

# The Perspective of the Green Bonds as Novel Debt Instruments in Sustainable Economy



Aura Draksaite, Vilma Kazlauskiene, and Leonid Melnyk

**Abstract** Being relatively new, even definition of green bonds is under scrutiny. As the market of green bonds is rapidly growing (with the small recent setback in growing rates), it is crucial to establish the main determinants of the green bonds market growth and evaluate the perspectives of green bonds in sustainable economy. The main objectives of the research are the following: to evaluate the need for the green bonds as instruments, fostering the sustainability of economy; to identify the determinants of both green bonds related and green investment; to analyze the green bond yields and prices in comparison to non-green bonds; to estimate the perspective volatility of the green bonds price. Green bonds characteristics were compared against characteristics of the non-green bonds. Covariation and regression based analysis was used for the identification of green investment determinants. Variance was estimated in the assessment of bond price volatility. The results showed that price of both green bonds and non-green bonds has tendency to fluctuate in the similar trend; green bond appeal determinants are in coherence with the determinants of green investment; green bonds tend to be less volatile than non-green bonds. It is concluded that the use of green bonds has significant potential to add to the sustainability of the economy.

**Keywords** Green bonds · Green bond yield · Green investment · Financial instruments · Green debt securities · Debt instruments

---

A. Draksaite (✉) · V. Kazlauskiene  
Finance Department, Kaunas University of Technology, Kaunas, Lithuania  
e-mail: [aura.draksaite@ktu.lt](mailto:aura.draksaite@ktu.lt); [vilma.kazlauskiene@ktu.lt](mailto:vilma.kazlauskiene@ktu.lt)

L. Melnyk  
Economics and Business Administration Department, Sumy State University, Sumy, Ukraine

## 1 Introduction

The word “green” in nowadays economy is associated with the green growth, which in turn often means the way of economic development that is oriented towards the sustainability of the economy. Simultaneously, the term alludes to the saving or preserving the natural resources so that natural assets would be sustainable as well (OECD 2011).

But in order to save or preserve or even increase the natural assets, funding is necessary. Especially in case if there is a need for structural changes to meet the green economy challenges. Nevertheless, the importance of funding the green growth is recognized more and more clearly. Therefore, special tools for funding the green economy and tools for green economy development encouragement are being developed and used. For example, the so called green bonds were introduced in the market. First green bonds issuance was made in year 2007 by the World bank (i.e. International Bank for Reconstruction and Development). The main aim and intend of the green bonds is to raise funds for the projects that are carried out in order to increase the green growth or to add to the sustainability of the green economy mostly through addressing the challenges of the climate change.

As it is relatively new tool, it is important to analyze its effects on the green growth and sustainability of the economy on the whole. Different aspects of green economy and green growth itself is quite wide analyzed (Barbier 2016; Criscuolo and Menon 2015; Loiseau et al. 2016; Ng and Tao 2016; Shah et al. 2016; Vazquez-Brust et al. 2014; Yue et al. 2016 etc.).

The other reason for the closer analysis of green bonds as a debt instrument is also important, because there is obvious increase of the green bonds based investment. Therefore, it is important to analyze also the incentives behind the investment in the green bonds. The green investment aspects have been analyzed by Voicaa et al. (2015), Martin and Moser (2016), Mella et al. (2016), Markandya et al. (2015), Lesser et al. (2016) and González Ruiza et al. (2016).

Furthermore, since the first issuing of the green bonds, today there is much wider scope of the emitents of such bonds. For the first time, green bonds are issued not only on the international institutions or governments level, but also on the company level. And the increase of demand of such bonds is also increasing in the market.

Therefore, it is important to examine the incentives of the investors, as well, as the green bonds’ input in the sustainable economy. Different aspects of the possibilities and effects on the sustainability and green financing of the economy have been analyzed by Yadav et al. (2016), Silva and Cortez (2016), Little et al. (2015) and Heckerta and Rosan (2016) etc. Considering all this, the aim of the paper is to analyze the perspectives of the green bonds as novel debt instrument in the sustainable economy. Respectively, the main objectives of the research are the following: to evaluate the need for the green bonds as instruments, fostering the sustainability of economy; to identify the determinants of green bonds related investment and the green investment; to analyze the green bond yields and prices in comparison to

non-green bonds; to estimate the perspective volatility of the green bonds price volatility.

