Understanding Determinants and Common Factors of Railway and Sovereign Securities during the First Era of Globalisation

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Despite substantial research on sovereign securities during 1880-1913, quasi-sovereign railway securities, as second most important avenue for investment at that time, have received little attention. This leaves a wide gap in our understanding on how investors formed and optimised their portfolios of global securities. I use a unique dataset drawn from multiple sources and address three gaps in the literature. First, I analyse the underlying relationship between yield spreads on railway and government securities and explore the existence of any common factors between the two. Second, I argue that country risk influenced investor perceptions on the creditworthiness of railway securities. This is undertaken by categorizing countries under the taxonomy of capital-rich and capital-poor countries. Third, I extend the above argument by investigating the mechanisms through which sovereign creditworthiness affects pricing of railway securities and argue that the spillover of sovereign creditworthiness to yield spreads on railway securities was through the issuance of railway securities carrying a government guarantee.

During the first era of globalisation (1880-1913), government and railway securities, were the two most important avenues of investment on the London Stock Exchange comprising a combined share of 83.2 percent of British investment in 1893 (Goetzmann & Ukhov, 2006). Railways, among the first enterprises to access large-scale external finance, were quasi-sovereign in character, having shades of both public and private ownership and management. Railways could not have attracted substantial investment without active government support in the form of subsidies on land, capital and preferred treatment for concessionaires. Investment in railway securities presented a lucrative asset class, safe due to most railway securities carrying a government guarantee, but offering corporate yields in excess of sovereign yields. This makes it important to study the underlying relationship between the two and understand how this affected investors' portfolio choice.

Taking the investor's perspective, I investigate this relationship through analysing the determinants of yield spreads on railway and government securities together. I analyse yield spreads on railway and government securities across fifteen advanced and emerging economies from 1880-1913. I use a variety of different databases comprising financial, macroeconomic and firm-specific variables on railways and sovereigns. These are illustrated in the bibliography.

Consistent with the theoretical framework of Modern Portfolio Theory (Markowitz, 1952), I attempt to explore how risk-averse investors of that time constructed portfolios and optimised the balance between expected return and the risk. The paper makes three important contributions. First, it disentangles the relationship between the two most important securities and analyse any 'common factors', between the two. Second, current research on the first era of globalisation has exclusively focused on analysing investors' perceptions regarding country risk by analysing sovereign securities alone. This paper expands the debate by looking at both sovereign and the quasi-sovereign securities (railways), thereby highlighting matching importance of the latter. Third, this paper provides a historical reference to the growing quasi-sovereign debt market of today.

The econometric analysis provides the following three key results. First, for the overall sample, interest servicing emerges as the common factor explaining both yield spreads on railway and government securities. A 10 percent increase in the interest servicing to revenue ratio leads to a 32 basis point increase in spreads on railway securities. Second, results indicate that country risk investor influenced investor perceptions about the creditworthiness of railway securities. More specifically, investors considered railway indebtedness alone when investing in capital rich countries whereas both

railway indebtedness and country interest servicing capacity are determinants for yield spreads on railway securities in capital poor countries. Country interest-servicing capacity emerges as a stronger determinant for quasi-sovereign entities than their own indebtedness in capital poor countries. Third, the sovereign creditworthiness influenced pricing of railway securities through the issuance of railway securities with a government guarantee.

Methodology and Variable Description

Figure 1 exhibits yield spreads on railway and government securities across fifteen capital-rich and capital-poor economies from 1880-1913. In tradition with Flandreau and Zumer (2004), capital-poor countries reliant on foreign capital comprise of Argentina, Brazil, Italy, Spain, Portugal, Russia, Canada, India, New Zealand Australia and Turkey. Capital-rich countries comprise of Austria, Belgium, France and Sweden. Country selection rests on data availability on yield spreads on railway securities and a broad range of macroeconomic and industry-specific indicators.

Calculation of Railway and Government Yields

I construct the total returns to any security as the sum of capital gains and dividend yield. First, on any year t, the capital gain is the increase in the average value of the security in that year relative to the previous year. This is given as follows:

$$Capital\ Gains_{it} = (P_{it} - P_{i,t-1})/P_{i,t-1}$$

Here P_t is the price of security *i* in year *t*.

