

MATHEMATICS

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RECENT MATHEMATICAL PROJECTS AT UITM, SEREMBAN CAMPUS

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Solution of Fisher's Equation Using Integral Iterative Method

> Covid - 19 and Political Crisis Effects on Risk Minimising Portfolios

> > Determinants of Graduate Starting Salary

Applications of Institutionistic Fuzzy Analytic Hierarchy Process

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• Dr. Nor Azni Shahari

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for all the dedications and

Happy Retirement

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KMV MODEL IN PREDICTING SOVEREIGN DEBT DEFAULT

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1. Introduction

Extensive research recognized that Greece is one of the countries that faced sovereign debt default due to its bankruptcy in 2009 (Arghyrou & Tsoukalas, 2011). The failure of a government to manage well its sovereign debt in the earlier stage can harm a country. According to the Ministry of Finance Malaysia (2018), Malaysia's sovereign real debt and liabilities amounted to RM1,065 billion by the end of June 2018, almost RM350 billion higher than the officially approved estimation of the previous government. This led to many concerns about the country's financial position. KMV model is one of the successful default models initiated to give an early precaution on default risk. However, the application of the KMV model is primarily focusing on the default risk of firms. Therefore, this study attempts to adapt the KMV model to the case of predicting the default risk of sovereign debt. Samples of data from Malaysia and Greece from 2007 to 2016 are utilized to predict the probability of default (PD) in one-year advance and at once to test the model's ability.

2. Restructuring the KMV Model

The KMV model is restructured to predict the default risk of sovereign debts. Here, default risk is defined as the probability that the value of the sovereign's asset falls below the value of the sovereign liability, and this is expressed as:

$$P_t = \Pr\left[V_t \le L \middle| V_0 = V_t\right] \tag{1}$$

where P_t is the probability of default (PD) at any time t, V_t is the total value of the sovereign asset at time t, V_0 is the initial total value of the sovereign asset, and L is the total value of sovereign liabilities (Crosbie & Bohn,2003).

According to Merton (1974), the asset behaved as a log-normal random walk function that follows the Geometric Brownian Motion as below:

$$dV_t = \mu V_t \, dt + \sigma \, dV_t \, dW_t \tag{2}$$

where dV_t is the asset changes, μ is the drift rate, σ is volatility, and dW_t is the Wiener process that describes the randomness of asset return. By using the Ito lemma's process, V at any time t is defined as:

$$v_t = V_0 e^{\left(\left(\mu - \frac{1}{2}\sigma^2\right)t + \sigma W_t\right)}$$
⁽³⁾

Therefore Eq. (1) is expressed as

$$P_{t} = \Pr\left[V_{t}e^{\left(\mu - \frac{1}{2}\sigma^{2}\right)t + \sigma W_{t}} \le L\right]$$
(4)

Rearranging Eq. (4) until it becomes

$$P_{t} = \Pr\left[W_{t} \leq -\left(\frac{\ln\left(\frac{V_{t}}{L}\right) + \left(\mu - \frac{1}{2}\sigma^{2}\right)t}{\sigma\sqrt{t}}\right)\right]$$
(5)

Let

$$\frac{\ln\left(\frac{V_t}{L}\right) + \left(\mu - \frac{1}{2}\sigma^2\right)t}{\sigma\sqrt{t}} = d$$
(6)

where d is the distance to default (DD). Since P_t can be written as a standard normal cumulative distribution function of d (Merton, 1974), thus Eq. (1) is rewritten as

$$P_{t} = \Pr[W_{t} \le -d] = N(-d) = \int_{-\infty}^{-d} \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}z^{2}} dz$$
(7)

According to Zieliński (2013), the PD for any time t is related to DD. The larger the DD, the smaller the PD, which means the less likely the entity will default.

3. Data Descriptive

Samples of monthly data from Malaysia and Greece are obtained from the websites of Bank Negara Malaysia (BNM) and the National Bank of Greece from 2007 until 2016. The data obtained are described in Tables 1 and 2.

Table 1: The components of Malaysia data

Asset	Liability
Gold and Foreign Exchange and Other Reserves	Currency in Circulation
including SDR	 Deposits by: Financial Institutions, Federal
Malaysian Government Paper	Government and Others
 Deposits with Financial Institutions 	Bank Negara Papers
 Loans and Advances 	 Allocation of Special Drawing Rights
 Land and Buildings 	Other Liabilities
Other Assets	

Asset	Liability
Gold and gold receivables	Bank notes in circulation
Claims on non-euro area residents dominated in foreign currency	• Liabilities to euro area credit institutions related to monetary policy operations denominated in euro
• Claims on euro area residents dominated in foreign currency	• Other liabilities to euro credit institutions denominated in euro
Claims on non-euro area residents dominated in euro	• Liabilities to other euro area residents denominated in euro
 Lending to euro area credit institutions related to monetary policy operations denominated in euro 	• Liabilities to non-euro area residents denominated in euro
• Other claims on euro area credit institutions denominated in euro	 Liabilities to euro area residents denominated in foreign currency
• Securities of euro area residents denominated in euro	• Liabilities to non-euro area residents denominated in foreign currency
General government long-term debt denominated in euro	• Counterpart of special drawing rights allocated by the IMF

Table 2: The components of Greece data

4. Results

The PD of Malaysia and Greece are predicted for 2008 to 2017. The PD and the primary inputs to predict the PD are presented in Table 3 and Table 4.

