer (2014) show that an unexpected shock of 100 basis points to Spanish sovereign CDS translates into a 68 bps increase in Italian sovereign CDS over the following week. Gande and Parsley (2005) examine the spillover effect of a change in sovereign credit rating of one country on the sovereign credit spreads of other countries. They distinguish between differential versus common information spillovers, and show that the diffusion process of learning from peers depends on the net impact between common and differential information effects. More recently, Rojas (2016) proposes a model in which he shows that creditors learn about the default probabilities of sovereign bonds contracts from the past behavior of other similar countries.

The political science literature argues that policymakers may not have the required resources and time to evaluate their policy choices. As such, they rely on previous experiences from other jurisdictions (Weyland, 2004). Berry and Baybeck (2005) and Shipan and Volden (2008) argue that in solving problems, decision-makers adopt solutions that were successful elsewhere. Meseguer (2006) demonstrates that countries learn from the performance of their peers in deciding to open up and liberalize their trade regime, and the learning exercise is constrained by the availability of information. Shipan and Volden (2008) adopt a Bayesian inference approach in which they argue that learning can occur under two conditions. On the one hand, policymakers need to hold uncertain prior beliefs about the outcome of policies. On the other hand, they should have abundant and reliable evidence from the experiences of many other governments on the outcome of a specific policy choice.

From a Bayesian updating perspective, we expect borrower countries to learn from their peers in setting the coupon rate of their bond offerings. We, therefore, expect a positive association between the coupon rate of a borrower country and the average coupon rate of peer countries with a close bond maturity, as well as those with similar economic conditions. Hence, we hypothesize:

H1a: The coupon rate of a sovereign bond issuance is positively associated with the average coupon rate of peer countries with a close bond maturity.

H1b: The coupon rate of a sovereign bond issuance is positively associated with the average coupon rate of peer countries with similar economic conditions and close bond maturity.

Prior research on peer effects shows that peer quality matters. In the corporate finance literature, for example, the board of directors usually evaluates the performance of CEOs on a relative basis against their peers (Nalebuff and Stiglitz, 1983). Francis et al. (2016) explain that CEOs are motivated by relatively strong peers. They find that CEOs learn from strong peers to perform better and receive a higher relative-performance-based bonus. Building on the above, we argue that borrower countries learn from relatively strong peers. Specifically, we refer to prior research on credit rating that classifies and compares borrowers in a single rating scale (Espeland and Stevens, 2008), and distinguishes between "investment grade" and "below investment or speculative-grade borrowers (Abdelal, 2007). Kamin and von Kleist (1999) show evidence that during financial crises, investment-grade borrowers benefit from a "flight to quality" status compared to speculative-grade borrowers. Building on this, we expect borrower countries within the investment-grade group to learn from each other, whereas learning to be weaker within the group of speculative-grade borrower-countries.

There is moreover some evidence that learning is conditional on the perception of peers' quality and trust in their ability to provide reliable feedback and solutions.[3] Previous asset management literature suggests that economic agents deal with biased information and have thus bounded rationality (Rigby and Bilodeau, 2011). Therefore, they benchmark and focus their learning from the best-in-class asset manager in building their portfolios (Strang et al., 2014). This suggests that the perception of quality and the credibility of peer countries affects the outcome of the learning exercise in the diffusion process.

Building on the above, and given the uncertainty of the financial markets, we argue that countries with uncertain beliefs about the

[3] Prior research in education sciences shows evidence that learning depends on the positive perception of peer students and the confidence in the quality of their feedback (Sacerdote, 2001; Wu et al., 2015; Hong and Lee, 2017; Ge, 2019).

internal and external conditions of their sovereign bond issuance are more likely to learn from their peer countries. Hence:

H2: Compared to lower quality groups, the coupon rate of a sovereign bond issuance is more positively associated with the average coupon rate of peer countries in higher quality groups.

Prior research suggests that IMF programs are usually adopted to manage foreign reserves crises and to reduce the political costs of adjustment policies on governments (Przeworski and Vreeland, 2000). The IMF mission states in the Articles of Agreement that it aims at facilitating "the expansion and balanced growth of international trade, and to contribute thereby to the promotion and maintenance of high levels of employment and real income and to the development of the productive resources of all members as primary objectives of economic policy," and promoting "exchange stability, to maintain orderly exchange arrangements among members, and to avoid competitive exchange depreciation."[4]

Despite its predefined goals, the implementation of an IMF program is usually accompanied by short-term controversial economic outcomes. For example, Reichmann and Stillson (1978) and Gylfason (1987) find no effect on economic growth. Przeworski and Vreeland (2000) document a drop in economic growth rates during the IMF involvement, followed by economic improvements after IMF loan programs. Hutchison and Noy (2003) find that an IMF program leads to lower economic growth in Latin America, whereas Gebregziabher (2015) documents mixed results in the African region. More recently, Balima, Sokolova (2021) find an average positive effect on economic growth with significant variations in the estimates. Moreover, Reichmann and Stillson (1978) find that IMF programs does not affect the balance of payments, whereas Gylfason (1987) and Bird (1996) show improvements in the balance of payments. As such, IMF programs are likely to cause popular resistance and divergence, which increase short-term uncertainty about their positive effects on economic growth (Hutchison, 2003). Despite the certification role of IMF, we argue that countries under an IMF program are more likely to be subject to a higher uncertainty than those without an IMF program.

H3: Compared to country under IMF program, the coupon rate of a sovereign bond issuance is more positively associated with the average coupon rate of peer countries without IMF program.

3. Data and methodology

We test our predictions using a sample of USD denominated sovereign bonds issued in the period from January 1953 to February 2021 retrieved from the Eikon Thomson database.[5] Eikon Thomson provides data on bond characteristics such as the issuing country, the amount of the issue, the maturity date, the coupon, and the denomination currency. Our sample consists of 3672 country-level observations from 115 countries. A country may have more than one sovereign debt offering at the same time. We therefore use the dollar weighted average coupon and maturity. Table 1 presents the distribution of bond issues in our sample. Panel A shows that in addition to the United-States, countries such as Israel, Sweden, Argentina, Turkey, and Peru had a large number of sovereign USD-debt offerings. Table 1 Panel B and Fig. 1 presents the total dollar volume by year. The table and figure show that while there is an increase in the number of sovereign bond offerings over our sample period, there seem to be waves during which the number of sovereign offerings reach high levels. For example, the number of countries involved in sovereign offerings increased in the first wave in mid-90s, and then in a second wave in 2001, and in a third wave in the period

Table 1
Sample characteristics.