The dividend yield is calculated as follows:

$$Dividend\ Yield_{it} = \frac{Interest\ Rate_{it}}{Latest\ Price_{it}} * ParValue_{it}$$

$$railyield_{it} = Capital\ Gains_{it} + Dividend\ Yield_{it}$$

$$govyield_{it} = Capital\ Gains_{it} + Dividend\ Yield_{it}$$

Using the yield on UK government gold bonds to calculate the yield spreads on railway and government securities was appropriate, as both are long-term bonds.[1] This is expressed in the following equation:

$$r\_spread_{it} = railyield_{it} - ukgovgold_t$$

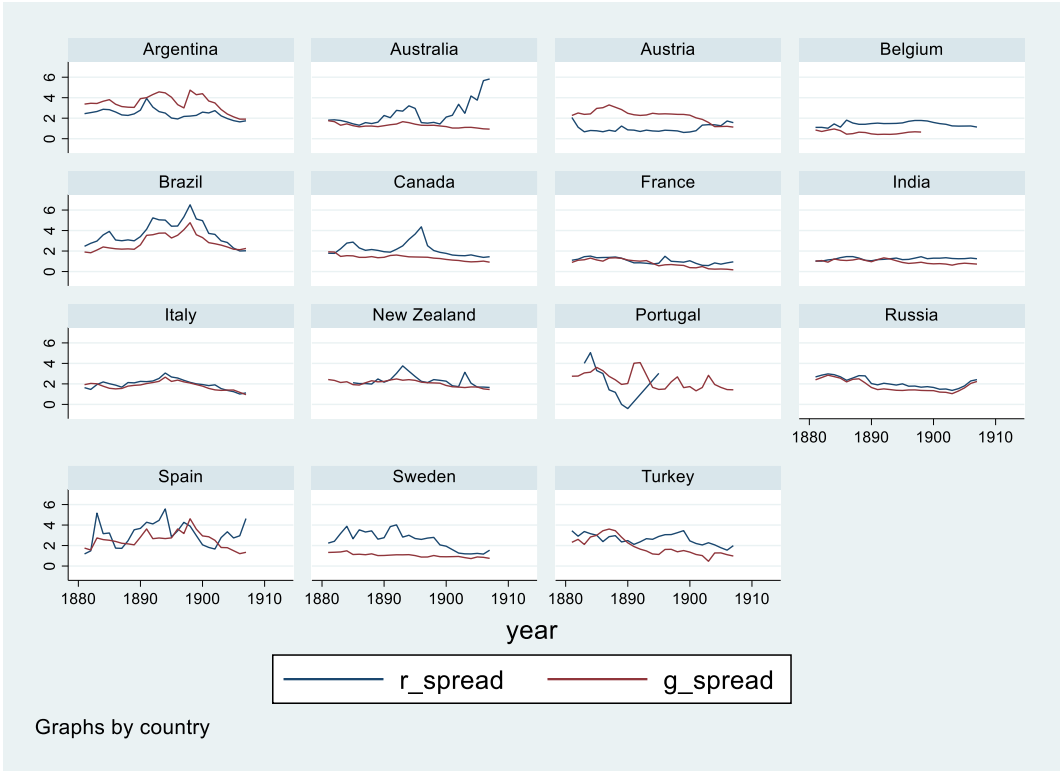
$$g\_spread_{it} = govyield_{it} - ukgovgold_t$$

The latest price of the security is used to calculate market capitalisation.

$$Market\ Capitalisation_{it} = Capital\ outstanding_{it} * \frac{Latest\ Price_{it}}{Capital\ Amount\ per\ Share_{it}}$$

[1] Available maturity data on railway securities from the IMM suggests the average maturity to be long-term justifying the use of UK gold-bonds as a reference rate. UK government gold bonds is also used as a reference rate in other studies such as Flandreau and Zumer (2004).

Figure 1: Yield spreads on railway and government securities



For regression estimates, I follow Esteves and Jalles (2016) and divide variables used in three blocks. I have also used these blocks to combine variables for performing principal components regression later in the paper.

a) *Investment Climate and Monetary Stability*: Yield spreads reflect perceived riskiness of bonds and are affected by fiscal fundamentals. Fiscal controls include ratio of interest servicing to government revenue (*intrev)* which also reflects country debt-servicing burden. Also included are ratio of budget deficits to government revenue and exports per capita. I also include an interaction term (*guaint*) is the product of a dummy variable showing whether the issue is guaranteed or not and the interest payment capacity captured by *intrev*. Monetary environment is captured by a dummy variable for the years in which countries adhered to gold standard (*golddummy*).

b) *Firm-specific characteristics*: Firm-specific variables controlling for unobservable heterogeneity in industry risk include ratio of passenger traffic to population, ratio of freight traffic to population, and log of country railway network.

c) Bond-specific *characteristics*:

Liquidity represented by bond-specific characteristics is a key determinant of yield spreads and is taken as the ratio of market capitalization to country public debt (*debtratio*).