Year	Drift Rate	Volatility	Distance to Default (DD)	Probability of Default (PD)
2008	0.6424	0.709886	0.6639	0.2533861
2009	0.6861	0.082565	9.6385	2.75E-22
2010	0.6929	0.032801	25.3276	7.93E-142
2011	0.6959	0.039431	18.6229	1.047E-77
2012	0.7031	0.066579	11.6315	1.425E-31
2013	0.6926	0.011698	63.6269	0
2014	0.6931	0.023154	35.1434	7.32E-271
2015	0.6897	0.018586	44.1883	0
2016	0.6944	0.082196	13.1461	8.96E-40
2017	0.6908	0.034422	30.0277	2.14E-198

Table 3: The drift rate, volatility, DD, and PD for Malaysia from 2008 to 2017

Table 4: The drift rate, volatility, DD, and PD for Greece from 2008 to 2017

Year	Drift Rate	Volatility	Distance to Default (DD)	Probability of Default (PD)
2008	0.6309	0.6951	0.6629	0.2537095
2009	0.7183	0.1275	5.9842	1.087E-09
2010	0.7044	0.1179	6.3382	1.162E-10
2011	0.7183	0.0969	7.7956	3.205E-15
2012	0.7040	0.0719	10.4021	1.212E-25
2013	0.6931	0.1320	5.6274	9.15E-09
2014	0.6727	0.0669	11.5022	6.433E-31
2015	0.6865	0.0705	11.4116	1.83E-30
2016	0.7230	0.2098	3.6570	0.0001276
2017	0.6857	0.0266	29.0706	4.22E-186

Table 3 and Table 4 show the drift rate, volatility, DD, and PD for Malaysia and Greece from 2008 to 2017. The PD is predicted between the range 0 (lowest PD) to 1 (highest PD). Based on Tables 3 and 4, Figure 1 is presented.



Figure 1: The comparison of DD of Malaysia and Greece

Figure 1 presents the comparison of DD of Malaysia and Greece. Overall, the DD of Malaysia is found to be greater than the DD of Greece. This means the possibility of Malaysia defaulting on its sovereign debt is lower than Greece.

6. Conclusion

Adapting the KMV model to the case of sovereign debt default gets this paper to the two main results. Firstly, the overall default risk of Malaysia is found to be lower than the default risk of Greece. Secondly, PD is predicted to be low every year for both countries except in 2008; the default risk for both countries is 25% which is the highest compared to the other selected years. This is parallel to the fact that the world financial crisis occurred during the years of 2007 to 2009 (Nastase et. al, 2010). All of these imply that the KMV model could predict the default risk of sovereign debt during normal and financial crisis conditions in one-year advance. In addition, the information contained in the KMV model on default risk is useful and valuable to be used in many cases, such as sovereign debt.

References

- Arghyrou, M. G. and Tsoukalas, J. D. (2011). The Greek Debt Crisis: Likely Causes, Mechanics and Outcomes. *The World Economy*, 34, 173-191. doi:10.1111/j.1467-9701.2011.01328.x
- Crosbie, P.J. & Bohn, J.R. (2003). Modeling default risk. Technical Report, Moody's KMV. Available at <u>https://www.moodysanalytics.com/-/media/whitepaper/before-2011/12-18-03-modeling-default-risk.pdf</u>
- Merton, R. C. (1974). On the Pricing of Corporate Debt: The Risk Structure of Interest Rates. *Journal of Finance*, 29(2), 449-470. https://doi.org/10.2307/2978814
- Ministry of Finance Malaysia. (2018). Budget 2019. Retrieved from https://www.treasury.gov.my/pdf/budget/speech/bs19.pdf
- Nastase, M., Cretu, A. S., & Stanef, R. (2010). Effects of Global Financial Crisis. *Review of International Comparative Management*, 10, 691-699.
- Zieliński, T. (2013). Merton's and KMV Models in Credit Risk Management. *Economic Studies / University* of Economics in Katowice, 123-135. Retrieved at https://www.ue.katowice.pl/fileadmin/_migrated/content_uploads/8_T.Zielinski_Mertons_and_ KMV Models....pdf

M A T H E M A T I C S

VOLUME III