The historic data was used for the analysis. In the paper, green bonds related data covers period from the issue of first green bonds, i.e. from year 2007, to year 2016. Green investment related data covers period of year 2000–2016. Green bonds characteristics were also compared against characteristics of the non-green bonds. The covariation and regression based methods were used for identification of green investment determinants. Variance was estimated for the assessment of the bond price volatility. Bloomberg database, databases of World Bank, European Investment Bank, public official statistics and public market databases were used.

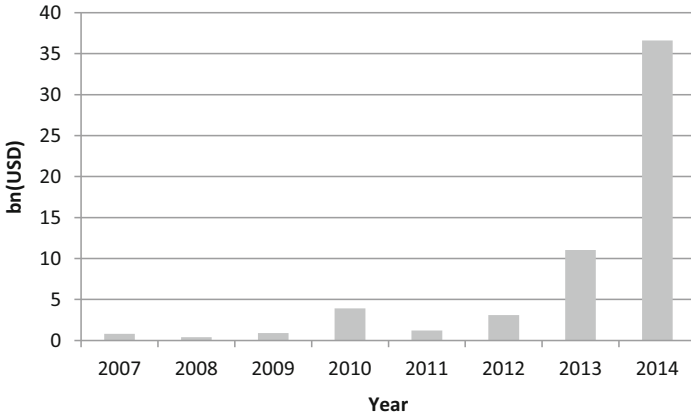
## 2 The Concept of Green Bonds as Debt Instrument

As the term green bonds is relatively new (to compare with the bonds history), even up to this day there are cases, where it is interpreted differently. But despite some differences in the aspects of the concepts of green bonds, generally it is agreed that green bonds are the debt instrument that raises funds for the causes, one way or another related to the green economy.

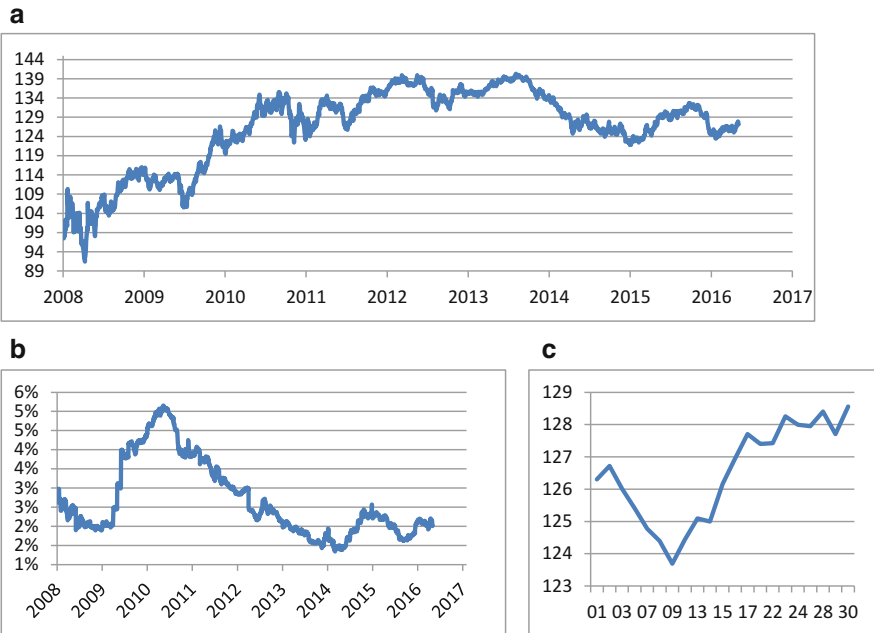
On the other hand, there is a lot of evidence that green economy is directly linked to the sustainability of the economy. And there is a little or no doubt that green economy is kind of an attribute of the sustainable economy.

Furthermore, green economy is directly linked to the green investment, which is already more familiar concept in the economy. Therefore, for the investors, acquiring the green bonds, it is way of making the green investment. The emittents of green bonds use them to accumulate the needed funds for the green economy enhancement. The object of the intended funding is under scrutiny since the beginning of the issuance of green bonds. It was not clear, what the green project is or how green should the project be to pass for the funding. To address this problem, in many cases, green bonds issuers apply specific criterions. Therefore, green bonds can be treated as a debt instrument for the specific funding purposes. And, being also part of the green investing, investment in green bonds should share the same determinants as green investment. It is evident that investors base (market) is rapidly growing (Fig. 1).

