Bulletin
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227/8 - JANUARY-FEBRUARY 2020

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Do late customer payments impact companies' probability of default?

The payment delays granted by suppliers to their customers expose the former to cash flow disruptions, which are aggravated in the event of late payments and may put them in financial difficulty.

However, estimating companies' probability of default using a bankruptcy prediction model shows that the effects of late customer payments are relatively limited. Indeed, while the existence of late customer payments raises a company's probability of default by 25%, and by 40% if payments are over one month late, deteriorated financial structures increase it by at least a factor of four.

Finally, only 8 out of 100 failing companies are potentially exposed to this risk, three-quarters of which owing to late payments over 30 days. Nevertheless, when payments are made increasingly late, all types of companies are affected, regardless of their size, age or financial situation.

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34.7%
share of companies experiencing late payments on average over the period 2014-2017

1.24
ratio between the probability of default of companies that experience late payments and that of companies that are payed on time

1.42
ratio when late payments exceed one month

Relative impact of late payments on companies' probability of default
(ratio of the probability of default to the state of financial ratios [a])
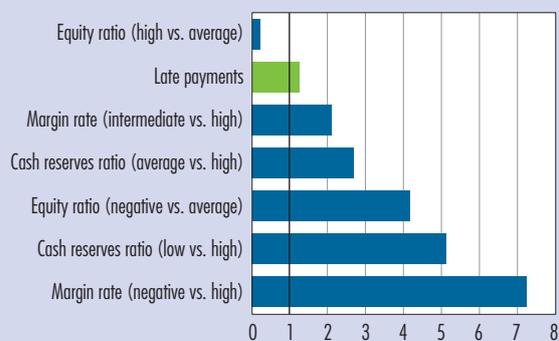
(a) A ratio of 1 reflects the absence of a relation, a ratio above 1 indicates a strong relation (the higher the number, the stronger the relation).
Source: Banque de France, FIBEN database (data at end-October 2019 and estimate in November 2019).

Bulletin
de la Banque de France

227/8 - JANUARY-FEBRUARY 2020

Companies

BANQUE DE FRANCE
EUROSYSTÈME

2

1 Exceeding the legal limit for payment delays: one in three suppliers is affected

Trade credit: from financing to the risk of contagion

Trade credit, which is credit granted through payment delays negotiated between customers and suppliers, is an important source of financing for businesses. According to the *Observatoire des délais de paiement*, in 2017, trade payables amounted to EUR 607 billion, i.e. 7.5% of French companies' total liabilities.[1]

The intensity of trade relations implies that the trade credit chain is a potential vector for spreading business difficulties, as late payments and payment defaults by customers can cause difficulties for suppliers themselves. This contagion mechanism can contribute to propagating macroeconomic and liquidity shocks along the trade credit chain and aggravate a recession.

However, while longer payment delays are a very common indicator of customer difficulties, it remains to be demonstrated that late payments by customers lead to supplier difficulties and trigger a contagion mechanism. This article sets out to accurately measure the impact of the length of customer payment delays on suppliers' financial situation by using a bankruptcy prediction model (see Box 1) to estimate the increase in the probability of default associated with late payments.

1 See Banque de France, *Rapport annuel de l'Observatoire des délais de paiement* 2018.

BOX 1

The bankruptcy prediction model: a logit model

Bankruptcy prediction models are tools for measuring probability of default (PD) that apply statistical methods to corporate accounting and financial data. The first models date back to the 1960s, with the work of Beaver (1966) and Altman (1968). In France, the Banque de France made a significant contribution to the dissemination of the scoring method (Bardos, 2001).

To build such a model, it is necessary to: (i) have two populations, a population of failing firms and a population of healthy firms; (ii) choose a default horizon (one year or more) and select the financial variables that reflect the major risk factors, the selected variables not being correlated with each other; (iii) adopt a statistical methodology. Gouriéroux and Jasiak (2007) and Bart, Roësch and Scheule (2016) provide comprehensive presentations of the frequently used methodologies.

The most widely used statistical model is the logit model. This is the one used in this study, in which entry into receivership is used as a default criterion.

This model has the great advantage of incorporating categorical variables. For example, equity ratios are grouped here into three categories: negative, average and strong. Other categorical variables are included in the model to reflect differences in terms of sector, firm size, and age. Since the estimates are made over the long term, the model also incorporates time dummies, which make it possible to take the effects of the cycle into account. The growth categories of sales and days sales outstanding reflect the existence of inter-firm differences - intended or experienced - in business development strategies. The predictive factors of default are approximated on the basis of the financial ratios of the previous year.

