

Optimization of Interest Income by Determining Interest Rate of Revolving Credit Line

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Abstract. Banking has strategic role as an intermediary institution that will fund from parties who have excess funds to those who need funds. The bank will provide revolving credit line to meet short-term liquidity needs. The revolving credit line provides the flexibility of the company as a debtor to use credit facilities and debtor must pay interest expense based on the utility of the credit line. This flexibility will affect the achievement of interest income. This study was conducted to determine effect of credit line characteristics, companies as debtors, and banks as creditors on utility of revolving credit line and create regression modeling to predict credit line utilities (UCL). Based on the resulting equation, known that Line Age (LAGE), Asset, Return of Asset (ROA), and Equity to Asset (ETA) harm UCL. While the Non-Performing Loan (NPL) ratio has a positive effect on UCL. The method used in optimizing interest income is the linear programming method. Optimization of existing assets can achieve interest income at IDR 241,63 billion and achieve a yield target of 9,00%. Optimization interest income can be applied to plan credit expansion so creditor has reference the maximum range of credit distribution and also determine of interest rate's debtors.

Keywords: revolving credit line, utility, yield, interest rate, interest income, expansion

1. Introduction

Banking has an essential role in the movement of the economy and facilitates economic growth with its position as an intermediary institution. In carrying out its function as an intermediary institution between surplus party units and deficit parties, banks extend credit. Banking lending activities are also carried out by banks to generate profits but also provide risks to banks (Siringoringo, 2012). Companies can get funding to support company activities from 2 (two) sources, namely from internal and external companies. Company policy in determining the source of funding is an important thing that will influence the company's capital structure (Astuti, 2015). Banks will provide funding for companies in the form of credit lines, also known as revolving credit lines to meet short-term liquidity needs and also provide term loans for long-term investment financing (Strahan, 2005). According to Gu, Wang, Yang, and Xu (2019), revolving credit is considered to be more flexible where the debtor is given leeway to use credit facilities under the company's working capital needs. Besides, interest costs borne by the company under the credit value used by the debtor (Strahan, 2005). The credit market has unexpected characteristics and is susceptible to changes as indicated by the emergence of a phenomenon of unequal needs (mismatch) between the debtor and the creditor. This phenomenon also occurs in banks in Indonesia. The mismatch phenomenon arises due to an increase in credit demand, which is faster than

the actual needs or lending itself so that the utilization rate of credit line usage is not optimal (Becsi, Li, and Wang, 2013).

Sufi (2009) has researched that credit line utilities are influenced by company characteristics, including profitability, age, and size of the company, especially in the management of company liquidity. Companies with a high level of liquidity, mature company age, and significant asset value (size) of the company will have a low credit line utility. Whereas in terms of industry, the level of utility of credit facilities varies. According to Jiménez, Lopez, and Saurina, (2009), several factors also influence the use of credit lines, including credit line characteristics, company characteristics as debtors, banking characteristics as creditors, and macroeconomic conditions. Campello, Giambona, Graham, and Harvey (2011) and Kizilaslan and Manakyan Mathers (2014) stated that credit line drawdown or also called credit line utilities is influenced by the size, cash, capital expenditure, rated companies, credit market tightness, and GDP. Companies with a smaller size (noncash assets) will have higher credit line utilities. The same thing happens to companies with significant cash positions, while companies with small cash positions will have higher credit line utilities. Companies with high capital expenditure will need more significant cash, thus encouraging companies to use credit lines. The company's rating shows the company's ability to obtain alternative funding sources that are varied so that companies tend to have low credit line utilities. When credit market conditions are tight and macroeconomic conditions are not right which is characterized by low GDP, companies tend to use credit lines.

Under these conditions, an initial phase of research will be conducted to find out the factors that influence the credit line utility. The study will be conducted one of commercial credit business banking unit of bank in Surabaya with variable characteristics of credit lines, companies, and banks while the macroeconomic condition variable is not taken into account because the study focuses on a credit management unit of the medium business segment with the characteristics of the location of the debtor in one province in East Java so that it has the same regional economic growth parameter values. In the next stage in this study, based on the value of the utility obtained, the optimization of income modeling is performed by determining the interest rate of each debtor in one of the commercial credit business banking units of a bank in Surabaya. The first objective of this study is to determine the effect of credit line characteristics, company characteristics, and bank characteristics on credit line utilities. The second objective is to obtain a linear programming model to obtain the maximum interest income by determining the interest rate. The results of the study are expected to be used by banks as creditors to determine strategies for achieving interest income targets to increase bank profitability.