Therefore, in normally cyclical economy *ceteris paribus* the market for the green bonds is growing. The rate of the green bonds market growth is already slowing down at times though. Indexes of green bonds show the same trend in the market. S&P green bond index is shown in the Fig. 2 (as the index was created in year 2014, data is backtested for the period before year 2014). It is understandable that highly rated green bonds of respectful international institutions are appealing to many investors in fixed income market. Recently, there is also increase of the green bonds, issued by the companies.



**Fig. 1** Green bonds market growth, year 2007–2014. Source: Climate Bonds Initiative (2017)



**Fig. 2** S&P Green bond index for performance (a) and yield to maturity (b) (both back tested before 2014), 2008–2017 (Barclays Green Chips TR USD Index, 2017–03 (c)). Source: S&P Dow Jones Indices (2017), Barclays (2017)

### **3 The Perspective Impact of Green Bonds on the Economic Sustainability**

Sustainability of economy does not depend only on the green growth or the green economy sustainability. But it is obvious that green investment and thus the green bonds (which also could even be referred to as green borrowing from the bond issuers' position) directly impacts the sustainability of the green economy and economy as a whole. In this paper we use the term sustainable economy to describe the general economy, not specific to any particular country, but the one, that is affected by the funds, raised by launching the green bonds.

So, there is no question if the green bonds add to the sustainability of the economy. The question is how sustainable is it as a novel tool altogether. Even best intended debt tools can be even harmful if not effective. Therefore, it is important to analyze the relatively novel debt instrument and its perspective to add to the sustainability of the economy. Obviously, the debt instrument can add to the sustainability of the economy if it has ability to attract investors and thus raise the funds. On the other hand, it is important to consider the use of the funds, raised by green borrowing. In this sense, if green borrowing stays true to the concept of green bonds (i.e. where the funds, raised by the green bonds, are used to fund the green projects), the problem of using these funds becomes not so much about the use of funds, but the criteria for the projects that can be funded. Again, the question of the greenness of the project becomes of the essence.

Because of relatively short history of green bonds, as of yet it is impossible to perform comprehensive analysis of the green bond market behavior. But, given the available data and within the research limitations, we can make conclusions on the perspectives of green bonds as a debt instrument in sustainable economy. In this paper, it is assumed that increase of demand of green bonds would have positive effect on the sustainability of the economy.

As already discussed, market of green bonds is growing relatively rapidly. Also, considering the results of researches mentioned above, the main incentives of investors in the green bonds can be grouped in the following main groups: the prestige of investing in the green economy, the reliability of the bonds (due to the high rating) and the positive effects of the growing market itself.

The prestige stimulus is likely less important to the mass market if to compare it for example with the financial incentives, such as reliability of the investment (especially in case of investment in fixed income markets) or the profit of the investment. In perfect scenario, the reliability of the investment should be also accompanied by the appealing yields. If the yields of green bonds would be lower than the non-green bond yields, *ceteris paribus* investor most likely would prefer the investment in non-green bonds. In this case, the perspective of green bonds as debt instrument would not be bright in terms of becoming important factor to the sustainability of the economy. The investors' expectations also reflect on the results of green bond markets.

Furthermore, the bond price sensitivity is one of important factors in the fixed income market. The interdependence between the price and interest rates directly affect the value of the investment. This can also cause the increase or the decrease of demand of green bonds if to compare its price volatility to the price volatility of the non-green bonds. This, in turn also affects the perspectives of green bonds as debt instrument in the sustainable economy.

Also, the beneficiaries of the funds, raised by issuing the green bonds add directly to the enduring sustainability of the economy. Therefore, in case of well performing green bonds market, the green bonds have potential to add to the sustainability to the economy.

## 4 Research Methodology and Results

As the history of the green bonds is relatively short, we compare performance of green bonds against the non-green bonds. Also other green bonds characteristics were compared against characteristics of the non-green bonds. Non-green bonds' performance is well documented and can be forecasted to some degree (within the applied limitations frame).