Panel A - Distribution of sovereign bond issuances by Country

Country	Number	Country	Number	Country	Number
Algeria	1	Ghana	8	Oman	3
Angola	13	Greece	12	Pakistan	10
Argentina	114	Grenada	4	Panama	43
Armenia	4	Guatemala	13	Papua N-G.	1
Aruba	7	Honduras	5	Paraguay	11
Australia	13	Hongkong	3	Peru	70
Austria	68	Hungary	5	Philippines	33
Azerbaijan	2	Iceland	10	Poland	12
Bahamas	7	Indonesia	27	Portugal	12
Bahrain	9	Iraq	3	Puerto Rico	2
Barbados	9	Ireland	21	Qatar	8
Belarus	46	Israel	597	Romania	21
Belgium	79	Italy	51	Russia	17
Belize	4	Ivory Coast	7	Saint Vincent	1
Bermuda	7	Jamaica	16	Saudi Arabia	3
Bolivia	3	Jordan	15	Senegal	4
Brazil	42	Kazakhstan	6	Serbia	4
Bulgaria	10	Kenya	3	Seychelles	4
Canada	69	Kuwait	1	Slovakia	6
Cayman Islands	1	Laos	2	South Africa	13
Chile	16	Latvia	3	South Korea	9
China Mainland	11	Lebanon	58	Spain	63
Colombia	59	Lithuania	7	Sri Lanka	22
Costarica	55	Malaysia	9	Sweden	126
Croatia	5	Maldives	1	Tajikistan	1
Cyprus	1	Mauritius	1	Thailand	12
Czech Republic	1	Mexico	67	Trinid. &Toba.	11
Denmark	71	Micronesia	3	Tunisia	3
Dominican Rep.25	Moldova	2	Turkey	82	
Ecuador	29	Mongolia	5	Turks &Caicos	1
Egypt	92	Morocco	5	Ukraine	79
El Salvador	16	Namibia	2	UK	5
Ethiopia	1	Neth. Antilles	3	USA	864
Faroe Islands	1	New Zealand	56	Uruguay	50
Fiji	3	Nicaragua	6	Uzbekistan	1
Finland	56	Nigeria	6	Venezuela	43
Gabon	4	N. Macedonia	2	Vietnam	10
Georgia	2	Norway	5	Zambia	4
Germany	2				

Panel B - Distribution of sovereign bond issuances by Year

Issue Year	Number	Issue Year	Number	Issue Year	Number
1953	1	1981	32	2002	79
1955	1	1982	34	2003	85
1958	3	1983	29	2004	87
1959	1	1984	45	2005	85
1960	3	1985	56	2006	91
1962	1	1986	83	2007	96
1963	2	1987	54	2008	75
1965	4	1988	59	2009	125
1966	1	1989	57	2010	124
1968	3	1990	91	2011	108
1970	1	1991	87	2012	129
1971	2	1992	92	2013	126
1972	6	1993	115	2014	91
1973	9	1994	110	2015	90
1974	8	1995	74	2016	89
1975	11	1996	121	2017	92
1976	22	1997	122	2018	75
1977	29	1998	91	2019	63
1978	31	1999	98	2020	83
1979	29	2000	81	2021	16
1980	28	2001	136		

[4] https://www.elibrary.imf.org/view/books/013/20222–9781475593549-en/ch01.xml.

[5] We focus on sovereign debt issued in dollars to have comparable currency, regardless of the issuing country. This allows us to generate unbiased estimates, which exclude foreign exchange rate risk.

This table presents of the distribution of our sample of 3672 Sovereign USD Bond Issues in the period from January 1953 to February 2021. Panel A presents the sample distribution by country. Panel B presents the sample distribution by year.

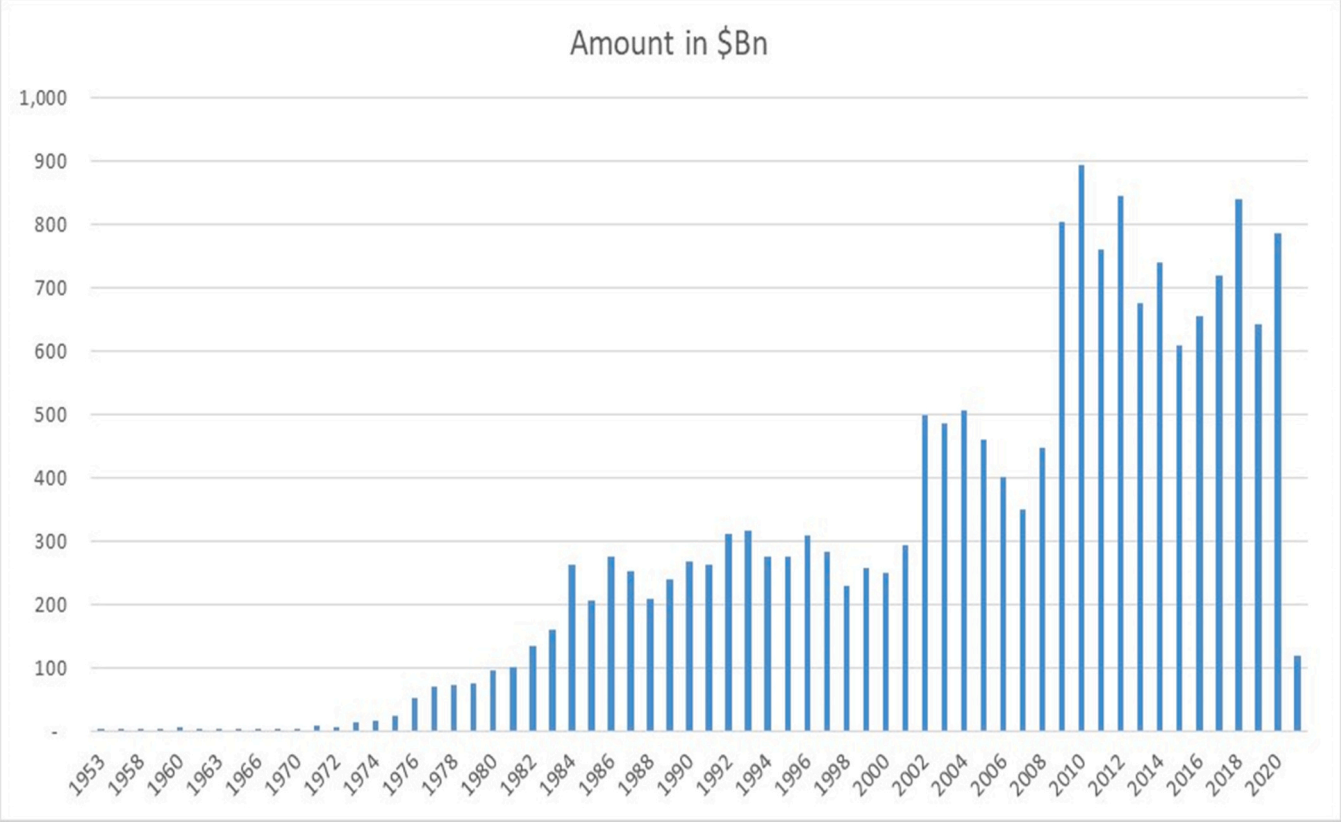

Fig. 1. Sovereign Debt Issuances, Dollar Amount by Year. This figure shows the total dollar amount of sovereign bond issues by year for our sample of 3672 Sovereign USD Bond Issues in the period from January 1953 to February 2021.

following the 2009 sub-prime crisis. This overlaps with the period when interest rates are low in the US and suggests that the number of countries with USD sovereign offerings increases in periods of lower US interest rates. The market for USD sovereign debt is clearly sensitive to US interest rates.