Model

Following the rich debate on modelling sovereign spreads and their determinants (Flandreau and Zumer, 2004; Accominotti et al.,2011), I have used standard specification as follows.

$$y_{it} = \beta x_{it} + \varepsilon_{it}$$

where $i = 1, \dots, N; t = 1, \dots, T$ [1]

Equation 1 expresses railway spreads y_{it} for country i in year t capturing how investors priced risks as a function of a number of variables. x_{it} is a vector of control variables captured to include investment climate, firm and bond specific characteristics and the error term denoted by ε_{it}.

I find the presence of serial correlation, cross sectional dependence and heteroscedasticity, and chose linear regression with panel corrected standard errors. This technique developed by Beck & Katz (1995) is best applied to panels where N<T and the disturbances are assumed to be either heteroscedastic across panels or heteroscedastic and contemporaneously correlated across panels.[2]

Results

Table 1 presents the estimation results. A key theme highlighted by the results is how investor perceptions on capital-poor and capital-rich countries influences yield spreads on railway securities. Yield spreads on government securities, significant across all specifications, is crucial in explaining yield spreads on railway securities (column 1). Investors perceived fluctuations in government securities in relation to the nation's creditworthiness; a negative sign of the government spread variable reflects investor perceptions on the underlying relationship between government and railway securities to be substitutes in capital-rich countries whereas they were perceived to be complements in capital-poor countries (column 3-4). Compared to a complementary relation, substitution between railway and government securities in capital-rich countries allows more hedging opportunities.

The theme of differing investor perceptions for capital-rich and capital-poor countries is also evident when the role of fiscal fundamentals on the yield spreads on railway securities is analysed. Fiscal fundamentals captured through debt-servicing burden (*intrev*) is significant only for capital-poor countries. Investors perceived sustainability of debt-servicing burdens of capital-rich countries with good fiscal fundamentals but required a higher risk-adjusted return on investment in capital-poor countries (column 3-4). More importantly, investors considered both debt-servicing burden and railway indebtedness (*debtratio*) important for capital poor countries but only railway indebtedness for capital-rich countries (column 3-4). For the overall sample, a 10 percent rise in the debt-servicing burden results in a rise of 32 basis points of railway spreads.

Interestingly, debt-servicing burden also emerges as the common factor and is a determinant of yield spreads on both government and railway securities (column 1-2). Results for the overall sample and disaggregated into capital-rich and capital-poor countries remain so after controlling for macroeconomic factors, firm-specific factors and the international monetary environment.

What is the mechanism through which sovereign creditworthiness influences railway securities? I create a binary variable, which takes the value of one when countries issue guaranteed securities and interact it with the debt-servicing burden (*guaint*). Results show that regardless of whether countries are capital-rich or capital-poor an increase in debt-servicing when debt carries a government guarantee raises yield spreads on railway securities.

Dealing with Endogeneity

Given the nature of study, endogeneity is likely to be a concern. This could be possible due to three reasons. First, debt-servicing burden is the common factor determining yield spreads on government and railway securities and could likely be endogenous reflecting changes in yield spreads on railway securities rather than anticipating them. Second, some of the fiscal and trade controls might explain government securities leading to inconsistent parameter estimates. Third, the presence of serial correlation might result in reverse causality. To deal with potential endogeneity, I use two-staged least squares techniques with the debt-servicing burden and yield spreads on government securities as the endogenous variables. I use the first lags of both these variables as instruments. There is no qualitative change in the results and post-estimation results of over identifying restrictions indicate instrument validity (column 5 of Table 1).

[2] In my case N=15 and T=33.

Table 1: Panel Corrected Standard Errors Regression

	(1)	(2)	(3)	(4)	(5)
	Overall	Overall	Cap Rich	Cap Poor	2SLS
Dependent Variable	r_spread	g_spread	r_spread	r_spread	r_spread
g_spread	0.281**		-0.452***	0.322**	0.220***
	(0.113)		(0.165)	(0.126)	(0.060)
intrev	3.193***	1.925***	-0.551	4.438***	3.399***
	(1.133)	(0.624)	(3.177)	(1.173)	(0.543)
debtratio	-0.287***		-12.613***	-0.286**	
	(0.108)		(1.673)	(0.124)	
guaint	0.087*		0.043***	0.011*	
	(0.523)		(0.832)	(0.652)	
golddummy	0.064	-0.038	-0.765***	0.040	0.159*
	(0.109)	(0.089)	(0.207)	(0.128)	(0.109)
Fiscal Controls	YES	YES	YES	YES	YES
Firm Controls	YES	YES	YES	YES	YES
Country Effects	YES	YES	YES	YES	YES
Year Effects	YES	YES	YES	YES	YES
Test of overidentifying restrictions					0.107
Observations	306	363	99	207	297
R-squared	0.683	0.719	0.908	0.728	
Number of cc	13	14	4	9	13
VIF	12.83	7.16	98.19	17.96	2.11

Robust Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Notes: Variable description is given in the section on 'Methodology and variable description'.