For the comparison we select green bonds and non-green bonds of the same issuer, i.e. bonds, issued by the European Investment Bank (as it is the biggest issuer of the green bonds (considering the respective market share), also issues bonds with the highest rating). The necessary data was obtained in the Bloomberg database and European Investment Bank database. The historic data was used. Green bonds related data covers period from the issue of first green bonds, i.e. from year 2007, to year 2016. Green investment related data covers period until year 2016. We have analyzed 32 investable green bonds, issued by European Investment Bank.

Due to lack of information about the floating rate green bonds (e.g. World Bank launched first 550 million USD 18 month floating rate green bond in year 2014), only fixed rate green bonds and non-green bonds were analyzed.

The determinants of the green investment were selected based on the concept of both the investment and green investment. Based on the results of the above mentioned researches, the concept of green bonds and the limitations of this research, interest rates, population, income level, production costs, economic growth (GDP and GDP growth), income level, R&D spending, etc. as they are described in the paper by Eyraud et al. 2013. For this calculation the following regression equation was used (Eyraud et al. 2013):

$$y_{it} = a_i + \sum_{k=1}^K \beta^{k*} x_{it}^k + \varepsilon_{it}, \quad (1)$$

where  $y$  denotes green investment,  $x$ —the covariates,  $a$ —country-specific fixed effects.

As this research includes also the determinants of any investment, and based on the given above reasoning of interdependence between the green bonds and green investment, within limitations of this research, we conclude that determinants of investment in green bonds are in coherence with the green investment determinants.

Variance was estimated for the assessment of the bond price volatility. Databases of Bloomberg, European Investment Bank, public official statistics and market databases were used. As the evaluation methods are common and due to the limited size of the paper, in the paper we do not show the formulas/equations that are classical, but present the main results. Example of the used data is shown in Table 1.

The following indicators were examined: ask price, ask yield to convention, spread to benchmark, interpolated spread to government curve, interpolated spread to swap curve, option adjusted spread, default swap basis, asset swap spread, also zero volatility spread. Example of the pricing is shown in Table 2.

In analysis of the value, bid price, bid yield, current bid yield, respectively also lowest and highest value, also change in basis points from average, standard deviation from average, and standard deviation from average difference to the sector were analyzed. Example of the data for the standard deviation calculation is shown in the Table 3.

Also the correlation was analyzed. The results show positive or negative correlation. Example of the correlation is shown in the Table 4.

**Table 1** Sample of the green bonds, used for the analysis

Issuer name	Ticker	Issue date	Coupon	Amount issued	Maturity
European investment bank	EIB	11/19/2013	6.750	225.78MM	09/15/2017
European investment bank	EIB	09/10/2014	1.250	1.94MMM	11/13/2026
European investment bank	EIB	07/18/2013	1.375	3.93MMM	11/15/2019
European investment bank	EIB	04/13/2016	2.125	1.5MMM	04/13/2026
European investment bank	EIB	10/05/2016	0.500	560.29MM	11/13/2037
European investment bank	EIB	04/08/2014	2.250	3.01MMM	03/07/2020

Source: Bloomberg

**Table 2** Sample of the analyzed indicators

Security	Price	Yield	Spread	G-Spread	I-Spread	OAS	Basis	ASW	Z-Spread
1–2 years									
EIBKOR 1 3/4 02/27/18	100.65	1.695	58.45	79.5	52.1	80.9	–38.7	50.8	51.5
EIB 7 3/4 03/12/18	99.767	7.903	–16.11	–12.6	40.8	–8.1	–10.9	22.4	22.9
2–3 years									
EIB 8 1/2 03/27/19	95.529	10.479	8.87	8.6	–98.3	–5.4	120	–97.4	–107
EIB 3 04/23/ 19	107.613	–0.198	50.04	48.1	16.9	47.4	–4.1	17	17.4
EIB 1 3/4 11/15/19	105.111	–0.355	32.96	31.9	–27.6	21.8	41.6	–28.1	–27.4

**Table 3** Sample of data for standard deviation

Security	Bid price	Bid yield	Yield	Low	High	bps	SDs	S.SDs
1–2 years								
EIBKOR 1 3/4 02/27/18	99.97	1.774	1.774	1.3	2.1	0.1	0.4	–1.8
EIB 7 3/4 03/12/18	99.634	8.018	8.018	6.4	8.7	0.3	0.5	–1.5
2–3 years								
EIB 8 1/2 03/27/19	95.239	10.625	10.625			0	0	0
EIB 3 04/23/19	107.467	–0.14	–0.14	–0.2	0.7	–0.3	–1.2	–0.4
EIB 1 3/4 11/15/19	105.061	–0.338	–0.338	–0.5	0.3	–0.2	–0.9	–1.9