Prior literature on international transmission of monetary shocks and spillovers used methodologies such as conditional value-at-risk (CoVaR), Granger-causality, or generalized vector autoregressive framework (see e.g., Beirne and Fratzscher, 2013). We use an Unbalanced Panel regression model with country fixed effects. An unbalanced panel regression model accommodates countries with bond issues over different data periods and generates long-run average coefficient estimates that drive coupon rates for all countries in the sample. Country fixed effects allow us to control for time-invariant unobserved country-level characteristics that can be correlated with the observed independent variables. We also ran specifications using individual year dummies. Many of our variables follow a time pattern and as a result are omitted when we use year dummies. We therefore present specifications with our variables of interest rather than with year dummies.

Our regression model is as follows:

$$\text{Coupon}_{it} = \text{Average Peer Coupon}_{t\text{-}3} + \text{Maturity}_{it} + \text{LnAmount}_{it} + \text{GDP Per Capita}_{Y\text{-}1} + \text{GDP Growth Rate}_{Y\text{-}1} + \text{Inflation CPI}_{Y\text{-}1} + \text{Interest Rate}_{Y\text{-}1} + \text{External Debt to GDP}_{Y\text{-}1} + \text{IMF dummy} + \text{Recession dummy} + e_t \quad (1).$$

where, $Coupon_{it}$ is the weighted average coupon of all USD sovereign bonds issued by a specific country (i) on a specific day (t). The *Average Peer Coupon* is calculated over the last (t-3) three-month period.[6]

When defining the peer group, several choices are possible. Our main definition of peer countries used in our base regression is the *Average Peer Coupon* and is calculated as the average coupon rate of all countries which sovereign bonds are within ± 25 % the maturity of the borrower-country's bond offering. The Mean (Median) number of countries in the peer group is 4.14 (4). The peer-group is rather broad as it only uses peer group countries with similar maturity bond issues. Information spillovers are therefore separate from the effects of similar rating or similar wealth levels. We also add two alternative definitions of peer group countries using macro-economic factors. One alternative is to use a peer group defined as countries with a close bond maturity and with the same long-term rating. The second alternative is to use countries with a close bond maturity and within ± 25 % of the GDP per Capita of the borrower-country.

Our regression models include several additional control variables usually used as determinants for the coupon rate of sovereign bonds (Eichengreen and Mody, 1998). In terms of sovereign bond characteristics, we use bond maturity (in years) and issue size (in $million). *Maturity* is equal to the weighted average bond time to maturity of a specific country for all USD sovereign bonds issued on a specific day. We calculate *LnAmount* as the sum of all USD sovereign bonds issued by a specific country on a specific day (*Amount*) and use the natural logarithm of *Amount*. We expect the coupon rate to be positively associated with the maturity and the offering amount. In terms of variables that

[6] In robustness tests, we use the *Average Peer Coupon* over the last *one-year* period to validate our hypotheses.

capture domestic economic conditions (Jaramillo and Weber, 2013), we include *GDP per Capita*, *GDP Growth rate*, *Inflation CPI*, *Interest Rate*, and *External Debt to GDP*. All of these control variables are calculated at the end of the calendar year prior to the year of the bond issue (Y-1). We also add *IMF Program* dummy as an additional control variable to measure the risk level and quality of the borrower–country. All our regression models include a recession year dummy to control for changes in market conditions. Recession years are as defined by NBER with the calendar year designated as a recession year if the economy is in a recession for any part of the year.[7] Many of our variables, e.g. the recession dummy, follow a time pattern and are omitted when we use year dummies. We, therefore, present specifications with our variables of interest rather than with year dummies.

To test our second hypothesis on the differential impact of the quality of borrower countries on learning from peers, we consider bonds of borrower countries with a rating of BBB- (on the Standard & Poor's and Fitch scale) or Baa3 (on Moody's) or better as "investment-grade" borrower-countries, speculative otherwise. We further use a segmentation of borrower countries with or without an IMF program to the test of our third hypothesis.

In robustness tests, we calculate the average peer coupon while adding cultural-based constraints in peer selection. We control for countries that share a common border to test the effect of geographically proximity, and control for countries with a common official language for the effect of cultural similarity. We also use an alternative dependent variable, and we verify whether borrower-countries learn from their peers using the excess coupon, i.e. the spread paid in excess of US treasury rate on equivalent time period.

4. Empirical results

In this section we present summary statistics of our data and the empirical results of our base multi-variate regression model and robustness tests.

4.1. Descriptive statistics

Table 2 presents the descriptive statistics of our sample. The sovereign bond offerings in our sample have an average coupon of 5.583 % with a standard deviation of 2.250 %. The average maturity is 7.323 years. The issue sizes are large with an average amount of $4.869 billion. With respect to issuer characteristics, the average GDP per Capital of the issuing country is equal to $18,192 and the average growth rate of GDP is 3.035 %. The average external debt to GDP ratio is 54.1 % and 30.1 % of the countries in our sample are under an IMF program.

4.2. Learning from peer countries – base results

Learning occurs when a sovereign bond issuer observes and learns from the pricing of sovereign bonds issued by peer countries. Table 3 presents the unbalanced panel regression results. Model (1) presents the results when using the average coupon of all peer countries, that is all countries issue a bond with similar time to maturity over a three-month period. Model (2) controls for peers with the same rating, and Model (3) controls for countries with a close GDP per Capita, i.e. having a GDP per Capita within ± 25 % of the country issuing the focal bond.

Model 1 of the table confirms our prediction in Hypothesis (1a). We find a positive and highly statistically significant association between the bond coupon and the average peer coupon over the last three-month period. The coefficient indicates that for a 10 % change in the average coupon of peer countries over the three-month period, the sovereign bond offering increases by 2.55 %.

The results in Models (2) and (3) validate hypothesis (1b) related to learning from economically similar peers. The borrower-country coupon is also positively and significantly associated with the average coupon of peer countries with the same maturity and with similar economic conditions. For a 10 % increase in the average coupon of peer countries with similar economic conditions over the last three-months, the coupon of sovereign bond offering increases by 1.07–1.40 %. Borrower-countries therefore learn from previous successful experiences by economically similar peer countries in determining the coupon rate of their sovereign bond offerings. All Models show that the coefficients of the association between coupon and the average peer coupon are less than one. This suggests that while borrower-countries learn from their peers, other factors are also important in determining the coupon rate.

In terms of control variables, the coupon rate is positively and significantly associated with the maturity, i.e. time to maturity. Coupon is also positively associated with the natural logarithm of its loan amount. Not surprisingly, larger issues and issues with a longer maturity require a higher coupon. Table 3 also shows that Coupon is lower in borrower countries with high GDP per Capita, suggesting that the higher the wealth of the borrower country, the lower the coupon rate.[8]

4.3. The differential impact of Peer Quality on Learning from Peers

In Table 4, we test our predictions on learning from peers in the subsamples of investment- and speculative-grade borrower countries. Models (1) and (2) show a positive and significant association between the coupon and the average coupon of peer borrowers during the last three-month period. Yet, the positive association is significantly higher in the group of investment-grade borrowers compared to the group of speculative-grade borrowers (at the 1 % level).

For a 10 % increase in the average coupon of investment grade peer countries' over the last three-months, the coupon of a borrower-country's bond offering increases by 2.22 %. This is significantly higher than learning in speculative grade countries in which the coefficients on Average Peer Coupon is equal to 0.85 % over a three-month period.