2. Methods

The dependent variable used in this study to predict the utility of the revolving credit line facility is the credit line utility. Credit line utilities are the level of use of credit line facilities provided by creditors to debtors. While the independent variables used, include lineage (LAGE), assets, the return of assets, equity to total assets, and non-performing loan ratios (NPL). Line age is the age of credit line loans in units of years from the time a bank provides the facility to a company as a debtor. The asset is the book value of total assets recorded by the company (the variable used is lagged t-1). Return of assets is a profitability parameter of a company which is assessed from the ratio of earnings after interest and tax or earnings after tax (EAT) to total company assets (the variable used is lagged t-1). Equity to total assets is a parameter of company solvency which is assessed from the ratio of total capital (equity) to the company's total assets (the variable used is lagged t-1). The ratio of non-performing loans (NPLs) is the ratio of non-performing loans to the total loan portfolio disbursed by banks.

The data used in this study, especially in the stage of determining credit line utilization, is secondary data sourced from the report of one of the commercial credit business banking units of the bank in Surabaya. The study population is all companies that are debtors of one of the commercial credit business banking units of a bank in Surabaya who have credit line facilities for the period of 2017 to June 2019.

The initial stage in this research is to determine the calculation model for the utility revolving credit line facility. Based on this model, the calculation of the revolving credit line facility utility is performed as one of the data needed to optimize interest income. The analysis technique used to examine the effect

of a credit line, company, and bank characteristics on credit line utilities in this study uses Ordinary Least Square (multiple linear regression) with the following research steps. The calculation of the variables used in the study was conducted at steps one, while the variables included Credit Line Facility Utilities, Line Age, Assets, Return of assets, Equity to total assets, Non-performing loan (NPL) ratios. In steps two, multiple linear regression analysis was performed with SPSS software tools. These steps begin by testing the classical assumptions of multiple linear regression (Normality, Multicollinearity, and Heteroscedasticity Tests). Then proceed with estimating multiple linear regression models. This multiple linear regression analysis is used to find out how much influence the independent variable has on the dependent variable. Furthermore, stimulatory tests and t-tests were performed.

The next stage is the optimization of interest income; at this stage, an analysis is carried out to optimize interest income. The first step at this stage starts with setting the decision variable. In connection with the objectives of this study, the interest rate of each debtor becomes a decision variable. The second step is to determine the objective function, the objective function of this study is to maximize the interest income achieved by the credit management unit by optimizing the interest rate given to each debtor under management. The third step is to determine the limiting function, a constraint that must be considered in this study, meaning to achieve the goal some boundaries cannot be broken.

3. Result and Discussion

This research was conducted at one of the commercial credit business banking units of a bank in Surabaya with a focus on lending to institutional debtors both business entities and legal entities with a maximum credit of Rp. 15 billion to Rp. 300 billion. Types of credit facilities channeled in the form of working capital loans which are used for additional working capital for debtors and investment loans that are used for debtor investment activities. The nature of the working capital loans is divided into 2 (two), namely revolving credit lines and term loans. While the investment credit facility is a term loan, where every month the debtor has the obligation to pay by installment and interest of facility. The most significant type of credit facility disbursed by one of the commercial credit business banking units of a bank in Surabaya which is the location of the research is working capital loans which is a revolving credit line. The profile details of the types of loans extended are shown in Figure 1.