**Table 4** Example of correlation results

Security	EIB 0 1/2 03/16/16	EIB 6 3/4 09/15/17	EIBKOR 1 3/4 02/27/18	EIB 7 3/4 03/12/18
EIBKOR 1 3/4 02/27/18	0.67	0.75	1.0	0.5
EIB 7 3/4 03/12/18	29	0.86	0.5	1.0
EIB 8 1/2 03/27/19	0.78	0.74	0.84	0.47
EIB 3 04/23/19	0.53	–0.67	–0.35	–0.52

**Table 5** Sample results of standard deviation analysis

Security	EIB 0 1/2 03/16/16	EIB 6 3/4 09/15/17	EIBKOR 1 3/4 02/27/18	EIB 7 3/4 03/12/18
EIBKOR 1 3/4 02/27/18	1.9	2.48	1.0	2.07
EIB 7 3/4 03/12/18	1.98	–29	–2.07	1.0
EIB 8 1/2 03/27/19	1.13	1.19	0.85	1.14
EIB 3 04/23/19	2.12	1.92	1.43	2.17

In analysis of standard deviations, standard deviations that the spread exceeds its trailing average and those of which spread is below its trailing average were analyzed. Example of standard deviation case is shown in the Table 5.

Also, the performance of the green bonds was analyzed. The change in yields and returns was analyzed. Example of the green bond performance data is shown in the Table 6.

Respective analysis has been done using data of non-green bonds, issued by European Investment Bank. We had no means to take into calculation all the existing bond data due to the limitations of the evaluation tools used. But the used amount of the non-green bonds exceeds the green bonds amount by at least 200 times, therefore we consider the results reliable within the research limitations. Based on the results, green bonds tend to be less volatile than non-green bonds. Also, the results show that prices of green bonds and non-green bonds have tendency to fluctuate in similar trend. More detailed research would show the specifics of the difference between the



**Table 6** Green bond performance data sample

Security	1mYch	3mYch	6mYch	1yYch	2yYch	1 m R	3 m R	6 m R	1y R
1–2 years									
EIBKOR 1 3/4 02/27/18	−0.398	−0.563	−0.332	0.36	0.5	−3.4	−0.72	0.885	2.025
EIB 7 3/4 03/12/18	−0.045	0.257	0.448	−0.2	−2.4	5.85	7.98	8.311	7.367
2–3 years									
EIB 8 1/2 03/27/19	−1.796	−3.542	−2.971	1.06		−14	−6.57	2.251	9.386
EIB 3 04/23/19	−0.394	−0.947	−1.285	−1.9	−2.5	−2.6	−1.23	−0.5	0.87
EIB 1 3/4 11/15/19	−0.224	−0.849	−0.905	−0.7	−0.6	−1.4	−2.03		0.623

green and non-green bonds price fluctuations. Therefore, these results are only reliable within limitations of this research. In the future researches, we intend to use different analyzing tools that would allow taking into account even bigger amount of the non-green bonds issued.

## 5 Conclusions

The rapid growth of green bonds market shows the increasing demand for this kind of financial instruments. This might be also effect of the new market, as the first green bond was issued only in year 2007. Being new tool for raising the funds for mostly environmental causes, it adds to the green growth of the economy.

Results of the analysis of green and non-green bonds showed, that within the construct of the research, green bonds prices and non-green bonds prices have tendency to fluctuate in the similar trend. In this sense, both markets function similarly and the sensitivity of prices depends mostly on coupon rate, time to maturity and the demand for the bonds.

Also, it is argued that green bond appeal determinants are in coherence with the determinants of green investments. For the investors, acquiring the green bonds, it is way of making the green investment. As part of the green investing, in the long run investment in green bonds should share the same determinants as green investment. Based on the research results, green bonds tend to be less volatile than non-green bonds. As all the conclusions are reliable within limitations of the research, further more detailed investigation might show somewhat different results. Considering all the research results, it is concluded that the use of green bonds has significant potential to add to the sustainability of the economy by creating value to both the investors and beneficiaries of the proceeds from the bonds.