We also use an alternate proxy for peer quality based on whether countries are OECD/non-OECD countries. This test adds additional insight into the role of learning. As the classification of OECD and non-OECD countries is exogenous to the bond market, it is less likely to endogeneity concerns. The online Appendix B presents the results. This shows that the bond coupon is positively associated with Average Peer Coupon in both OECD and non-OECD countries, and the coefficient is higher for OECD countries. This is consistent with evidence of higher spillover effects and learning among higher-quality peers, perhaps because of a higher signal-to-ratio among countries that have stronger social and economic ties represented by membership in the OECD group of countries.

4.4. Learning from peers and the impact of IMF program

The IMF aims at facilitating "the expansion and balanced growth of international trade, and to contribute thereby to the promotion and maintenance of high levels of employment and real income as well as financial stability." Despite its predefined goals, the implementation of an IMF program is usually accompanied by short-term controversial

[7] https://www.nber.org/research/data/us-business-cycle-expansions-and-contractions.

[8] We also ran regression tests for an alternate specification using the long-term rating of the borrower country as a control variable instead of GDP per capital, as the two variables are highly correlated (correlation coefficient of 0.7). and creates multi-collinearity concerns. Rating is a scale variable ranging from 1 to 22 (lowest to highest rating), and which is calculated based on the last available rating of the borrower country by any of the major rating agencies: S&P, Moody's, or Fitch. Our results are presented in the online Appendix A. We find that the coupon is negatively associated with rating, i.e. to be lower for countries with a better rating.

Table 2
Descriptive Statistics.

	N.	Mean	s.d.	Q1	Q2	Q3	Q4
Coupon	3617	5.721	3.220	3.500	5.630	8.000	14.630
Average Peer Coupon	2923	5.583	2.250	4.000	5.452	6.913	17.193
Av. Peer Coup. (Rating)	589	5.733	3.087	3.800	5.645	7.625	18.340
Av. Peer Coup. (GDP Per Cap.)	1058	5.628	2.758	3.875	5.725	7.315	17.850
Av. Peer Coup. (Invest. Grade)	2461	5.530	2.493	3.965	5.377	7.065	17.193
Av. Peer Coup. (Spec. Grade)	1694	5.244	2.405	3.701	5.248	6.750	17.730
Maturity	3672	7.323	6.543	2.981	5.003	10.008	32.022
Amount (in $mil.)	3672	4869	9958	60	500	2750	44,511
GDP Per Capita	3663	18,192	15,936	5023	13,698	26,386	62,994
GDP Growth Rate	3659	3.035	3.024	1.619	3.115	4.784	10.954
Inflation CPI	3639	9.904	20.465	2.149	3.950	8.928	154.763
Real Interest Rate	2974	5.291	9.261	1.708	4.036	7.823	45.600
External Debt to GDP	2912	0.541	0.348	0.339	0.459	0.658	2.172
IMF Program dummy	3672	0.303	0.460	0.000	0.000	1.000	1.000

This table presents the descriptive statistics of our studied sample in terms of number of observations, mean, standard-deviation, and quartiles. Coupon is the weighted average coupon of all USD sovereign bonds issued by a specific country, as presented in Eikon database. The Average Peer Coupon is calculated for all peer countries which sovereign bonds are within ± 25 % the maturity of the borrower-country's bond offering. The Av. Peer Coupon (Rating) is the average coupon for all peer countries within a close ± 25 % the maturity of the borrower-country's bond offering and within the same class of long-term rating. The Av. Peer Coupon (GDP Per Cap.) is the average coupon for all peer countries within a close ± 25 % the maturity of the borrower-country's bond offering and within ± 25 % the GDP per Capital of the borrower-country. Av. Peer Coup. (Investt. Grade) and Av. Peer Coup. (Spec. Grade) are the average peer coupon of all peer countries within a close ± 25 % the maturity of the borrower-country's bond offering, within the sub-groups of investment-grade and speculative-grade countries, respectively. All peer coupon averages are calculated over the last three-month period. Maturity is equal to the weighted average loan time to maturity of a specific country for all USD sovereign bonds issued on a specific day. Amount (in $mil.) is equal to the sum of all USD sovereign bonds issued by a specific country on a specific day. GDP per Capita, GDP Growth rate, Inflation CPI, Interest Rate, External Debt to GDP are obtained from World Bank and IMF Database at the end of the calendar year prior to sovereign bond issuance. IMF Program dummy is a dummy variable equals to one if the country is under an IMF program, zero otherwise (Eikon database).

economic outcomes, and as such, IMF programs increase short-term uncertainty about economic growth. We study the impact of IMF program separately evaluating the impact of the Average Peer Coupon for issuer countries who are under an IMF program and for those who are not under an IMF program.

Table 5 presents the results of the regressions run for the sub-samples of countries with or without IMF program in Model (1) and Model (2), respectively. Both Models (1) and (2) show a positive and significant association between coupon and the average coupon of peer countries over a three-month period, yet the Wald-test for difference in coefficients indicates that the coefficient of the association between the coupon rate and the average coupon rate of peer countries under an IMF program is significantly lower than the one of countries without an IMF program at the 1 % level. As such, our results confirm that learning from peers is more likely in borrower-countries that are not under IMF program, in which uncertainty is lower than those under IMF program.

5. Further investigations

5.1. The differential impact of economic uncertainty on learning from peers

Although economic agents may follow their peers in periods of higher uncertainty, they become more risk-averse (Ahn et al., 2014), and they suffer from noise information (Dessaint et al., 2019). The increase in global uncertainty conditions is likely to affect the quality of available information on peer countries, and thus the overall outcome of learning from peers. Building on the above, we expect borrower-countries to learn less from their peers following the sub-prime crisis.

The 2007–2009 financial crisis started in advanced economies, mainly the United States and the United Kingdom, and spread globally. All developed markets and most emerging economies experienced a drop in their economic activity and high levels of financial pressure (Claessens et al., 2010). The integration of financial markets contributed to accelerate the global impact of the financial crisis (Beine et al., 2010). The rise in US uncertainty adversely affected the financial sector and the real economy of the emerging market economies (Bhattarai et al., 2020). This crisis revived fears about financial stability, and emphasized the key role played by central banks and the need for unconventional monetary policy choices. To measure the changes in the level of uncertainty, we refer to the global economic policy uncertainty index (GEPU) constructed by Baker et al. (2016). The GEPU is a normalized textual index which measures the citation of terms related to economy, policy and uncertainty in newspaper articles, and which has available data from January 1997–2021.[9] A closer look at the index shows a significant increase in the GEPU level in 2008 vs. 2007 (an average GEPU of 121.36 in 2008, compared to 69.82 in 2007). Moreover, the average GEPU from 1997 to 2007 is equal to 82.74, which is significantly higher than the average 167.54 GEPU from 2008 to 2021 (at the 1 % level).

Table 6 tests our predictions over two periods 1997–2007 vs. 2008–2021. Models (1), and (2) repeat our main model on the association between coupon and the average past coupon over the last three months during both 1997–2007 and 2008–2021sub-periods, respectively. Model (1) over the 1997–2007 period shows a positive association that is significant at the 1 % level, and Model (2) over the period 2008–2021 indicates a positive association at the 1 % level. The Wald-test for difference in coefficients indicates that the coefficient of the association between the coupon rate and the average coupon rate of peer countries over the last three months is significantly lower over the 2008–2021 period than the one calculated from 1997 to 2007 at the 1 % level. For a 10 % increase in the average coupon of peer countries over the last three-months, the sovereign bond offering increases by 1.27–0.67 % in pre- vs. post-2008 crisis, respectively. The results in Table 6 suggest that learning from peers is lower in periods of higher uncertainty following the 2008–2009 subprime crisis.