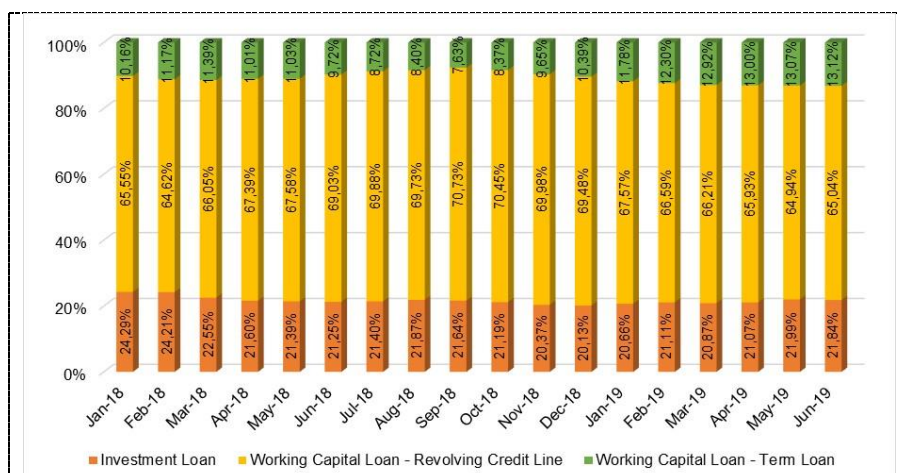


Figure 1. Profile of Credit Distribution

This study determines the model for predicting the utility of revolving credit line facilities using multiple linear regression analysis. The variables in the equation are 6 (six) variables, including lineage (LAGE) which is a characteristic of credit, company assets (ASSET), return of assets (ROA), and equity to total assets (ETA), which are characteristics of companies as debtors, and Non Performing Loans (NPLs) which are characteristic of banks. While the revolving credit line (UCL) utility used is the past performance from the use of existing credit facilities.

3.1. Classical Assumption Testing

Normality testing is done to assess the distribution of data in a group of data or variables, whether the distribution of data is normally distributed or not. The normality test is carried out using the normal probability plot graph method. Based on the test results it appears that the plot produced by the regression model has spread around the diagonal line. Figure 2 shows the results of the normal probability plot; it can be concluded that the assumption of normality in the regression model can be fulfilled. The heteroscedasticity test is used to determine the diversity of residual values (error) results from the estimation of the regression model. The regression equation is stated as good if it has the same diversity of residual values (homogeneity). Based on the scatter plot graph in Figure 3, it can be seen that the plot has spread irregularly and does not form a specific pattern so that it can be concluded that there is no heteroscedasticity problem in the regression equation. Multicollinearity testing is done with the aim to find out whether or not there is a deviation from the classic assumption of multicollinearity, namely the existence of a linear relationship between the independent variables in the regression model. VIF values of all independent variables that influence UCL have valued less than 10. While the tolerance value of all independent variables is greater than 0.1. Therefore, it can be concluded that the independent variables in the regression model do not occur multicollinearity problems.

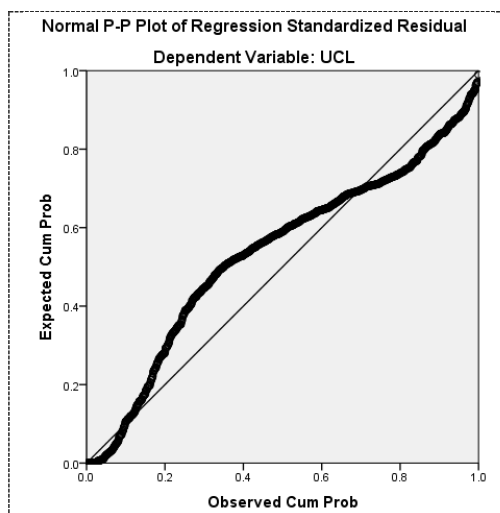


Figure 2. Normal Probability Plot

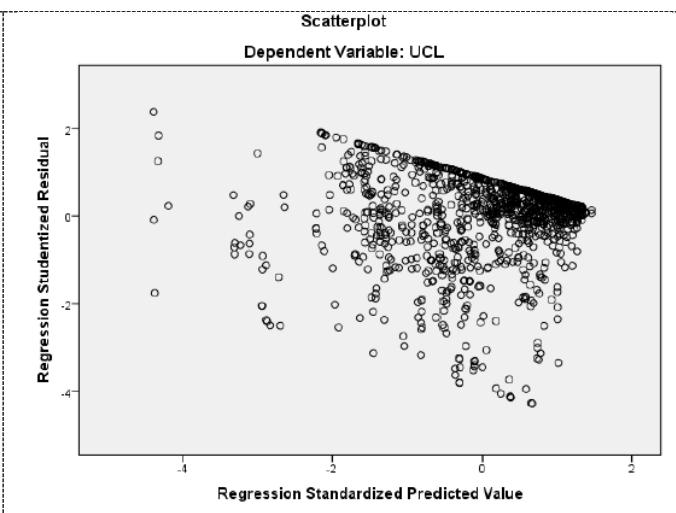


Figure 3. Scatter Plot

3.2. Regression Model

Based on the results of data processing with SPSS, the regression equation for the prediction of a revolving credit line (UCL) utility is as follows:

$$UCL = 1,007 - 0,000 LAGE - 3,412.10^{-13} Asset - 0,710 ROA - 0,710 ETA + 0,761 NPL$$

Respectively, LAGE: Line Age; Asset: Total Asset; ROA: Return of Asset; ETA: Equity to the total asset; NPL: Non-Performing Loan.