**Acknowledgement** This research was funded by a grant (No. TAP LU-4-2016) from the Research Council of Lithuania.

## References

- Barbier, E. B. (2016). Is green growth relevant for poor economies? *Resource and Energy Economics*, 45, 178–191.
- Barclays. (2017). *Barclays green chips TR USD index* [online]. Retrieved from <https://indices.barclays/IM/12/en/indices/details.app;ticker=BXIICNTU;tab=performance>
- Climate Bonds Initiative. (2017). *Explosive growth in green bonds market* [online]. Retrieved from <https://www.climatebonds.net/market/history>
- Criscuolo, C., & Menon, C. (2015). Environmental policies and risk finance in the green sector: Cross-country evidence. *Energy Policy*, 83, 38–56.
- Eyraud, L., Clement, B., & Wane, A. (2013). Green investment: Trends and determinants. *Energy Policy*, 60, 852–865.
- González Ruiza, J. D., Arboledab, C. A., & Boteroc, S. (2016). A proposal for green financing as a mechanism to increase private participation in sustainable water infrastructure systems: The Colombian case. *Procedia Engineering*, 145, 180–187.
- Heckerta, M., & Rosan, C. D. (2016). Developing a green infrastructure equity index to promote equity planning. *Urban Forestry & Urban Greening*, 19, 263–270.
- Lesser, K., Röble, F., & Walkshäusl, C. (2016). Socially responsible, green, and faith-based investment strategies: Screening activity matters! *Finance Research Letters*, 16, 171–178.
- Little, L. R., Hobday, A. J., Parslow, J., Davies, C. R., & Grafton, R. Q. (2015). Funding climate adaptation strategies with climate derivatives. *Climate Risk Management*, 8, 9–15.
- Loiseau, E., Saikku, L., Antikainen, R., Droste, N., Hansjürgens, B., Pitkanen, K., et al. (2016). Green economy and related concepts: An overview. *Journal of Cleaner Production*, 139, 361–371.
- Markandya, A., Antimiani, A., Costantini, V., Martini, C., Palma, A., & Tommasino, M. C. (2015). Analyzing trade-offs in international climate policy options: The case of the green climate fund. *World Development*, 74, 93–107.
- Martin, P. R., & Moser, D. V. (2016). Managers' green investment disclosures and investors' reaction. *Journal of Accounting and Economics*, 61, 239–254.
- Mella, I. C., Henneberryb, J., Hehl-Langec, S., & Keskin, B. (2016). To green or not to green: Establishing the economic value of green infrastructure investments in the wicker, Sheffield. *Urban Forestry & Urban Greening*, 18, 257–267.
- Ng, T. H., & Tao, J. Y. (2016). Bond financing for renewable energy in Asia. *Energy Policy*, 95, 509–517.
- OECD. (2011). *Towards green growth. OECD green growth studies*. Paris: OECD.
- S&P Dow Jones Indices. (2017). *Green bond index* [online]. Retrieved from <http://us.spindices.com/indices/fixed-income/sp-green-bond-index>
- Shah, K. U., Arjoon, S., & Rambocas, M. (2016). Aligning corporate social responsibility with green economy development pathways in developing countries. *Sustainable Development*, 24, 237–253.
- Silva, F., & Cortez, M. C. (2016). The performance of US and European green funds in different market conditions. *Journal of Cleaner Production*, 135, 558–566.
- Vazquez-Brust, D., Smith, A. M., & Sarkis, J. (2014). Managing the transition to critical green growth: The 'green growth state'. *Futures*, 64, 38–50.
- Voicac, M. C., Panaitb, M., & Radulescu, I. (2015). Green investments - between necessity, fiscal constraints and profit. *Procedia Economics and Finance*, 22, 72–79.
- Yadav, P. L., Han, S. H., & Rho, J. J. (2016). Impact of environmental performance on firm value for sustainable investment: Evidence from large US firms. *Business Strategy and the Environment*, 25, 402–420.
- Yue, S., Yang, Y., & Hu, Y. (2016). Does foreign direct investment affect green growth? Evidence from China's experience. *Sustainability*, 8(158), 2–14.