[9] The Global Economic Policy Uncertainty (GEPU) is a monthly index which reflects the relative frequency of own-country newspaper articles that contain a trio of terms pertaining to the economy (E), policy (P) and uncertainty (U). It is equal to the GDP-weighted average of national EPU indices for 21 countries: Australia, Brazil, Canada, Chile, China, Colombia, France, Germany, Greece, India, Ireland, Italy, Japan, Mexico, the Netherlands, Russia, South Korea, Spain, Sweden, the United Kingdom, and the United States.

Table 3
Learning from peers: base results.

	All Peer Countries With close Maturity	Same Rating & close Maturity	Close GDP Per Capita & close Maturity
	(1)	(2)	(3)
Constant	28.034***	41.000***	39.998***
	1.303	*2.789*	*2.185*
Average Peer Coupon	0.255***	0.107***	0.140***
	0.023	*0.033*	*0.028*
Maturity	0.025***	0.060**	0.056***
	0.009	*0.028*	*0.017*
Ln Amount	0.065***	0.103*	0.114***
	0.021	*0.058*	*0.044*
Ln GDP per Capita	-2.789***	-4.160***	-4.049***
	0.133	*0.274*	*0.212*
GDP Growth Rate	0.057***	0.025	-0.026
	0.015	*0.033*	*0.027*
Real Interest Rate	0.030***	0.019	0.018
	0.007	*0.018*	*0.013*
CPI	-0.003	0.008	0.020**
	0.004	*0.016*	*0.009*
External Debt to GDP	-0.015**	-0.889***	-0.045**
	0.008	*0.292*	*0.021*
IMF Program	-0.402	0.764	0.311
	0.266	*0.486*	*0.551*
Recession dummy	0.485***	0.518*	0.451**
	0.128	*0.272*	*0.219*
N. of Observations	2163	434	727
N. of Groups	99	67	79
Overall R-Squared	0.328	0.226	0.405
F-Statistics	135.340	58.550	83.180
Prob.	*0.000*	*0.000*	*0.000*

This table presents the results for Unbalanced Panel Regression with Country Fixed Effect of the borrower-country's coupon on the Average Peer Coupon for all peer countries with a close bond maturity, as well as those with similar economic conditions (Similar Rating and Similar GDP per Capita). The Average Peer Coupon in Model (1) is calculated for all peer countries which sovereign bonds are within ± 25 % the maturity of the borrower-country's Bond offering. In addition to the close bond maturity constraint, the Average Peer Coupon focuses in Model (2) on countries with the same rating as the borrower-country, and in Model (3) on countries with a GDP per Capita that is ± 25 % of the GDP per Capita of the borrower-country. All control variables are defined in Table 2. The superscripts ***, **, * stand for statistical significance at the 1 %, 5 % and 10 % level, respectively. White heteroskedasticity-consistent standard errors are in Italics.

5.2. *Learning from peers: does cultural similarity or geographic proximity matter?*

The spillover model does not clearly specify the reference group of peers who affects domestic governments' decisions. Learning from peers could be strengthened through a number of transmission channels, such as neighboring jurisdictions or countries with a similar cultural background. Given that policymakers are usually constrained by the level of available information (Meseguer, 2006), they employ 'shortcuts' to learn from their peers. Previous studies explore whether information spillovers are heightened between countries with cultural linkages (Gande and Parsley, 2005; Simmons et al., 2006), or among neighboring countries (Biesenbender and Tosun, 2014).

Table 7 repeats the empirical tests in Table 3 and explores the effect of geographic closeness or cultural similarity among countries in addition to the same maturity of sovereign debt issuance. In Model (1), we follow Baltzer et al. (2013) and we define peer countries that are

Table 4
Learning from Different Quality Peers: Investment vs. Speculative Grade Bonds.

Dependent Variable:	Investment Grade Bond Issuance Coupon	Speculative Grade Bond Issuance Coupon
	(1)	(2)
Constant	28.420***	27.281***
	1.412	*1.629*
Average Peer Coupon	0.222***[a]	0.085***[a]
	0.022	*0.022*
Maturity	0.042***	0.016
	0.011	*0.011*
Ln Amount	0.072***	0.088***
	0.023	*0.024*
Ln GDP per Capita	-2.842***	-2.703***
	0.143	*0.167*
GDP Growth Rate	0.068***	0.082***
	0.017	*0.019*
Real Interest Rate	0.032***	0.032***
	0.008	*0.008*
CPI	0.003	0.015***
	0.004	*0.006*
External Debt to GDP	-0.015*	-0.010
	0.009	*0.007*
IMF Program	-0.406	-0.578*
	0.272	*0.335*
Recession dummy	0.445***	0.623***
	0.142	*0.160*
N. of Observations	1794	1415
N. of Groups	96	94
Overall R-Squared	0.295	0.333
F-Statistics	116.280	59.330
Prob.	*0.000*	*0.000*

a: significantly different at the 1 % level.
This table presents the results for Unbalanced Panel Regression with Country Fixed Effect of the borrower-country's coupon on the average peer coupon in the sub-samples of Investment Grade and Speculative Grade countries. Models (1) and (2) present the results using the average peer coupon over the last three-month period. In both sub-samples, the *Average Peer Coupon* is calculated for all peer countries which sovereign bonds are within ± 25 % the maturity of the borrower-country's Bond offering. All control variables are defined in Table 2. The superscripts ***, **, * stand for statistical significance at the 1 %, 5 % and 10 % level, respectively. White heteroskedasticity-consistent standard errors are in Italics.

Table 5
Learning in high vs. Low Uncertainty Periods.

Dependent Variable:	1997–2007 Coupon	2008–2021 Coupon
	(1)	(2)
Constant	7.165	1.303
	4.588	*2.959*
Average Coupon	0.127***[a]	0.067***[a]
	0.042	*0.023*
Controls	Yes	Yes
N. of Observations	753	1075
N. of Groups	55	89
Overall R-Squared	0.053	0.499
F-Statistics	10.520	20.570
Prob.	*0.000*	*0.000*

a: significantly different at the 1 % level.
This table presents the results for Unbalanced Panel Regression with Country Fixed Effect of the borrower-country's coupon on the average peer coupon around the 2008-subprime crisis. Models (1) and (2) present the results using the average peer coupon over the last three-month period in (1997–2007) and (2008–2021), respectively. in both sub-periods, the *Average Peer Coupon* is calculated for all peer countries which sovereign bonds are within ± 25 % the maturity of the borrower-country's Bond offering. All control variables are defined in Table 2. The superscripts ***, **, * stand for statistical significance at the 1 %, 5 % and 10 % level, respectively. White heteroskedasticity-consistent standard errors are in Italics.

Table 6
The differential impact of IMF programs on learning from peers.