Robustness checks

I test the robustness of the debt-servicing burden as a common factor, investor perceptions on capital-rich and capital-poor countries and its reflection in yield spreads and the spillover of sovereign creditworthiness through guarantee securities in two ways. First, I use alternative definitions of calculating end December yields on railway and government securities. Second, to deal with potential multicollinearity (exhibited by the high VIF in Table 1) amongst variables, I apply principal components regression using principal components of the explanatory variables as regressors. Following Esteves and Jalles (2016), I distribute variables into two categories, investment climate and monetary stability and bond-specific variables.

Investment Climate and Monetary Stability: I use variables like interest servicing, government revenue, budget deficits, public debt and exports.[3] Two principal components are retained which explain 96 percent of the variance (pc1inv and pc2inv).

Bond-specific characteristics: Bond specific characteristics encompass railway debt captured through market capitalisation of railway securities, annual opening price, highest price at which bond was traded, and latest price at which the security was traded.[4] Again, two principal components are retained which explain 99 percent of the variance (pc1bond and pc2bond).

[3] The Bartlett's test of sphericity is rejected at the 1% level of significance.
[4] The Bartlett's test of sphericity is rejected at the 1% level of significance.

Table 2 confirms robustness to alternative definitions and technique. Yield spreads on government securities are significant across all specifications. In the overall results and for capital-poor countries, investors pay more importance to economic fundamentals captured in 'investment climate and monetary stability' whereas for capital-rich countries railway indebtedness is more important. Offering government guarantee is the mechanism behind spillover of sovereign creditworthiness to railway securities.

Summary and Conclusions

This paper studies the relationship between railway and government securities during 1880-1913, through analysing the determinants of yield spreads on railway securities in conjunction with yield spreads on government securities.

Overall, the paper presents three results. First, spreads on government securities and country debt-servicing burden emerge as the two key variables in explaining yield spreads on railway securities. Country debt-servicing burden emerges as the common factor explaining yield spreads on railway and government securities. Second, country risk captured in the taxonomy of capital-rich and capital poor countries mattered for investment. Investors considered only railway indebtedness important for capital-rich countries but both railway indebtedness and debt-servicing burden for capital-poor countries. Lastly, sovereign creditworthiness influenced pricing of railway securities when railway securities carried a government guarantee.

Table 2: Robustness Estimates using Panel Corrected Standard Errors Regression

	(1) Overall	(2) Capital-Rich	(3) Capital-Poor	(4) Overall	(5) Capital-Rich	(6) Capital-Poor
Dependent Variable	r_spread	r_spread	r_spread	r-spread2	r-spread2	r-spread2
g_spread	0.512***	-0.367*	0.311***			
	(0.106)	(0.219)	(0.120)			
g-spread2				0.383***	-0.349**	0.527***
				(0.058)	(0.177)	(0.078)
pc1inv	0.310**	0.155	1.263***	0.106*	-0.050	0.635*
	(0.144)	(0.145)	(0.389)	(0.059)	(0.131)	(0.328)
pc2inv	-0.032	-0.003	-0.059**	-0.025	-0.074	-0.050*
	(0.020)	(0.036)	(0.029)	(0.043)	(0.047)	(0.026)
pc1bond	0.044	-0.654***	0.150	-0.012	-0.646***	0.059
	(0.113)	(0.136)	(0.156)	(0.056)	(0.125)	(0.129)
pc2bond	-0.652***	-0.663***	-0.791***	-0.544***	-0.654***	-0.327*
	(0.161)	(0.169)	(0.228)	(0.061)	(0.171)	(0.181)
guaint	0.019**	0.201***	0.021***	0.028***	0.222***	0.023***
	(0.008)	(0.033)	(0.008)	(0.007)	(0.038)	(0.006)
		(0.153)				
Controls	YES	YES	YES	YES	YES	YES
Country Effect	NO	NO	NO	NO	NO	NO
Year Effect	YES	YES	YES	YES	YES	YES
Observations	371	99	272	369	98	271
R-squared	0.459	0.764	0.599	0.451	0.789	0.575
Number of cc	15	4	11	15	4	11
VIF	2.37	7.61	2.81	2.37	7.99	2.81

Standard errors in parentheses

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

Notes: r-spread2 is defined as the difference between the end December railway yield of country *i* at time *t* and yield of UK government gold bonds. g-spread2 is defined as the difference between the end December government yield of country *i* at time *t* and yield of UK government gold bonds.

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