The performance and the efficiency of the corporate bonds market in Paris 19th century Bourse

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Abstract

This paper studies the French corporate bond market during 19th century. Despite its importance the performance of the corporate bonds quoted on Paris Bourse has never been studied yet. Here in order to analyse this market a price index of the corporate bond market has been created by utilizing the modern techniques used at present days. The creation of the index was made possible thanks to an original data base created by new data which has never used before and collected directly from the publications of the market authorities during the nineteenth century. Thanks to the index the risk and the return of the market have been measured. Then we have compared the performance of the French corporate bonds with those of the stocks and government bonds; the results of the comparisons are quite interesting. First, the corporate bonds are the least risky securities and second, their rate of return is higher than the government bonds during the nineteenth century. The study is completed by some market efficiency tests.

JEL Classification Code: C12, G14, G15, N23.
Key words: Market efficiency, Corporate Bonds, Bond market Index, Performance of Financial Markets.

Introduction

The phenomenal development of financial markets was a characteristic of all the European countries during the nineteenth century. The Paris Bourse was not an exception; by 1801 the trading was concentrated on few assets such as gold and silver ingots, bill of exchanges, the 5% government consol and one stock, whereas by 1914 the market capitalization had reached 150 billions French francs, half in domestic and foreign bonds (Daumard, 1998).

The financing of the industrial revolution requiring heavy investments has partly contributed to placing the financial markets on the centre of French economy. Meanwhile, the market authorities and financial operators try to adapt the market to the rising capital demands of the industries, especially in the last quarter of nineteenth century.

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As it shown in Table 1 even by 1890 self-financing, in entire French economy, was still preferred to the stock and bond issues. Nevertheless in the end nineteenth and early twenty centuries the share of self-financing in the whole financing amount of all listed and unlisted French companies was falling down. It loose 10% per decade to dropping finally to lower than 50% in 1913. (Hautcoeur, 1994)

Table 1. Net long-term financing amount of all the French companies (listed and not listed in the stock market)

Year	Self-Financing	Stocks	Bonds	Total
1890	0,8 65%	0,125 10%	0,3 24%	1,225
1900	0,9 51%	0,5 28%	0,375 21%	1,775
1913	1,4 42%	0,85 25%	1,12 33%	3,37

Notes: Self-financing is measured as the amount of no-distributed profits. The stock and bond issues are the net public subscriptions The sums are in billion francs. Source: Hautcoeur, 1994.

Table 1 points also out the distribution of total amount of issued securities between stocks and bonds (listed and not listed in Paris Bourse). As shown, the part of issued stocks and bonds goes steadily upward but finally it is the bond financing which stays higher than stock issues.

Table 2 gives some hints about how the Paris bourse has contributed as a primary market to the absorption of a big part of these issued securities. As shown, since 1870, nearly one third of all market capitalization of Paris Bourse is made up of the corporate bonds.

Table 2. Market Capitalization of the Paris Bourse (foreign values excluded)

Year	1840	1850	1860	1870	1880	1890	1900	1910
Corporate Bonds	0,3%	2,4%	24,1%	34,8%	29,5%	40,3%	39,8%	35,2%
Stocks	12,1%	17,7%	24,4%	25,7%	24,2%	22,1%	21,7%	27,8%
Government Bonds	87,6%	79,9%	51,5%	39,5%	46,3%	37,6%	38,6%	37,0%

Source: Arbulu(1998) for stocks, Vaslin(1999) for government bonds & Author.

The contrast between the corporate and government bonds trend is interesting. When the part of corporate bonds during the period 1840-1870 literally explode from 0.3 to 34.8 per cent of whole market capitalization, the part of government bonds is cut by half for the same period (39.5%). The other interesting jump in the market share arrives to the stocks in the last decade of the studied period; when the share of stocks in the market goes beyond 27% due to the second industrial revolution. (Concerning mostly the issues from the new industries like chemical, automobile…)

From the point of view it is to mention that, during the 19th century, the corporate bonds, unlike the stocks, were less regulated. While in 1807 France has set up a Commercial law namely *Code de Commerce* regulating the commercial and financial activities, but it dose not considers the corporate bonds. The reason would be that even if the corporate bonds were known since long time but their use was not popular and they were still unknown to the street

people. Even after some reconsideration of the law in the last quarter of the century, the bond issuance stays unregulated over the whole 19th century.

In order to presenting the share of each sector of French economy in the corporate bond market, a detailed table has been prepared by avoiding to joint the weakly capitalized sectors together. As shown in Table 3, concerning the economic sectors which issued bonds, the sector that is financed largely by bonds has been with no doubt the railroad one.

Table 3: Corporate bond market capitalization in Paris Bourse in French francs (31/12/1900)

	Sectors		Market share
1	Railroad (Big Companies)	15 581 232 285	69,27%
2	Bank&Insurance	4 629 826 546	20,58%
3	Colonial Companies	509 344 945	2,26%
4	Railroad (Local networks)	377 796 079	1,68%
5	Gaz	283 079 661	1,26%
6	Channels	267 429 544	1,19%
7	Transportation (excepting railroads&Channels)	260 137 424	1,16%
8	Dock & Water	179 732 510	0,80%
9	French companies working abroad	122 425 701	0,54%
10	Miscellaneous	121 742 066	0,54%
11	Forges, Foundry, Mines & Coal	100 089 495	0,44%
12	Electricity	51 568 953	0,23%
13	Real estate	9 565 514	0,04%
	Total	22 493 970 722	100,00%

Source: Author

Concerning the bank and insurance sector, the second sector mostly financed by bonds, one have to take in to account the fact that more than 95% of the issuances come from a unique bank(Credit Foncier de France) who gives the mortgage loans. Strange that might be seen is the minor part of the bond issuances of the Forges, Foundry & Mine sector, considering its huge capital need. We could explain this phenomenon by the social character of these companies created mostly at the end of 18th and the beginning of 19th century by one or several wealthy families which traditionally financed by "family's banker", rather than by public issuances.[2]

Therefore as mentioned the sector which was really financed by bonds has been the railroad in which we find the famous "big 6", that is, the six most important railway companies. Every one of these companies had got a concession to run in specific area (some regions) of the country. As shown in Table 4, up to 1885, the first 6 big railway companies have issued nearly 10 billion francs in bonds, whereas, their stocks issues for the same period add only up to 1.5 billion francs[3].

[2] See Levy-Leboyer (1996)

[3] The same situation is observed on the big American railroad companies (see Cohen(2007)).