	IMF Program (1)	No IMF Program (2)
Constant	18.160***	42.169***
	2.362	*1.540*
Average Peer Coupon	0.121***[a]	0.345***[a]
	0.040	*0.025*
Controls	Yes	Yes
No of Observations	705	1411
No of Groups	56	57
Overall R-Squared	0.031	0.429
F-Statistics	17.620	371.570
Prob.	*0.000*	*0.000*

a: significantly different at the 1 % level.
This table presents the results for Unbalanced Panel Regression with Country Fixed Effect of the borrower-country's coupon on the average peer coupon in the sub-samples of countries with vs. without IMF program. Models (1) and (2) present the results using the average peer coupon over the last three-month period. In both sub-samples, the *Average Peer Coupon* is calculated for all peer countries which sovereign bonds are within ± 25 % the maturity of the borrower-country's Bond offering. All control variables are defined in Table 2. The superscripts ***, **, * stand for statistical significance at the 1 %, 5 % and 10 % level, respectively. White heteroskedasticity-consistent standard errors are in Italics.

Table 7
Learning from Peers: The Impact of Economic, Cultural, and Geographic Shortcuts.

	Common Geographic Border (1)	Common Language (2)
Constant	31.090***	28.593***
	3.100	*2.866*
Average Peer Coupon	0.071*	0.071
	0.038	*0.045*
Controls	Yes	Yes
No of Observations	501	439
No of Groups	64	48
Overall R-Squared	0.387	0.225
F-Statistics	18.650	15.100
Prob.	*0.000*	*0.000*

This table presents the results for Unbalanced Panel Regression with Country Fixed Effect of the borrower-country's coupon, geographically close (Common Geographic Border), and culturally similar (Common Language). Model (1) uses the Average Peer Coupon with a close maturity and neighboring countries sharing a common border with the borrower country. Model (2) uses the Average Peer Coupon with a close maturity and a common language as the borrower country. The results in Table 6 test learning from peer over a three-month. All control variables are defined in Table 2. The superscripts ***, **, * stand for statistical significance at the 1 %, 5 %, and 10 % level, respectively. White heteroskedasticity-consistent standard errors are in Italics.

geographically close as neighboring countries that share a common border. In Model (2), we consider the use of a common official language to define peer countries that are culturally close.[10] The results in Table 7 explore learning from peer over a three-month period.

Models (1) and (2) show weak evidence on learning from culturally and geographically close peers. This suggests that the benefits of learning from neighboring and culturally close countries are limited. Common borders and common language do not facilitate the diffusion of know-how or encourage communication on market conditions. As such, they do not help in the determination of coupon in the case of sovereign bond issuance.

[10] https://en.wikipedia.org/wiki/List_of_official_languages_by_country_and_territory.

5.3. Excess coupon: the potential base rate effect

Our empirical findings could be driven by a base rate effect. Assume that all countries issue at a spread over US treasuries, and the coupon rate is given by C = S + Y (where C is the coupon rate, S is spread, and Y is the yield on US treasury). So, Y would play a role in driving common movements. To control for the base yield level, we use the spread over US Treasuries, i.e. the excess coupon rate, as a dependent variable.

To control for the effect of the base rate on our main hypotheses, we repeat the unbalanced panel regressions run in Tables 3 and 4 with country fixed-effects using the excess coupon rate, as a dependent variable. *Excess Coupon* is calculated as the difference between the coupon rate of sovereign bonds and the yield to maturity of US treasuries over the same maturity. We omit sovereign bond offerings in the US from our sample in this test. As before, we use the *Average Peer Excess Coupon* over the last three-month period as our independent variable.

In Table 8, Models (1) (2a) and (2b) present the regression results using the average peer excess coupon over the last three-month period for the entire sample, investment-grade and speculative-grade sub-samples, respectively. All models confirm our predictions in hypotheses (1) and (2). They show a positive association between the excess coupon and the average peer excess coupon over a three-month period

Table 8
Learning from peers using excess coupons.

	Entire Sample (1)	Investment Grade Bond Issuance (2a)	Speculative Grade Bond Issuance (2b)
Constant	-4.479***	-5.050***	-4.524***
	1.333	*1.250*	*1.236*
Average Peer Excess Coupon	0.153***	0.332***[b]	0.208***[b]
	0.025	*0.054*	*0.028*
Maturity	-0.044***	-0.047***	-0.047***
	0.009	*0.008*	*0.007*
Ln Amount	0.065***	0.080***	0.083***
	0.021	*0.020*	*0.019*
Ln GDP per Capita	0.633***	0.646***	0.517***
	0.146	*0.138*	*0.136*
GDP Growth Rate	-0.048***	-0.049***	-0.040***
	0.017	*0.015*	*0.014*
Real Interest Rate	0.011	0.021***	0.014**
	0.007	*0.007*	*0.007*
CPI	-0.007*	-0.002	0.004
	0.004	*0.004*	*0.004*
External Debt to GDP	-0.012*	-0.009	-0.008
	0.007	*0.007*	*0.007*
IMF Program	-0.440*	-0.088	-0.038
	0.267	*0.251*	*0.258*
Recession dummy	0.721***	0.610***	0.779***
	0.149	*0.137*	*0.133*
N. of Observations	1541	1875	1834
N. of Groups	97	97	95
Overall R-Squared	0.002	0.006	0.017
F-Statistics	18.180	21.650	19.650
Prob.	*0.000*	*0.000*	*0.000*

b: significantly different at the 5 % level.
This table presents the results for Unbalanced Panel Regression with Country Fixed Effect of the borrower-country's Excess coupon on the average peer Excess coupon over the last three-month period. Excess Coupon is calculated as the difference between the coupon rate of sovereign bonds and the interest rate on US treasuries over the same maturity. The *Average Peer Excess Coupon* is the average excess coupon for all peer countries whose sovereign bonds are within ± 25 % of the maturity of the borrower-country's Bond offering. Models 1, 2a, and 2b present the results using the average peer excess coupon over the last three-month period for the entire sample, investment-grade and speculative-grade sub-samples respectively. All control variables are defined in Table 2. The superscripts ***, **, * stand for statistical significance at the 1 %, 5 % and 10 % level, respectively. White heteroskedasticity-consistent standard errors are in Italics.

($p < 0.001$). However, the positive association is significantly higher for investment grade than for speculative grade sovereign bond offerings (at the 5 % level).

In terms of control variables, the excess coupon rate is negatively related to maturity, i.e. time to maturity ($p < 0.001$), and to the growth rate of GDP ($p < 0.001$). It is positively associated with the natural logarithm of loan amount and with the natural logarithm of the GDP per Capita ($p < 0.001$). Finally, the excess coupon rate is higher during recession years ($p < 0.001$).

6. Robustness and identification tests

In this section, we examine the robustness of our results by repeating our tests using alternate definitions of the peer-group coupons, specifically using the averages calculated over a 1-year period rather than a 3-month period, and an alternate empirical specification to examine identification issues.

6.1. Learning from Peers using a one-year average peer coupon

To test whether our effects are dependent on the time period over which we define peer groups, we examine whether borrower countries learn from peers over a longer than three-month period. Table 9 presents the tests of our hypotheses using the average peer coupon over the last *one-year* period prior to a sovereign bond offering.