3.3. Simultaneous Test

Simultaneous test or also called the F test in multiple linear regression analysis aims to determine whether the independent variables together or simultaneously (simultaneously) affect the dependent variable. Based on the data above, it is known that the calculated F value of 59.8940 with a table F value of 2.221. Therefore, the calculated F value is higher than the F table so that the variables LAGE, ASSET, ROA, ETA, and NPL simultaneously affect the credit line utility (UCL).

3.4. Hypothesis Test

The significance value of the t-test results for lineage, asset, return of asset, equity to asset, and non-performing loan variables are 0.018, 0.000, 0.000, 0.000, 0.000, 0.050, respectively. That way, all independent variables affect the credit line utility and all hypotheses can be accepted.

3.5. Interest Income Optimization

Solving optimization problems in this study using solver tools in Microsoft Excel. The solver model made consists of 312 variables with the decision variable interest rate (II) of each debtor. Based on the linear regression equation to predict the credit line utility (UCL), it will be used to calculate the UCL of each debtor with data from the latest annual financial statements. The results of the calculation of the value of UCL, which is negative, will be adjusted to 0, while those above 1 will be adjusted to 1. This adjusts to the actual conditions where the debtor, when not using the credit line facility, has a UCL parameter of 0 while using the maximum credit line facility of 1. Figure 4 and Figure 5 show the appearance of the built solver model.

Debitur	UC	MC	Class	IR (Decision Variable)	Interest Income (UC.MC.IR)	Cost of Fund
1	0.949	58.000.000.000	2	11,75%	6.470.699.239	3.114.600.000
2	0.897	104.300.000.000	3	11,75%	10.998.318.334	5.600.910.000
3	0.812	126.355.492.020	3	10,50%	10.769.497.841	6.785.289.921
4	0.872	11.414.559.038	1	12,75%	1.269.415.397	612.981.820
5	0.906	10.973.759.700	1	12,75%	1.266.970.225	589.290.896
6	0.665	40.720.000.000	1	11,25%	3.046.028.774	2.186.664.000
7	0.863	75.000.000.000	2	10,25%	6.637.832.175	4.027.500.000
8	0.885	28.500.000.000	1	12,33%	3.111.608.921	1.530.450.000
9	0.926	86.160.000.000	2	11,25%	8.971.898.259	4.626.792.000
10	0.888	21.500.000.000	1	12,75%	2.434.630.972	1.154.550.000
11	0.665	64.000.000.000	2	12,25%	5.212.003.218	3.436.800.000
12	0.896	77.000.000.000	2	4,00%	2.760.490.596	4.134.900.000
13	0.747	15.000.000.000	1	11,25%	1.260.495.042	805.500.000
14	0.752	33.651.500.000	1	11,00%	2.784.366.006	1.807.085.550

Figure 4. Spreadsheet Model

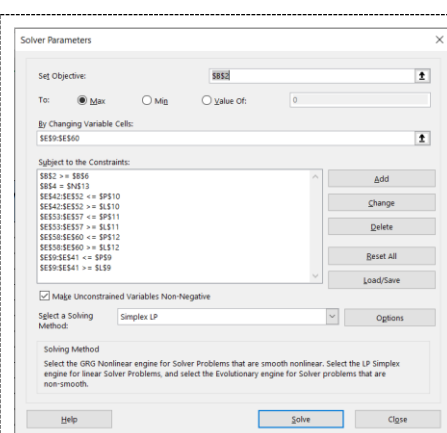


Figure 5. Solver Parameters

Initial optimization is carried out on the existing maximum credit condition before the plan to add credit extended to new debtors so that the asset value of the credit management unit is still the same. Based on the optimization, the results obtained in Table 1. The optimization results above show that compared to the current interest rate, as many as 28 debtors have decreased, 2 permanent debtors, and 30 debtors have increased. The optimization interest rate is the minimum interest rate that can be set for debtors to support the achievement of targets set by the company. This value can be used as a guide in negotiating with customers. If the determination of the interest rate to the debtor is higher than the reference, it will increase the interest income obtained by the credit management unit. Table 2 shows the increase in interest income obtained from all debtors under the management of the credit management unit from the previous Rp.236.73 M to Rp.241.63 M. Besides, the target yield set can be achieved by 9.00% from the previous under the yield target of 8.82%.