Table 4: Amount of the securities issues by the 6 big railroad companies by 1885 (francs)

Company	Bonds(a)	Stocks(b)	a/b
Nord	1 038 815 164	231 875 000	4,5
Est	1 518 290 094	292 000 000	5,2
Ouest	1 296 716 823	150 947 918	8,6
Paris-Orléans	1 355 503 721	307 784 570	4,4
PLM	3 514 632 588	340 968 056	10,3
MIDI	954 708 126	146 319 020	6,5
Total	9 678 666 516	1 469 894 564	6,6

Source: A. Picard, *Traité de chemin de fer ...,1887*

In spite of the importance of the bond market we find very little number of studies on this big market and nothing on its performance and efficiency. The few number of existing studies on the bond market during 19th century are generally suffering from tow main problems; first they study just partly the market, either in terms of chosen period(not any long term study) or in terms of sector of activity.(just few sectors are studied)

For instance, Neymarck (1911) worked merely on the bonds issued by the 6 biggest railway companies and over the limited period of 1880 through 1908. Conversely, Hautcoeur(1994) in his doctorate dissertation on "Financing the French companies", has simply excluded all the railway companies of his database. Finally in a thorough study on the securities, Moreau-Néret (1939) makes no difference between corporate and other kinds of bonds; therefore all the municipal, governmental and corporate bonds are put in the same category. Hence the questions like: what was the performance of the corporate bonds? Why the traditional investors who used to invest in government bonds changed idea and decided to invest in the new corporate bonds market? Which security was more risky? Was it an efficient market, considering its fast evolution? are left unanswered

In this paper we have considered the entire corporate bond market during 19th century and covered all the period since the listing of the first bond in 1838 to the First World War. In order to study the performance and efficiency of the French corporate bonds market for the period 1838-1914, through a database created by the bonds prices, we have constructed an index of corporate bonds listed in the Paris Bourse. Studying the evolution of this index enable us to measure the performance and risk-return characteristics of the quoted corporate bonds in the Paris financial market. Considering these results as a natural experience, the examination of their characteristics permit us to realize whether the Paris bourse has passed definitely from an emerging market in the last nineteenth century to a modern market at the beginning of 20th century.(Arbulu, 1998)

The Bond Market

The study of a corporate bond market requires beforehand the creation of a database of issuers as well as market prices. As mentioned above, at the beginning of the nineteenth century there was no bond listed on the Paris Bourse. The first[4] corporate bond traded on the floor (*parquet*) is those of the first railroad company which has transported travellers in France, namely "Paris-Saint-Germain Railroad Company". Hence the year of its listing (1838)

[4] In fact, the first listed bond was issued by *Caisse Hypothécaire* but it was not really traded due to the small amount of its issues.

is also the beginning year of our study, which lasts to the start of WWI in 1914, covering 75 years.

One of our sources about the issuers is the official yearbook of listed securities, published by the stock exchange committee (*Annuaire de la Chambre Syndicale de la Compagnie des Agents de Change de Paris*) which presents an exhaustive amount of data about the listed companies.

Unfortunately the year book is published only since 1880; so to find the information about the bond issuers before this year, especially concerning the bonds which were crossed of from the market, we have had to use a very few number of unofficial handbooks published before 1880.Considering the prevailing lack of transparency of the financial world over the 19th century, it was generally difficult, for one to collect the information about companies. So these unofficial handbooks, suffer, in some way, of either incomplete or incorrect information making more difficult the research of disappeared bonds[5].

Before going further and exploring the results obtained by creation of issuers' database, it seems necessary to explain how was working the Paris Bourse over 19th century. The Paris bourse was founded by Napoleon's decree in 1802 and installed in an appropriated building (*palais de la Bourse*) since 1823. The Napoleon decree, combined with the *Code de Commerce* (commercial law mentioned above) legislated in 1807 set the basic of nineteenth century exchange. By the law the stockbrokers (*agents de change*) as government officials (*officiers ministeriel*) achieved a monopoly of the trade of the listed securities. Though, the law left the cash market lightly regulated (the exchange committee, *chamber syndicale*, allowed to create the internal rules) but the forward market was not given legal status.

Although the forward markets had not become legal by 1885, the brokers continue to handle a forward market for securities in the Paris Bourse. The reason of this disobey by the government's officials of the state law was simply the important demand for this market by the time investors and speculators. It is important to mention that the investors as the brokers' client had an important influence on the exchange committee decisions.

By drawing up an inventory of issued and listed bonds in the market (number of lines in the official bulletin), resumed in Table 5, we show that the Paris bond market was literally dominated by the railway bonds. Since 1890 almost more than 85% of bonds listed and 90% of the corporate bond market capitalization was issued by railway companies.

[5] See Bresson (1840), de Bririeux (1857) and Courtois fils (1875)

Table 5: Number of the French corporte bonds in Paris Bourse, Guaranteed by the government (Guara) and quoted on the Forward market(Fw)

		1858			1868		
	Sector	n° lines	Guara	Fw	n° lines	Guara	Fw
1	Railroad (Big Companies)	39	33%	0	39	35%	0
2	Bank	4	0	100%	9	0	75%
3	Forges, Foundry, Mines et Coal	1	0	0	4	0	0
4	Gaz	1	0	0	5	0	0
5	Colonial Companies	-	0	0	1	0	100%
6	Dock&Water	-	0	0	3	0	0
7	Transportation (excepting railroads&channels)	-	0	0	5	0	0
8	Miscellaneous	-	0	0	4	0	0
9	Railroad(Local network)	2	0	0	15	0	0
10	Real estate	-	0	0	-	-	-
11	Channels	-	0	0	1	0	0
12	French companies working abroad	-	0	0	-	-	-
13	Electricity	-	0	0	-	-	-
14	Insurance	-	0	0	-	-	-

		1878			1888		
	Sector	n° lines	Guara	Fw	n° lines	Guara	Fw
1	Railroad (Big Companies)	41	56%	0	43	56%	0
2	Bank	6	0	83%	14	0	86%
3	Forges, Foundry, Mines et Coal	7	0	0	11	0	0
4	Gaz	6	0	0	12	0	0
5	Colonial Companies	7	29%	0	17	59%	12%
6	Dock&Water	5	0	0	10	0	0
7	Transportation (excepting railroads&channels)	3	0	0	8	0	0
8	Miscellaneous	11	0	0	15	0	0
9	Railroad(Local network)	43	0	0	34	18%	0
10	Real estate	1	0	0	2	0	100%
11	Channels	3	0	0	13	0	0
12	French companies working abroad	1	0	0	2	0	0
13	Electricity	-	-	-	-	-	-
14	Insurance	-	-	-	-	-	-

		1898			1908		
	Sector	n° lines	Guara	Fw	n° lines	Guara	Fw
1	Railroad (Big Companies)	51	78%	69%	44	89%	73%
2	Bank	12	0	83%	3	0	0
3	Forges, Foundry, Mines et Coal	17	0	0	15	0	87%
4	Gaz	15	0	0	22	0	0
5	Colonial Companies	11	73%	27%	16	0	0
6	Dock&Water	11	0	0	19	68%	37%
7	Transportation (excepting railroads&channels)	8	0	0	11	0	0
8	Miscellaneous	22	0	0	14	0	0
9	Railroad(Local network)	21	18%	4%	21	25%	5%
10	Real estate	1	0	0	32	31%	13%
11	Channels	17	0	100%	6	0	67%
12	French companies working abroad	6	0	0	3	0	0
13	Electricity	3	0	0	9	0	0
14	Insurance	-	-	-	15	0	0

Source: Author

Table 5 shows also how the French government deals with different sectors by promoting them with some *ad hoc* advantages, like guaranteeing the yields or permitting the access to the forward market.

In fact by 1852 the railway companies had encountered many important obstacles to financing the expensive construction of the railroads works and all other related infrastructures (i.e., train stations, bridges, rolling equipments, etc.). Since France was late, compared to her neighbours (England and Germany) in term of the length of railroad network, the government decided in 1852, to help indirectly the rail transport sector by signing an agreement with the five biggest companies and through that guaranteeing the yields of the railroad bonds[6]. Thus the government assimilates in some how the corporate bonds to the government ones. The convention has, with no doubt, rescued the big 5 and contributed henceforth to their rise during the rest of the century.