The results presented in Table 9 validate our empirical results validate our base results in Tables 3 and 4, and confirm both hypotheses (1) and (2). Although a longer-term average peer coupon may suffer from some extraneous events, there is evidence that borrower countries learn from their peers and that learning from peers in the investment-grade sub-group of countries is more significant than in the speculative-grade sub-group of countries.

6.2. Identification and Simultaneity

An important thread in the peer-group literature is whether the identification of peer effects is hindered by econometric problems, such as *selection* into peer groups and a simultaneity bias known as the *reflection* problem (Manski, 1993), spillover via unobservable, and fuzzy definition of peers. There have been a variety of attempts to overcome these problems. Some researchers exploit random variations in peer composition arising from natural experiments and unexpected shocks (Ding and Lehrer, 2007) or use a random assignment of peers (Sacerdote, 2001; Sojourner, 2013). In the absence of such randomness, others have tried to eliminate confounding factors by controlling for a rich set of fixed effects (Burke and Sass, 2013).

We are unable to use an expanded set of fixed effects, especially time fixed-effects, because of the macro variables that have time patterns that are absorbed by a time fixed-effect. We use an alternate approach to test for identification concerns and consider the impact of a change in the credit rating score of a country as a shock that could alter learning from peers. Specifically, we examine whether a borrower-country that had a change in its credit rating score learns from peers in the new rating class. If learning exists in the new rating class, it would exclude potential reflection concerns.

Given the limited number of sovereign bond offerings during the short-term period following a change in credit rating score, in Table 10 we test our prediction using two sub-samples. In the first sub-sample, we examine sovereign bond offerings over all the sovereign bond offerings following a change in a country's credit score rating. In the second sub-sample, we examine sovereign bond offerings in the six-month period prior to a country's sovereign bond offerings. As the change in rating is a one-time event, we use ordinary least squares to do our analysis. Panel A-Table 10 presents the results. In line with our main methodology, we also repeat our tests using unbalanced panel regressions with country

Table 9
Learning from Peers: Robustness Tests.

	All Peers (1)	Same Rating (2)	Per Capita Close GDP (3)	Investment Grade (4a)	Speculative Grade (4b)
Constant	24.108***	36.589***	35.244***	26.767***	26.488***
	1.308	*1.941*	*1.578*	*1.313*	*1.389*
Average Coupon (1Y)	0.452***	0.135***	0.205***	0.381***	0.124***
	0.028	*0.025*	*0.023*	*0.024*	*0.026*
Maturity	0.021***	0.062***	0.033***	0.028***	0.025***
	0.008	*0.015*	*0.010*	*0.008*	*0.008*
Ln Amount	0.056***	0.159***	0.083***	0.052**	0.093***
	0.020	*0.036*	*0.026*	*0.020*	*0.020*
Ln GDP per Capita	-2.463***	-3.793***	-3.570***	-2.698***	-2.647***
	0.131	*0.194*	*0.155*	*0.133*	*0.140*
GDP Growth Rate	0.065***	0.018	0.058***	0.079***	0.070***
	0.015	*0.022*	*0.019*	*0.015*	*0.015*
Real Interest Rate	0.028***	0.025**	0.022***	0.032***	0.042***
	0.007	*0.012*	*0.008*	*0.007*	*0.007*
CPI	0.000	0.009	0.020***	0.001	0.014***
	0.004	*0.010*	*0.006*	*0.004*	*0.005*
External Debt to GDP	-0.014**	-1.050***	-0.035***	-0.013	-0.010
	0.007	*0.201*	*0.013*	*0.008*	*0.007*
IMF Program	-0.122	-0.053	0.179	-0.301	-0.523**
	0.253	*0.351*	*0.342*	*0.254*	*0.264*
Recession dummy	0.283**	0.685***	0.594***	0.392***	0.499***
	0.120	*0.199*	*0.151*	*0.121*	*0.136*
N. of Observations	2480	954	1524	2312	2057
N. of Groups	99	91	89	99	97
Overall R-Squared	0.353	0.295	0.413	0.338	0.345
F-Statistics	194.730	114.380	159.070	198.060	89.950
Prob.	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*

This table presents the robustness tests for Unbalanced Panel Regression with Country Fixed Effect of the borrower-country's coupon on the average peer coupon for all peer countries with a close bond maturity (Model 1), those with similar economic conditions (Similar Country Rating and Similar GDP per Capita, Models 2 and 3, respectively), and those within the Investment Grade (Model 4a) and Speculative Grade (Model 4b) sub-groups. All models are run using the average peers over the last one-year period. The Average Peer Coupon in all models is calculated for peer sub-groups using countries which sovereign bonds are within ± 25 % the maturity of the borrower-country's Bond offering. All control variables are defined in Table 2. The superscripts ***, **, * stand for statistical significance at the 1 %, 5 % and 10 % level, respectively. White heteroskedasticity-consistent standard errors are in Italics.

Table 10
Learning from Peers: Reflection and Identification.

Changes in Rating during the last:	All Observations		6-months	
Panel A- Ordinary Least Squares Regression				
	(1a)	(1b)	(2a)	(2b)
Constant	7.917***	5.876***	-5.629	-4.990
	1.271	*1.221*	*3.979*	*4.052*
Average Peer Coupon	0.335***		0.365***	
	0.044		*0.123*	
Average Peer Coupon (1Y)		0.498***		0.367**
		0.049		*0.153*
Controls	Yes	Yes	Yes	Yes
N. of Observations	728	804	129	144
Adjusted R-Squared	0.446	0.453	0.659	0.631
F-Statistics	59.520	67.460	25.710	25.490
Prob.	0.000	0.000	0.000	0.000
Panel B - Unbalanced Panel Regressions with Country Fixed Effect				
	(3a)	(3b)	(4a)	(4b)
Constant	25.475***	21.021***	19.673**	14.982*
	2.239	*2.298*	*8.851*	*8.584*
Average Peer Coupon	0.102**		0.204*	
	0.045		*0.112*	
Average Peer Coupon (1Y)		0.279***		0.330*
		0.058		*0.197*
Controls	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes
N. of Observations	728	804	129	144
N. of Groups	90	91	22	24
Overall R-Squared	0.357	0.368	0.250	0.239
F-Statistics	24.100	25.760	7.900	7.960
Prob.	*0.000*	*0.000*	*0.000*	*0.000*

This table presents the results for regressions of the borrower-country's coupon on the average peer coupon over the last *three-month* and *one-year* periods. Panel A includes the Ordinary Least Squares regressions, and Panel B presents the Unbalanced Panel regressions with country fixed effect. Models (1a and 1b) and (2a and 2b) include all sovereign bonds offerings that followed a change credit rating score. Models (1a), (1b), (3a) and 3(b) examine the sample of bonds issued by countries that had a change in credit rating at any time in the data period from January 1953 to February 2021. Models (2a) (2b) (4a) and (4b) contain the sample of countries that had a change in their credit rating score during the last six months prior to a sovereign bond offering. The *Average Peer Coupon* is calculated for all peer countries which sovereign bonds are within ± 25 % the maturity of the borrower-country's Bond offering. All control variables are defined in Table 2. The superscripts ***, **, * stand for statistical significance at the 1 %, 5 % and 10 % level, respectively. White heteroskedasticity-consistent standard errors are in Italics.

fixed effects. Results are presented in Panel B-Table 10.