Table 1. Interest Rate Optimization Results.

Debtor	Interest Rate (IR) Existing	Interest Rate (IR) Optimization	Δ	Debtor	Interest Rate (IR) Existing	Interest Rate (IR) Optimization	Δ
1	11,75%	11,25%	-0,50%	27	11,31%	10,75%	-0,56%
2	11,75%	11,25%	-0,50%	28	3,60%	11,25%	7,65%
3	10,50%	11,25%	0,75%	29	11,50%	11,75%	0,25%

Table 1. Interest Rate Optimization Results.

Debtor	Interest Rate (IR) Existing	Interest Rate (IR) Optimization	Δ	Debtor	Interest Rate (IR) Existing	Interest Rate (IR) Optimization	Δ
4	12,75%	11,75%	-1,00%	30	12,75%	11,75%	-1,00%
5	12,75%	11,75%	-1,00%	31	11,75%	11,75%	0,00%
6	11,25%	11,75%	0,50%	32	11,75%	12,75%	1,00%
7	10,25%	11,25%	1,00%	33	12,25%	12,75%	0,50%
8	12,33%	11,75%	-0,58%	34	11,25%	11,75%	0,50%
9	11,25%	11,75%	0,50%	35	11,75%	11,75%	0,00%
10	12,75%	11,75%	-1,00%	36	11,56%	11,75%	0,19%
11	12,25%	11,75%	-0,50%	37	12,75%	11,75%	-1,00%
12	4,00%	11,25%	7,25%	38	11,00%	10,75%	-0,25%
13	11,25%	11,75%	0,50%	39	11,00%	9,00%	-2,00%
14	11,00%	12,75%	1,75%	40	12,45%	11,25%	-1,20%
15	4,50%	11,75%	7,25%	41	11,75%	12,75%	1,00%
16	11,50%	11,75%	0,25%	42	11,00%	11,75%	0,75%
17	11,00%	11,75%	0,75%	43	9,00%	11,75%	2,75%
18	12,25%	11,75%	-0,50%	44	12,75%	10,75%	-2,00%
19	12,25%	11,25%	-1,00%	45	11,80%	11,75%	-0,05%
20	12,25%	11,75%	-0,50%	46	11,75%	10,78%	-0,97%
21	12,30%	11,25%	-1,05%	47	11,25%	11,75%	0,50%
22	12,25%	11,75%	-0,50%	48	12,25%	11,75%	-0,50%
23	11,75%	10,75%	-1,00%	49	12,25%	11,75%	-0,50%
24	11,50%	11,75%	0,25%	50	12,00%	11,75%	-0,25%
25	11,50%	11,75%	0,25%	51	12,75%	11,75%	-1,00%
26	11,82%	11,25%	-0,57%	52	12,25%	11,75%	-0,50%

Table 2. The Effect of Optimization on Existing Assets.

	Before Optimization	After Optimization
Interest Income	236,729,134,639	241,628,738,676
Yield	8.82%	9.00%
Maximum Total Credit	2,684,763,763,068	2,684,763,763,068
Total Cost of Fund	144,171,814,077	144,171,814,077