According to Modigliani & Miller (1958) in a perfect market, the financing decision of a company has no impact on its stockholders wealth but one of the assumptions concerning a perfect market is that, no subsidies would be received by the companies participating in this market. Whereas in a real world in which the public authorities operate for motivating the economy (here by guaranteeing the yields) the company's financing choice is substantially affected. Accordingly, it prefers the debt; here bond issuances, to call up capital, because this choice contributes to increasing the wealth of stockholders by reducing the costs of alternative financings.

The impact of the agreement on the market was considerable. In one hand the companies started to issue an important quantity of bonds with, on average, lower interest rates than before and on the other hand the investors started to consider the railroad bonds as risky as government bonds in their portfolios[7](We will show later that they were even less risky). Consequently, the part of railroad bonds on the total French wealth passes from 1% in 1853 to 23% at the end of 1910s. In the same period the percentage of all the stocks on the French people's wealth changes just 17 %.(Daumard, 1973)

Meanwhile, strangely enough, the government gets banded the access of the railroad bonds to the forward market. The raison of this decision would be the symbolic value of the government bonds for the authorities. The government bonds (*rentes*) were important components of the state budget[8], so any decline of the demand for them would have had catastrophic consequences for the future governmental issues. Since the listing of the railroad bonds on the forward market would increase the demand for them and possibly decreases the demand for the government bonds, the public authorities decided to prevent their trading on the forward market (*négociation à terme)*.

Another interesting phenomenon highlighted in the Table 5 is the financing of the new technologies by the market. In fact, the second industrial revolution and the development of the sciences and technologies promote the creation of the venture capitals and hence the emerging of new sectors, like Gas and Electricity in the Stock exchange listings. Many of the companies composing these sectors were the risk capitals which could be compared to the "dot com" ones set up at the end of the 20th century.

Finally Table 5 details the government's colonial policy during the nineteenth century. This materialized by guaranteeing the yields as well as the permission for the colonial bonds to be traded on the forward market. This policy was justified at the time by the dazzling expansion of the British colonial companies in the second half of the nineteenth century and the late of France in the colonial expansion. (Goetzmann, 2005)

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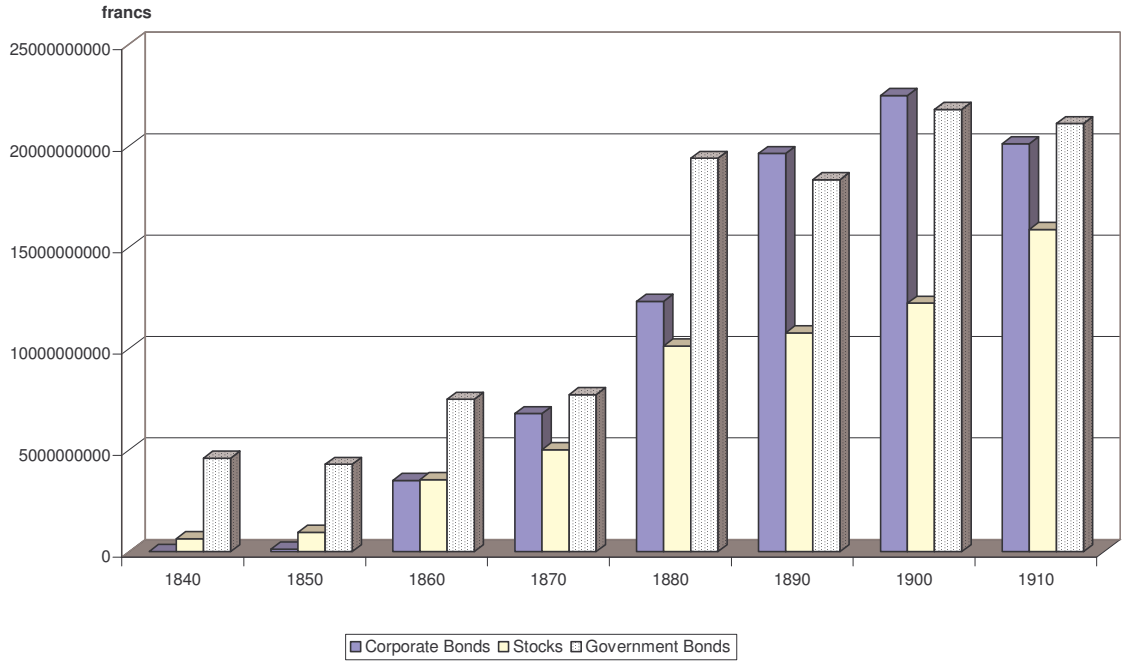
[6] See Caron (2005) & Feldmann (1894).

[7] As we see in Figure 1 during the period 1860-70, thought the government bonds' part of the market stay stable, the corporate bonds' part goes continuously up (the same for the period 1880-90 after the Franco-Prussian war)

[8] Over the last 19th century they compose almost, 15% of the public expenditure. (Levy-Leboyer, 1985)

The next step after the creation of a bond issuers' data base is to find the market capitalization of the corporate bonds. For this, we chose to calculate the market capitalization of entire bonds every 10 years. Figure 1 shows the evolution of the market capitalization of Paris bourse during almost 80 years. Unlike stocks and government bonds, the corporate bonds' market capitalization is rising up to 1900 almost steadily. Here the security's prices were obtained thanks to the official bulletin of securities prices (*Cour officiel des valeurs admises à la cote*) published every trading day of the Bourse by the Paris Stock Exchange committee.

Figure 1. Evolution of the market capitalization of Paris stock exchange



Since the objective of this paper is to studying the performance and the efficiency of the bond market, the creation of an index of bonds prices is henceforth necessary. Thus the next stage is to create a database of market prices for a representative market portfolio.

Data

The data base of bonds prices is created by capturing manually the monthly market prices of the bonds since 1838 (as mentioned, the year of the listing of the first corporate bond). At the beginning years of the studied period, all of the bonds have been considered and their prices were added to the data base, but as the number of listed bonds goes up, we were obliged to choose the bonds with the largest market capitalisation in each sector. The largest market capitalizations were considered also because of their high liquidity permitting a continuous market quotation, whereas, in the case of smaller companies, we encounter long periods without quotation, because of the lack of trades.

Therefore we chose 57 corporate bonds from 7 economic sectors to create our portfolio the share of each sector in the portfolio is nearly the same proportion as in the real market. (Table 6). The bank sector is excluded from our index. As mentioned before this sector is composed mainly (more than 95%) by the lottery bonds issued by a mortgage bank namely

Credit Foncier de France. Since the calculation of an index for lottery bonds involves specific procedure which is different from the corporate bonds method, they have been excluded. Additionally as shown in the bottom of the table 6, the portfolio represents all along the period at least 50% of the corporate bond market.