Our results show that even if a borrower country has gone through a rating change shock, the coefficient on our *Average Peer Coupon* variable is still positive and significant, suggesting strong spillover effects, beyond the effect of similar rating or GDP levels. These results hold after controlling for potential reflection concerns, and confirm that our predictions do not necessarily suffer from simultaneity bias.[11] Countries with a change in rating still learn from peers in the new rating class, and this is especially true in sovereign bond offerings that occur during the six-month period or more following a change in credit rating score.

7. Conclusion

This paper examines cross-country information spillover and learning-by-observing in the sovereign debt market. Building on prior research in corporate finance and in political science, we argue that countries observe and learn from their peers. As a key asset class in the capital markets, sovereign bonds represent an interesting channel to explore cross-country links and information spillovers. Governments usually hire investment banks to assess market conditions, structure the transactions, and underwrite their sovereign bonds' issuance. Governments are likely to learn about the impact political risk, default risk, liquidity risk and investors' appetite on the coupon rate from the information extracted from previous issuances of peer countries.

We find that governments observe the information that spills over from their peers and learn to determine the coupon rate of their sovereign bonds issuance, and this is significant among economically similar peers, using same rating and same level of GDP per Capita. We find that learning from peers occurs in high-quality group of countries, as proxied by their investment grade, but not in speculative grade countries. This is consistent with additional findings which show a more significant learning among countries that are not subject to an IMF program compared to those under an IMF program.

Our results hold in the period following the sub-prime crisis, a period with a greater market uncertainty. However, the learning effects are smaller compared to less uncertain periods prior to the crisis. This suggests that country-level uncertainty adversely affects the process of learning from peers, perhaps because of a lower signal-to-noise ratio when there is uncertainty. We do not find evidence of learning among countries with common border or common language, suggesting that close geographic distance or cultural similarity do not improve the learning process.

Our empirical tests indicate that learning by observing improves the ability of sovereign bond issuers to set the coupon rate of their bond offerings. Our results also add to recent evidence at the firm level, and show the importance of peers at the country-level. Our work offers some of the first evidence with respect to the impact of peer countries' decisions in affecting policy-makers' monetary choices, which has the effect of strengthening price stability in sovereign bond markets.

Appendix A. - Learning from peers using rating as a control variable

This table presents the results of robustness tests for Unbalanced Panel Regressions with Country Fixed Effect of the borrower-country's coupon on the average peer coupon for all peer countries with a close bond maturity (Model 1), those with similar economic conditions (Similar Country Rating and Similar GDP per Capita, Models 2 and 3, respectively), and those within the Investment Grade (Model 4a) and Speculative Grade (Model 4b) subgroups. All models are run using the average peers over the last three-month period. The *Average Peer Coupon* in all models is calculated for peer subgroups using countries which sovereign bonds are within ± 25 % the maturity of the borrower-country's Bond offering. All control variables are defined in Table 2. The superscripts ***, **, * stand for statistical significance at the 1 %, 5 % and 10 % level, respectively. White heteroskedasticity-consistent standard errors are in Italics.

[11] Focusing on observations with a change in credit rating score during the last three-months, we find 79 sovereign bond offerings, which is a very low number of observations. The OLS regression of the borrower country's coupon on the average peer coupon shows a positive, yet not statistically significant coefficient. Focusing on countries with a change in credit rating score during the last year, we have 365 observations, and the coefficient of the association between coupon and the average peer coupon of the last year is positive and significant at the 5 % level.

	All Peers (1)	Same Rating (2)	Close GDP Per Capita (3)	Investment Grade (4a)	Speculative Grade (4b)
Constant	2.003***	11.977***	5.078***	2.700***	3.317***
	0.751	*2.735*	*1.874*	*0.891*	*0.839*
Average Coupon	0.483***	0.290***	0.341***	0.412***[a]	0.176***[a]
	0.023	*0.038*	*0.033*	*0.023*	*0.024*
Maturity	0.058***	0.199***	0.095***	0.078***	0.038***
	0.010	*0.034*	*0.021*	*0.012*	*0.012*
Ln Amount	-0.028	-0.122*	-0.029	-0.011	0.031
	0.022	*0.072*	*0.054*	*0.025*	*0.026*
Rating	-0.029	-0.453***	-0.168**	-0.087**	-0.076**
	0.034	*0.114*	*0.078*	*0.040*	*0.038*
GDP Growth Rate	0.104***	0.078*	0.063*	0.120***	0.105***
	0.017	*0.041*	*0.034*	*0.019*	*0.021*
Real Interest Rate	0.072***	0.106***	0.091***	0.076***	0.080***
	0.008	*0.022*	*0.015*	*0.008*	*0.009*
CPI	0.059***	0.087***	0.078***	0.068***	0.055***
	0.005	*0.019*	*0.010*	*0.006*	*0.006*
External Debt to GDP	-0.012	-1.261***	-0.049*	-0.010	-0.006
	0.009	*0.373*	*0.026*	*0.009*	*0.009*
IMF Program	-0.126	-0.405	-0.787	-0.162	-0.419
	0.316	*0.618*	*0.732*	*0.326*	*0.387*
Recession dummy	0.594***	0.293	0.555**	0.587***	0.640***
	0.141	*0.342*	*0.274*	*0.158*	*0.176*
N. of Observations	2053	434	715	1692	1364
N. of Groups	97	67	78	94	92
Overall R-Squared	0.365	0.231	0.406	0.400	0.356
F-Statistics	91.610	24.000	31.450	78.690	28.430
Prob.	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*

Appendix B. - Learning from different quality peers: OECD vs. non-OECD countries bonds

Dependent Variable:	OECD Countries Coupon (1)	Non-OECD Countries Coupon (2)
Constant	50.501***	15.147***
	2.003	*2.333*
Average Peer Coupon	0.208***[a]	0.121***[a]
	0.024	*0.037*
Maturity	0.083***	-0.007
	0.017	*0.024*
Ln Amount	0.022	0.161***
	0.040	*0.037*
Ln GDP per Capita	-4.815***	-1.486***
	0.191	*0.256*
GDP Growth Rate	0.137***	0.036
	0.024	*0.030*
Real Interest Rate	0.047***	0.021*
	0.013	*0.012*
CPI	0.023***	0.003
	0.006	*0.008*
External Debt to GDP	-0.053***	0.000
	0.013	*0.015*
IMF Program	0.806	-0.781*
	0.678	*0.427*
Recession dummy	0.758***	0.722**
	0.179	*0.293*
N. of Observations	711	608
N. of Groups	25	66
Overall R-Squared	0.567	0.129
F-Statistics	232.010	10.290
Prob.	*0.000*	*0.000*

a: significantly different at the 1 % level.

This table presents the results for Unbalanced Panel Regression with Country Fixed Effect of the borrower-country's coupon on the average peer coupon in the sub-samples of OECD and Non-OECD countries. Models (1) and (2) present the results using the average peer coupon over the last three-month period. In both sub-samples, the *Average Peer Coupon* is calculated for all peer countries which sovereign bonds are within ± 25 % the maturity of the borrower-country's Bond offering. All control variables are defined in Table 2. The superscripts ***, **, * stand for statistical significance at the 1 %, 5 % and 10 % level, respectively. White heteroskedasticity-consistent standard errors are in Italics.

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