3.6. Discussion

Based on the regression results above, lineage variables or loan age have a significant adverse effect on the utility of credit lines. This shows that the longer the debtor's loan life to creditors, the lower the use of credit lines. Debtors with high lineage have indicated that they have long received credit line facilities as a source of corporate funding that replaces the company's cash holding. The regression results above show that assets have a significant negative effect on the utility of credit lines. These conditions indicate that the higher the company's total assets, the smaller the use of revolving credit line facilities. Companies with high asset values indicate that the size of the company has been large-scale, well-

established, and is predicted to be long enough for the company's operations to run so that it has been effective in managing the company's finances. One of them is to use the most liquid asset component first for the company's operational activities, cash. Based on the regression results above, the return of the asset (ROA) variable has a significant adverse effect on the credit line utility. This shows that the higher the value of ROA, the use of credit lines decreases. Profitability reflects a measure of the ability to obtain earnings (earning power) from a company that will reflect the level of effectiveness achieved in company operations. The regression results above show that equity to assets (ETA) has a significant negative effect on the utility of credit lines. These conditions indicate that the higher the company's ETA, the smaller the use of revolving credit line facilities. A company with a high level of ETA shows that the company has been effective in managing its business capital to obtain the addition of total assets to finance business operations. This encourages companies to minimize the use of their credit line facilities. Based on the regression results above, the non-performing loan (NPL) variable has a significant positive effect on the utility of the credit line. This shows that the higher the NPL ratio, the greater the use of credit lines. The high bank NPL ratio indicates the high default credit facilities in the banking system so that it reflects the unhealthiness of banks. This condition also shows that most debtors have high default risk, so they will tend to use the revolving credit line facility in the maximum amount possible.

4. Conclusion

The linear programming model used in the optimization of interest income in this study has been designed and stated in a mathematical model and solver model. The solver can work well and produce optimal solutions. The optimization carried out was able to set the interest rate on each debtor so that it reached an interest income of Rp.241.63 billion and the yield target set at 9.00%. The optimization model can then be used to obtain a reference to the determination of the interest rate on the debtors of the commercial credit business banking unit of the bank in Surabaya along with the expansion of lending to support the increase in company assets. The credit line utility is influenced by the characteristics of the Credit Line, the Company, and the Bank. This research is to find out the effect of the credit line, company, and banking characteristics on the credit line (UCL) utility using only 5 (five) variables. Further research can add other variables in each character such as the default credit probability, the level of credit line maturity, and credit guarantees in the characteristics of the credit line, the level of company risk, the length of time-related to banking, and how many relationships the company has with several banks in the characteristics companies, as well as central banks, bank shares, and types of banks that distribute credit in the characteristics of banking.

5. References

- [1] Astiti, N. P. Y. 2015 Pengaruh profitabilitas dan struktur asset terhadap struktur modal pada perusahaan. *Juima*, **5**(2), 59–73.
- [2] Becsi, Z., Li, V. E., and Wang, P. 2013 Credit mismatch and breakdown. *European Economic Review*, **59**, 109–125. <https://doi.org/10.1016/j.euroecorev.2012.11.002>
- [3] Campello, M., Giambona, E., Graham, J. R., and Harvey, C. R. 2011 Liquidity management and corporate investment during a financial crisis. *Review of Financial Studies*, **24**(6), 1944–1979. <https://doi.org/10.1093/rfs/hhq131>
- [4] Gu, J., Wang, J., Yang, Y., and Xu, Z. 2019 Credit line models for supply chain enterprises with channel background and soft information. *Sustainability (Switzerland)*, **11**(10). <https://doi.org/10.3390/su11102985>
- [5] Jiménez, G., Lopez, J. A., and Saurina, J. 2009 Empirical analysis of corporate credit lines. *Review of Financial Studies*, **22**(12), 5069–5098. <https://doi.org/10.1093/rfs/hhp061>
- [6] Kizilaslan, A., and Manakyan Mathers, A. 2014 Strategic credit line usage and performance. *Journal of Financial Research*, **37**(2), 243–265. <https://doi.org/10.1111/jfir.12036>
- [7] Siringoringo, R. 2012 Karakteristik Dan Fungsi Intermediasi Perbankan Di Indonesia. *Buletin Ekonomi Moneter Dan Perbankan*, **15**(1), 61–83. <https://doi.org/10.21098/bemp.v15i1.57>

- [8] Strahan, P. E. 2005 Borrower Risk and the Price and Nonprice Terms of Bank Loans. *SSRN Electronic Journal*, (October). <https://doi.org/10.2139/ssrn.192769>
- [9] Sufi, A. 2009 *Bank Lines of Credit in Corporate Finance : An Empirical Analysis Bank Lines of Credit in Corporate Finance : An Empirical Analysis*. **22**(3), 1057–1088. <https://doi.org/10.1093/rfs/hhm007>