Table 6. Evolution of the compsition of the corporate bond's index

		1840	1860	1880	1900	1910	Share in the index portfolio	The total number of bonds*
1	Railroads	3	36	24	21	19	70%	49
2	Docks & Water		2	2	2	2	7%	2
3	Transportation				1	1	4%	1
4	Gaz				1	1	4%	1
5	Electricity					2	7%	2
6	Forges, Foundries, Mines & Coal					1	4%	1
7	Real Estate					1	4%	1
	Total	**3**	**38**	**26**	**25**	**27**	**100%**	**57**
	MK of Index portfolio/Total MK of the Corporate Bonds(%)	100	93	86	58	53		

*The total number of bonds ever entered in the index portfolio

The prices are the monthly (last traded day of month) prices and the bonds with a very short life time have been excluded from the database [9]. The studied period lasts for 75 years up to the July 1914. This deadline was chosen for two reasons; first, because of the beginning of the World War that brought the direction of stock exchange to decide the closure of the bourse for a few months and second that in historians' opinion, the veritable end of nineteenth century has been 1914, and the beginning of the World War I.

In general the average maturity at issuance of the bonds during 19th century was much longer compared to today's bonds. For example, almost all of the railroad bonds had a maturity longer than 90 years. The same for our portfolio values, which have, uniformly a maturity longer than fifty years. This allows us to put them together in the same portfolio without technical problem of the homogeneity of maturities.

Another technical problem concerns the yields payments, as the coupons were traditionally paid twice a year, the prices of bonds were affected by the accrued interests. Therefore the day after in which a bond goes ex-coupon, the bond price starts to be augmented for the amount of accruing interest, that is, the coupon value divided to the days remaining to next payment (when the coupons will be detached from the bond). Saying that, construction of index with market prices would introduce an additional volatility due to a technical factor, that is, accrued coupon. Vaslin (1999) found the difference between annualised returns standard deviations calculated by both market prices, and ex-coupon prices as roughly 50%. Consequently henceforth in this paper, we use exclusively the ex-coupon prices (*cours nu*) to avoid this artificial volatility in our results.

Methodology

The construction of the corporate bond market "general index" is made in 3 following stages: first the creation of individual indices for each bond, second constructing the sector indices and finally developing of the index of all the sectors.

[9] Less than 15 years, relatively low for the time.

The base price for the calculation of individual indices is the price of bond at 31 December of its listing year. So our index is based 100 for the 31 December 1838.

As for the repayment of capital of the bonds, the companies used, annual instalments method; the volume of the amortised and floating bonds is calculated by using this method for all the 57 bonds of the index portfolio.

The arithmetic average of the individual indices of the same economic sector gives the index of each sector. As the index composition changes with adding of newly listed bonds the splicing method (*chainnage*), is applied every time that a new individual index is added into the portfolio of the sector index. Hence, when a new individual index appears, the previous portfolio is sold for buying the new portfolio. The same is done when an individual index comes out of the index composition, (either because the bond is no more listed on the stock market or that it is entirely amortized).

The weighted average of sector indices gives the "general" index of the corporate bonds market. Each sector is weighted by its market capitalization. Although the sectors indices are just representative of their economic sector but applying the entire market capitalisation to the sector index gives us a general index of all the listed bonds at the Paris bourse.

As mentioned, the general index has been calculated to measure the evolution of the corporate bond market prices without considering the yields. But evidently, one of the main incentives for investors to acquire a bond is to receive the cum coupons interest. So also a buy-and-hold strategy index has been built to capture the wealth generation of a bond holder who re-invested the interests once he had received the coupons. We call our total return index the "portfolio Index". It measures the increase in wealth for an investor who re-invests the earnings yields (coupons) in the bonds with the same proportion that they compose his portfolio.

Since at the beginning of the studied period the index portfolio has been made up of all the existing bonds, even in the end of period (1914), they still constitute 70 percent of the values of the index portfolio, so the results of this study are spared from the survival bias.

In order to compare the performance of the divers securities over the nineteenth century the same indexes are used, that is, the general index and the portfolio index, computed for the stock prices as well as government bond prices. Here we used the stock market index built by Arbulu (1998) from 1801 through 1914 and the government long-term bonds index calculated by Vaslin (1999) over the period 1798-1914. We also borrowed the Historical CAC40 index, a capital appreciation index, calculated by LeBris(2008) representing the performance of the stock market blue chips from mid 19th century up to 2007.

Results

From an emerging market to a modern one?

Figure 2 depicts the evolution of the Paris stock exchange securities' indices. It indicates clearly that, in terms of total return, corporate bonds take the middle place of listed securities: lower than stocks and higher than government bonds. Over the first 15 years of the period the returns are not really different. It is just from middle 1850s that stocks and bonds start to diverge from the government bonds returns. Thus, for example, 300 francs invested on the whole market (100 francs per security portfolio) in 1838, with all cash flows reinvested, would have accumulated to nearly 13 000 francs at the end of the period! In which the stocks portfolio represents 55%, the corporate bonds 29% and finally the government bonds 21%.

On the figure 3 one can distinguish the events which caused some rise and falls of the "General index" of different compartments of the market.

Figure 2. Portfolio Indexes of Paris Bourse. (Base 100, 31/12/1838)

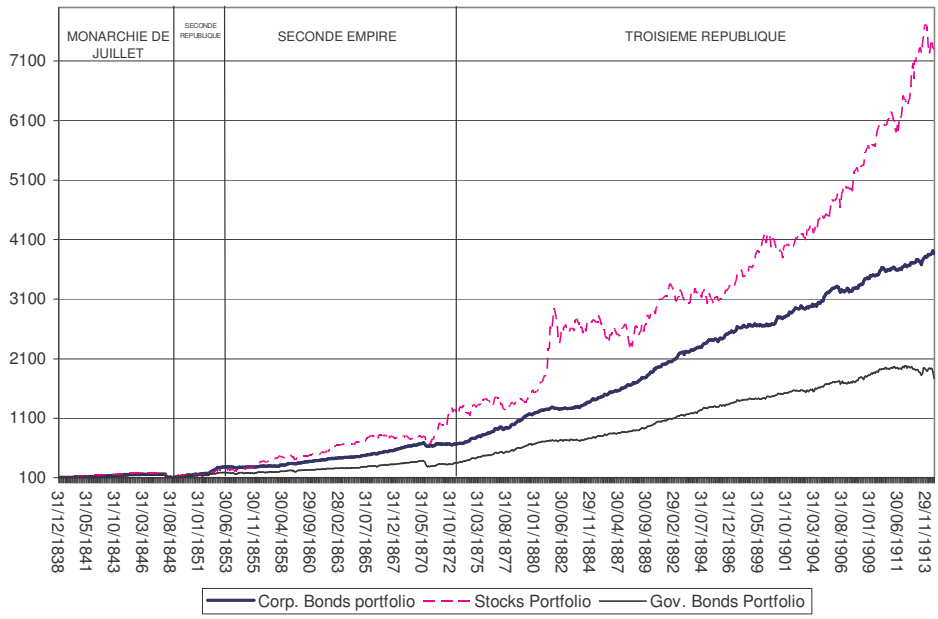
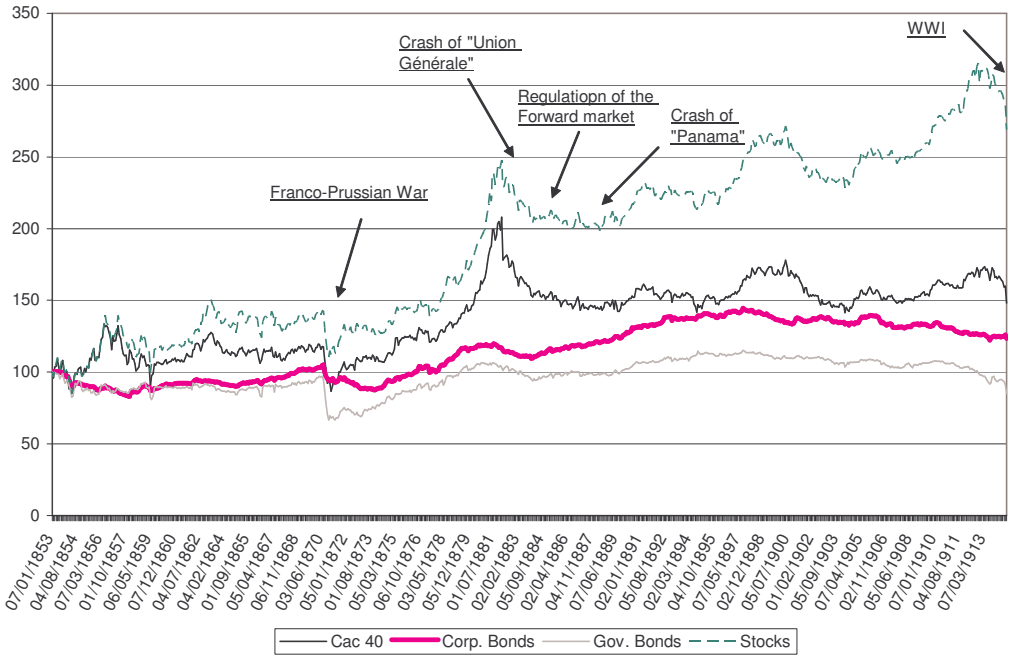


Figure 3. General price indexes of the Paris bourse (Base 100, 31/12/1853)



The Capital Asset Pricing Model (CAPM) based on the works of Markowitz(1952) and developed by Sharpe(1964) shows that the performance of a portfolio depends on its return as well as the risk taken to reach this return. Table 7 depicts the securities returns as well as the standard deviations as the risk parameter. Here, the sub-periods are the historical periods, in

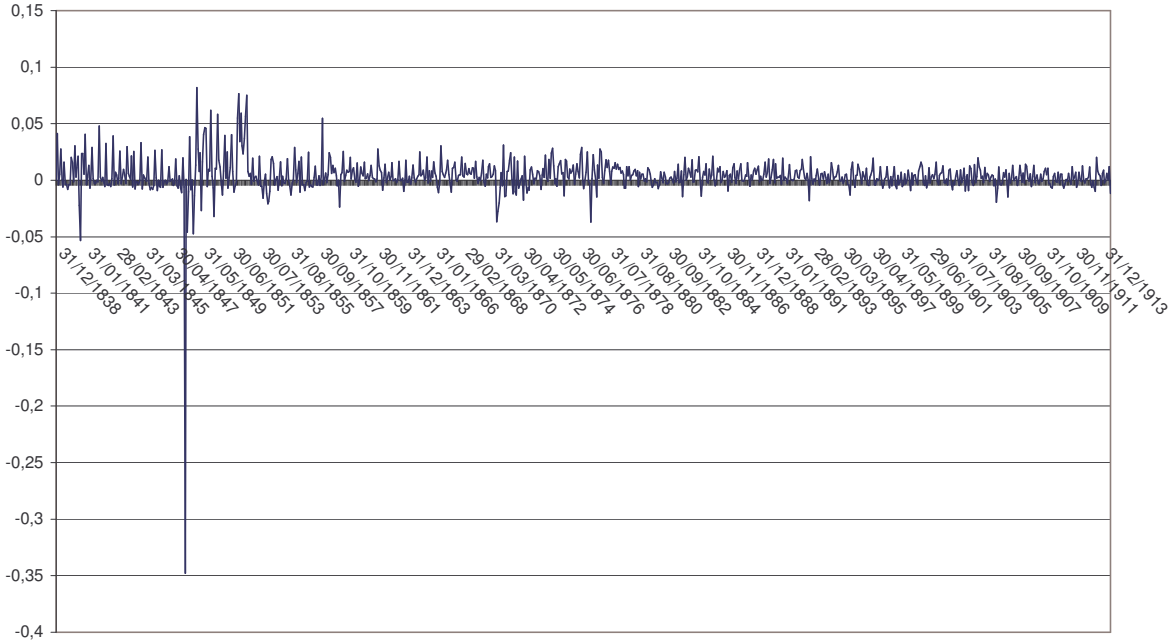
fact, since over the period of study the French political regime changed three times, the lifetime of these regimes has been chosen as the sub-periods. Thus, the average return of the corporate bonds is 0.5 per cent per year over the entire period. This performance is placed nearly between the government bonds (-0.22%) and the stocks (1.97%) returns. The most interesting thing depicted in this table is the low magnitude of risk presented by the standard deviation of the corporate bonds compared to the government bonds and opposite of the CAPM considering the government bond as the unique risk less security in the market.

Table 7. Average yearly returns (Standard deviations in brackets)

		Portfolio Index(%)			General Index (%)			
Periods	n° of months	Corporate bonds	Gov. bonds	Stocks	Corporate bonds	Gov. bonds	Stocks	CAC 40
MONARCHIE DE JUILLET 1838-1848	110	5.09 (5.04)	4.03 (4.27)	5.57 (8.53)	0.47 (3.49)	0.28 (3.93)	2.20 (8.88)	
SECONDE REPUBLIQUE 1848-1851	45	2.28 (20.6)	-0.92 (36.29)	-2.26 (52.14)	-5.12 (19.72)	-6.55 (36.97)	-6.30 (38.74)	
SECONDE EMPIRE 1851-1870	225	6.99 (4.81)	4.57 (7.33)	8.29 (11.51)	1.74 (3.93)	-0.12 (7.40)	4.00 (11.93)	0.16* (10.70)
TROISIEME REPUBLIQUE 1870-1914	527	4.07 (2.8)	3.82 (4.30)	5.25 (8.91)	0.53 (2.29)	0.16 (4.18)	1.77 (5.59)	0.83 (6.47)
ALL PERIODS 1838-1914	907	4.83 (5.84)	3.80 (9.50)	5.67 (14.83)	0.54 (5.23)	-0.22 (9.60)	1.97 (11.67)	
ALL PERIODS EXCEPTE "SECONDE REPUBLIQUE"	862	4.96 (3.76)	4.04 (5.25)	6.09 (9.61)	0.84 (2.97)	0.10 (5.19)	2.41 (8.14)	0.64* (7.90)

* The CAC40 caculated since January 1853

Figure 4. Volatility of the corporate bonds general index (monthly returns)



Since the period of the Second Republic was a revolutionary era creating an extreme instable environment in the both political and economical points of view, the market performances have computed without this period. Even so, the order of the performances is not changed, but, interestingly, the rate of return of the government bonds stays quit low. This would constitute an argument in favour of the Equity Premium Puzzle proposed by Mehra&Prescott (1985) and developed by many other authors in Finance. In which the authors pose the question of the strange high risk premium of the stocks considering the risks taken. As we show here, one of the eventual reasons would be the quit low rate of returns of the government bonds. According to the efficient market hypotheses, in an efficient market the prices reflect all the past and future information so arriving new information has no effect on the market prices simply because they are already integrated in the prices. Therefore in an efficient market there is no excessive fluctuation of the prices. Considering the standard deviations we observe a slight decrease, since mid nineteenth century in volatility for all the categories of security in Paris Bourse. Since the main characteristic of the emerging markets is their high volatility, we could consider the nineteenth century Paris Bourse as an emerging market which evolves. (Figure 4)

Guaranteed vs. Non-guaranteed

As mentioned, in order to promoting the railroad transportation in the country the French government decides to guarantee the bond yields of the big railroad companies. The decision has largely contributed to the expansion of the railways all over the country; nevertheless the agreement between the companies and the government took long times and consumed much energy of the two sides to be concretized and that because of its complicated procedures. Indeed, the agreement made the accounting of the railroad companies very tedious and overwhelming to understand. As shown in table 5 all of the companies were not profited of this device.(Caron, 2005) The bonds issued before 1852 stay largely uncovered and kept their initial cracteristics, but even after the signature of the agreement some companies continue to issue non guaranteed bonds. For example the famous “Nord railroad

Company" is one of these companies which have never used the government guarantee to cover its bonds.

Sure the yields guaranteed let the companies to issue a huge amount of bonds with lower yields but here one could ask that, is this agreement changed really anything, in term of financial performance, for the bond holders. In theory the guaranteed bonds have to follow the same behaviour of the government bonds and enjoy of the lower market price fluctuations compared to the non-guaranteed bonds. On the other hand the non-guaranteed bonds have to give a higher market returns related to their default risk. In order to answer the question some series of the monthly returns of the two most representative bonds of each group have been compared. These two guaranteed and non-guaranteed bonds belong respectively to Lyon and to Nord railroad companies; they have the same technical characteristics (maturity, yields and face values). The results of the analysis are presented on table 8.

Table 8. Guaranteed and non-guaranteed bonds' return analysis 1852-1914

	Average annual returns	Standard deviation
Nord(non-guaranteed)	0,09%	0,045
Lyon(guaranteed)	0,13%	0,050
Government bonds	-0,26%	0,052

Comaprision of the statistical moments and distributions

	Student t-test (p-value)	Different averages?	Fischer-Snedecor test (p-value)	Different SDs?	Chi-squared test (p-value)	Different Distributions?
Nord Vs. Lyon	0,96	NO	0,002	YES*	0.0000	YES
Nord Vs. Government bonds	0,69	NO	0,000	YES*	0.0000	YES
Lyon Vs. Government bonds	0,66	NO	0,307	NO	0.0000	YES

*Significant for 1%

The first results are in contrast with our expectations, that is, even if the average annual returns are different (0.04% per year) but their comparison is not statistically significant so to be guaranteed dose not make changes in the returns of the bond. On the other hand the standard deviations are quite lower for the non-guaranteed Nord bonds and the tests confirm this difference between the guaranteed and non-guaranteed bonds. Accordingly the yields guarantee was differentiated two bonds in terms of the risk but it has neither influence on the returns of the bonds nor on their statistical distribution.

Here also have been compare the returns of the sector indexes composing the index. As shown in table 9 the performances do not diverge really from the General index and one can not reject the hypothesis of the equality of the average returns. Here the reason would be the homogeneity in the returns of the different sectors of the Paris bond market during the nineteenth century.

Table 9. Monthly average returns of the sectors

Period	General Index	Railroads	Dock& Water	Transportation	Gaz	Electricity	Forges, Foundry, Mines & Coal	Real Estate
MONARCHIE DE JUILLET 1838-1848	0,47%	0,47%						
SECONDE REPUBLIQUE 1848-1851	-5,13%	-5,13%						
SECONDE EMPIRE 1851-1870	1,75%	1,74%	1,47%					
TROISIEME REPUBLIQUE 1870-1914	0,54%	0,54%	0,72%	-2,56%	-0,55%	-0,74%	-1,17%	0,87%
ALL PERIODES	0,55%	0,55%	0,87%	-2,56%	-0,55%	-0,74%	-1,17%	0,87%
Student t-test between sector and the general index (p-value)*	-	0,997	0,667	0,237	0,849	0,658	0,920	0,197

* None of the averages are significantly different.

Corporate bonds vs. Government bonds

As shown in table 7 the standard deviation of the corporate bonds, over all the periods, is almost always lower than the Government bonds. Accordingly the government bonds were more risky than the corporate bonds over the nineteenth century!

Generally, to compute the *ex post* risk premium of a stock, one takes the government bonds returns as the risk-free return. In this way, the calculation of the risk premium of the French stocks based on the government bonds becomes impossible due to the fact that the government bonds are not really, default-free bonds. Henceforth, these results add a new puzzle to a domain that does not miss any[10]. Two reasons would explain this phenomenon; first it concerns the instable political environment over nineteenth century. In fact, during the French revolutionary era, that is, last 18th century, the revolutionary government (*convention*) considering the huge public debt of the ancient regime as a barrier to development of the young republic, announced that it assumes just one third of the ancient public debt. It is not to mention that, the government bankruptcy announce ruined may of the bondholders and psychologically affected the investors' behaviour during nineteenth century. Henceforward, once a regime changes (because of revolution, war, etc.) the public issues prices collapses dramatically creating a huge gap between government bonds and corporate bond prices which resist better in case of market collapses due to a regime change. The table 10 depicts clearly this phenomenon. Here more than half of the most important falls of the market is directly related to the regime changes, but the drops in the corporate bond market is mostly due to the worsening of the economic circumstances.

[10] The pervious , as mentioned, is the Equity Premium puzzle advanced by Mehra&Prescott(1985)

Table 10.The most important falls of the bond market index 1838-1914

n°	Date	Corporate bonds	Date	Government bonds
1	31/03/1848	-35,31%	31/03/1848	-64,92%
2	30/09/1840	-5,34%	30/09/1870	-11,41%
3	31/10/1848	-5,04%	31/08/1870	-9,28%
4	31/07/1870	-4,94%	31/07/1870	-8,83%
5	31/05/1848	-4,59%	30/04/1859	-8,48%
6	30/04/1877	-4,14%	31/07/1914	-7,30%
7	30/04/1850	-3,43%	31/05/1849	-7,07%
8	31/08/1870	-2,79%	30/11/1848	-6,86%
9	30/04/1859	-2,76%	31/03/1854	-6,44%
10	31/05/1849	-2,74%	30/11/1854	-5,95%
Average		-7,11%		-13,65%
Standard deviation		9,96%		18,09%

Second reason of this high market volatility involves the government's management (mismanage) of the public finance. It is important to mention that the public bonds were issued as perpetual but to reduce their debt, once the market prices of the bonds go below of the par, the authorities ask often the bondholders either be repaid on the par value or accept to reduce the yield (nominal rate) of their bonds, for example to convert 5% bonds to 4.5%. In this way, the government reduces its future charges by issuing henceforth the bonds with lower coupon rates. In consequence, during each bearish market the risk of the conversion of the government bonds make them more volatile than the corporate bonds.

Efficiency of the bond market

As mentioned above, the market efficiency hypotheses state that security prices fully reflect the available information. In consequence the returns are unpredictable from past returns, and the best forecast of the return of a security is its historical mean. In other hand, these hypotheses suppose that market returns follow a normal distribution. It is to mention that the recent authors of finance reject this hypothesis and declare that the efficiency of a market do not depends to its normal distribution of the returns. Though we do some classic tests to find the real shape of the distributions.

Tests on the distribution of the returns

. We start the market efficiency tests with examining the distribution of the returns. Therefore, in order to test the normality of the return distribution three famous tests have been used, that is the skewness and kurtosis test, Jarque-Bera test and Chi-squared test of normality.

1- Skewness and Kurtosis test

It is to mention that, when a series of numbers follow the normal distribution the skewness and the kurtosis values are respectively equal to 0 and 3. A skewness equal to zero implies that there is as positive price variations as negative ones and a kurtosis equal to 3 shows that the probability of extreme price variations are weak. Table 11 depicts the third and the fourth moments of the corporate bonds returns.

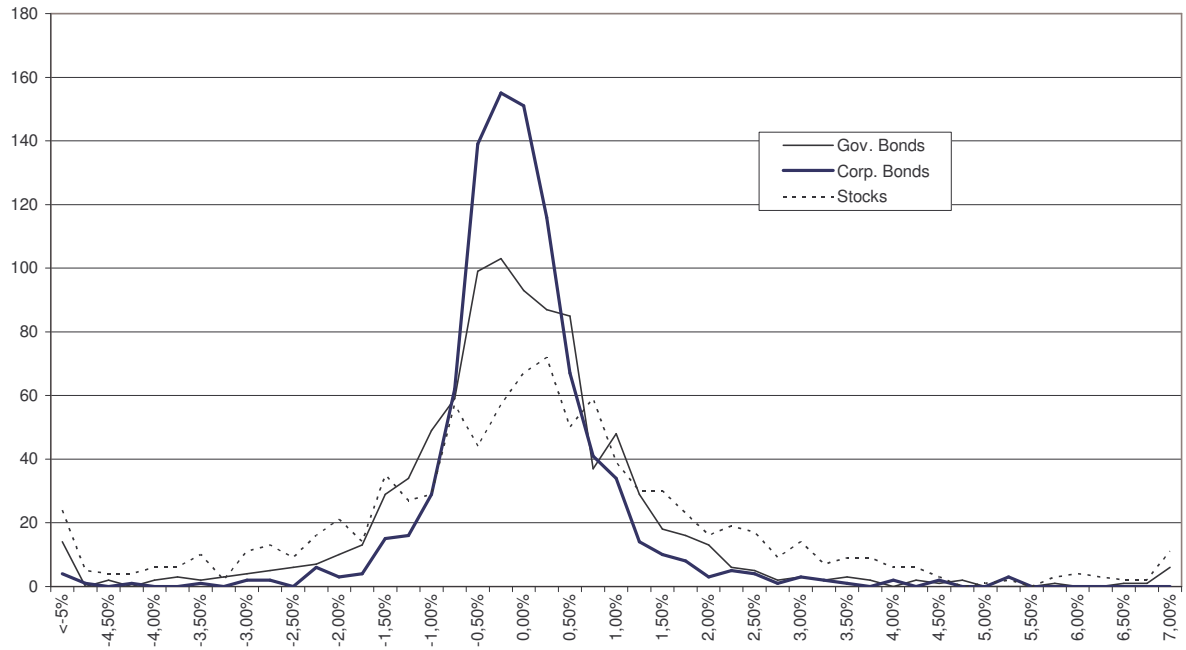
Table 11. Statistical moments of monthly returns

	Mean	Standard deviation	Skewness	Kurtosis
Value	0.54	5.23	-13.99	333.89
P-value*	0.362	-	0.0000	0.0000

*P-value attached to the null hypothesis when Value=0, for the Kurtosis Value=3

The tests show that the distribution is asymmetric and left-skewed. In addition, the distribution is leptokurtic and has a more acute peak around the mean compared to a normal distribution. The distribution has also long tails that show a higher probability of extreme returns than a normally distributed variable. (Figure 5) The leptokurtic character of the financial rate of returns is frequently observed and has shown for the first time in the works of Mandelbrot (1963) and Fama (1965). But the quite high value of the kurtosis of our rate of returns (ROR) is eventually due to the fact that the returns come from an emerging market that as shown in the financial literature present more extreme returns. In consequence, as we approach to the end of the nineteenth century we have to observe the lower Kurtosis values. (A hypothesis that will be proved on Table 12)

Figure 5. Distribution of the returns series (1838-1914)



The table 12 depicts the Skewness and Kurtosis of the corporate bonds returns and their statistic tests corresponding to each sub-period. Interestingly, as we approach to the end of the century the values of the parameters are decreasing. In the last sub-period we have almost the same skewness and kurtosis of the contemporary returns observed on the international stock exchanges. (Sk=-0.36 & Ku=6.97)

Table 12. Table of the skewness and kurtosis

	Number of observations	Skewness	Kurtosis
MONARCHIE DE JUILLET	110	-0,52 (0.028)	10,79 (0.000)
SECONDE REPUBLIQUE	45	-5,42 (0.013)	36,53 (0.000)
SECONDE EMPIRE	225	1,26 (0.055)	11,03 (0.000)
TROISIEME REPUBLIQUE	527	-0,36 (0.000)	6,97 (0.000)

* The values in to brackets are the p-values for Sk=0 and Ku=3

2- Jarque-Bera and Chi-squared tests of normality

The JB test permits one to compare the observed values of the third and forth moments with those of a normal distribution. Since the Chi-squared test of normality is considered more robust than the JB test (in fact JB statistics is so sensitive to the extreme values) we have calculated also the Chi-squared test for the statistical significance of 5 and 1%. The results are presented on the table 13.

Table 13. Tests of normality

	nomber of observations	JB Statistics	Chi-squared for 5%
MONARCHIE DE JUILLET	110	282.75	reject
SECONDE REPUBLIQUE	45	62.58	reject
SECONDE EMPIRE	225	663.92	reject
TROISIEME REPUBLIQUE	527	389.87	reject
ALL PERIODS	907	4167.75	reject

According to the tests, the normality of the returns is rejected for all the periods by JB and Chi-squared tests. As explained before these results do not reject the efficiency hypothesis of the corporate bond market but they inform us on the shape of the distribution

The Random Walk tests

A market is efficient (in its weak-form)[11] if the analyse of only the last prices do not permit to obtain a regular benefits, simply because the entire necessary information needed to evaluate the fundamental value of a security is already included in the last price. This weak-form hypothesis would be tested by the test of random walk process. Since the prices have already integrated the needed information to evaluate their future price therefore just unpredictable information is likely to change the prices. Between the mathematical processes just a stochastic process has these characteristics, therefore if the series of a security prices follow a stochastic process one could conclude that the market is efficient.

The theory of market efficiency is based on the hypothesis of the rationality of the agents. This hypothesis has been assumed to take essentially in count, the quality as well as the quantity of the available information.

[11] Definition is borrowed by Fama(1970,1991)

The rational anticipation of the agents is proposed by Muth(1961) explain that the agents evaluate the probabilities of future prices by using the available information which would affect the prices. In other word:

$$X^{e}_{t+1} = E(X_{t+1}/\Phi)$$
$$X^{e}_{t+1} = X_{t+1} + \varepsilon_t$$

Where X^{e}_{t+1} is the anticipated price

X_{t+1} Is the price at the time t+1. and

Φ_t Is the all available information at the time t.

This definition implies that degree of fluctuation of the prices is just equal to the term of error of a stochastic process called white noises (with zero mean and constant variance). So here we have a random walk process, that is, a process in which the present price is an without bias estimator of the future prices.

In order to test the market efficiency of the French bond market during 19th century; we utilize here the present available information, that is, the monthly index of the French corporate bonds from 1836 through 1914.The weak-form of market efficiency test, suppose that the prices follow the below process:

$$X_t = \alpha X_{t-1} + \varepsilon_t$$

Where X_t is the price index (in logarithm) at time t and ε_t is a white noise (0, σ^2).

Here we use the augmented Dickey-Fuller (ADF) test based on Dickey-Fuller (1981) test improved since, to find out if the prices follow a random walk process or not? The objective of this method is to examine if our series are (non)stationary. A set of data is stationary if its mean and variance are independent of the time. More precisely this test determine the number of differentiations needed (unit roots) to make the series stationary. For example a series is said to be integrated of order one, denoted I (1), if the fact of taking a first difference of consecutive prices produces a stationary process. Hence, in the above equation we have:

The hypotheses H0: a random walk process or unit root is verified if coefficient α =1.

In other word, the prices are integrated of order one (the returns are therefore stationary) and the prices follow a random walk.

Here ADF test from URADF procedure of the RATS software (version 6.2) was used. The main characteristic of this procedure is that it estimates directly the number of optimal lags which let ε_t become a white noise (absence of autocorrelation). The number of lags has been determined by Lagrange multiplier (LM)[12]. The ADF test is applied to the index of the bond prices (in log) over different periods. In addition, the Phillips-Perron(PP)[13] test often considered more robust than the ADF test is also applied for the verification of the results of the ADF test. The results are presented in table 14:

[12] See Tsay (2005).
[13] See Phillips&Perron (1988)

Table 14. Unit Root test (DS) of the sub periods*

	nomber of observations	nomber of lags	ADF test H0:1-α=0 (Sig. for 5%)	PP test H0:α=1 (Sig. for 5%)	Constant value (t-stud)	Joint H0 test Without constant** (Sig. for 5%)	Result: the prices follow
MONARCHIE DE JUILLET	110	0	-2.02 (-2.88)	-5.21 (-14)	0.22 (2.02)	2.15 (4.63)	ARIMA(0,1,0) Random Walk (DS)
SECONDE REPUBLIQUE	45	1	-0.50 (-2.93)	-0.82 (-13.3)	0.08 (0.53)	0.89 (4.86)	ARIMA(1,1,0) DS
SECONDE EMPIRE	225	2	-3.01 (-2.88)	-15.89 (-14)	0.15 (3.01)	4.61 (4.63)	ARIMA(2,1,0) DS
TROISIEME REPUBLIQUE	527	2	-2.10 (-2.86)	-2.63 (-14)	0.02 (2.14)	3.44 (4.59)	ARIMA(2,1,0) DS
ALL PERIODS	907	7	-1.87 (-2.86)	-6.99 (-14.01)	0.02 (1.89)	1.88 (4.59)	ARIMA(7,1,0) DS

* The H0 is accepted when the calculated coefficient is higher than the theoreical value(in the brackets)
** The Fisher test: the H0 is accepted if the calculated coefficient is lower than theoretical value(in the brackets)

The results are quite surprising, simply because they go against the Arbulu (1998) results obtained for the stock prices over the nineteenth century. First, table 14 shows that the bond prices do not follow systematically a random walk and the bonds' prices stationary hypothesis is rejected for whole period (1838-1914). However, the random walk hypothesis is a joint hypothesis of the market efficiency hypothesis and its rejection do not invalidate the market efficiency. Second, as mentioned in the previous paragraph the originality of our results is the contrast in term of trends observed in previous works on 19th century Paris bourse for example the results of Arbulu's thesis on the stocks suggest that more we approach to the end of nineteenth century more the prices seem follow a random walks process and consequently more the market is efficient. He argues that the agents in the beginning of the century are not yet mature and their behaviour is the same that a "gambler". They are mostly affected by the political events than by economic news, hence between the market's agents of the beginning of the century the information are hierarchical. That is, they pay more attention to some information rather than the others (while all information influencing the prices has to be considered equally). Whereas to the end of the period the agents become mature, they adopt a more "thought" behaviour so henceforth they anticipate rationally the prices by discounting the future cash-flows. Since the number of the lags in the last sub periods decrease Arbulu deduces that the information is already integrated immediately in the prices.

However, the previous results on the first four moments of the bond prices (see tables 7&10) depict the reduction, over the last sub periods, of the volatility and the number of extreme prices as the signs of the passage from an emerging one to a modern market, nevertheless the tests of normality as well as unit roots (ADF and PP) suggest an inverse trend. According to the results of these tests the corporate bond market as of its beginning is efficient. The prices follow a random walk process and the information is integrated into prices as soon as it arrives to the market (the absence of lag in the first period, 1838-1848). Whereas toward the end of the study period the series of the prices are no more a random walk and the number of lags increase. One could interpret these results in two manners:

First, a logic deduction could be that a financial market would be efficient as of its beginning. Therefore it is not the result of an evolutionist process of "come to maturity" of the agents but the work of the rational agents who anticipate future cash flows and evaluate the fundamental value of bonds correctly since the creation of the market. Nevertheless this argument can not be developed further due to the absence of stationary prices and the rise in the lag numbers over the last sub periods.

Second interpretation concerns the synchronisation problem. As mentioned in the introduction, the Paris Bourse as a stock exchange starts really to working by the quotation of

the first stock namely *Banque de France* in 1801. Since the listing of the first bonds tacks more than 35 years from the beginning of the Paris stock exchange, one could argue that the agents had accumulated the experiences in the stock market (emerging market) and once the bond market is created the mature agents apply what they have learned before to the new bond market.(modern market)

The other explications of this phenomenon would simply come from the difference in the sample sizes. As shown in the table 12 the number of the observations, in the first and the second sub period, are rather limited compared to the rest (45 and 110 compared to 225 and 527). According to Kleidon(1986) the sample size would influence largely the results of the tests for stock price rationality. Finally a reason of the lake of lags in the first sub-period would be that the market was less liquid in its first ten years of activity making a bias in the results of the tests.

Conclusion

Could we consider the Paris bond market during 19th century, as an emerging market developing toward a modern market? In this paper we tried to answer this question by creating an original data base and by that constructing a corporate bond market index. Then a set of statistical tools and tests is used to explore these data.

In fact, at the beginning of the 19th century bond market was an emerging market with all the characteristics of such market, that is, with high growth rate, high volatility and a risky market. It is also a market affected mostly by the political events instead of economic news. However, since the middle of the century the market transforms slightly and becomes less risky, permitting the rising of capital for the companies. Nevertheless this transformation do not results also the efficiency of the market.

The results, in this paper, obtained by the joint test of market efficiency show that toward the end of the century: a) the probability distribution of the bond prices moves away from the normal distribution, and b) the market prices do not follow a random walk process. Hence with these results we can not conclude the informational efficiency of the Paris corporate bond market during the 19th century. However this market accomplished the main role of a financial market in the French economy over the second half of the century, that is, a place for fund allocation. Hence, the bond market has considerably contributed to the rise of the French economy at a crucial era of the international economy, that is, the first globalisation of the end of nineteenth and the beginning of 20th century.

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