…/…

Bulletin
de la Banque de France
227/8 - JANUARY-FEBRUARY 2020

Companies

BANQUE DE FRANCE
EUROSYSTÈME

3

The logit model was first estimated by incorporating late payments as a binary variable reflecting the existence of late payments beyond the 60-day legal limit, regardless of how late. Late payments were then split into two levels: below 30 days and over 30 days. The estimation was carried out on the total population of the sample[1] and on sub-populations sorted by age, size and membership of one of the three risk categories constructed using the Banque de France rating.[2] All of the estimated models show good predictive and statistical performances.[3]

1 For the data used, see Appendix 1.
2 For the specifications of the *logit* model, see Appendix 2, Table a.
3 See Appendix 2, Table b.

Importance of late payments

Over one-third of companies record payment delays on receivable accounts over 60 days, a legal ceiling introduced by the *Loi de modernisation de l'économie* (Economic Modernisation Act - LME)[2]. On average, in the 2010s, one in five suppliers was less than 30 days late and one in six was more than 30 days late (see Table 1). The number of suppliers with days sales outstanding (DSO)[3] above the legal ceiling of 60 days is therefore still high, even though their share has dropped significantly since 2009, the date at which the Act[4] came into force.

T1 Breakdown of companies and failure rates by length of days sales outstanding since 2004

(in %)

	2004–2008	2009–2013	2014–2017
Breakdown of companies by categories of DSO			
≤ 60 days	57.1	63.8	65.3
> 60 days and ≤ 90 days	22.4	20.6	20.2
> 90 days	20.5	15.6	14.5
One-year failure rate			
≤ 60 days	0.86	0.97	0.75
> 60 days and ≤ 90 days	1.03	1.18	0.93
> 90 days	1.30	1.83	1.45

Scope: Non-financial corporations within the meaning of the Economic Modernisation Act (LME), excluding the agricultural sector.
Source: Banque de France, FIBEN database (data at end-October 2019 and estimate in November 2019).

However, the business failure rate increases with the length of days sales outstanding. This rate is almost twice as high when days sales outstanding exceed 90 days, compared to the level reached when customers meet the legal limit of 60 days. This finding points to the existence of a relation between business failure and late payments that should be investigated.

2 All late payments potentially increase the risk of failure

Late payments have a definite, but relative impact

The odds ratios obtained from a bankruptcy prediction model (see Box 2) provide an accurate measure of the extent to which business failure is associated with a breach of the legal limit for payment terms, i.e. the risk that late payments increase a company's probability of default (PD). The relation between the PD and late payments is measured by first considering all late payments beyond the 60-day legal limit, regardless of how late.[5] An odds ratio greater than 1 verifies the existence of an association between the PD and late payments. The estimation of the bankruptcy prediction model shows that it is equal on average to 1.24 and significantly different from 1 (see Table 2). Late customer payments are therefore likely to increase the PD by close to 25% on average compared to the PD of companies whose days sales outstanding are below the 60-day legal limit.

2 Act 2008-776 of 4 August 2008 (Economic Modernisation Act).

3 Days sales outstanding are calculated using companies' financial statements by expressing trade receivables (net of advances received) in days of sales (see Appendix 1).

4 On changes in payment delays and late payments, see "Les structures de production et les rapports de force figent la situation en matière de délais et de retards de paiement", *Banque de France Bulletin*, No. 227/6, January-February 2020.

5 In practice, the legal limit may be below 60 days in certain sectors – in particular, transport – or for certain products – in particular, 30 days for fresh produce. However, because of the multi-product nature of many companies' activity, it is difficult to isolate those that have derogatory payment terms. In this study, we therefore only consider the 60-day criterion.

Bulletin
de la Banque de France
227/8 - JANUARY-FEBRUARY 2020

Companies

BANQUE DE FRANCE
EUROSYSTÈME

4

BOX 2

The odds ratio measures the increase in the probability of default due to late payments and other risk factors

An odd is defined as the ratio of two complementary probabilities: for example, the probability of the failure occurring over the probability of it not occurring. An odds ratio is an indicator of relative risk that shows the links between two binary variables: here, failure versus non-failure in the numerator and, for example, payment delays over 60 days versus payment delays below or equal to 60 days in the denominator. Consequently, an odds ratio equal to 1 means that there is no link between the two variables. An odds ratio greater than 1 indicates a link between the two variables, and the higher the number, the stronger the link.

Formally, the odds ratio can be presented as follows:

	Occurrence	Non-occurrence	Odd	Odds ratio
Failure	a	$1 - a$	$a / (1 - a)$	
	> 60 days	< 60 days		$\dfrac{a / (1 - a)}{b / (1 - b)}$
Payment delay	b	$1 - b$	$b / (1 - b)$	

In this study, the odds ratio measures the link between the default binary variable (which is 1 if the firm is the subject of insolvency proceedings and 0 otherwise) and the binary variables reflecting the extent to which customer payments are late relative to the legal limit: all late payments, those below 30 days, and those above 30 days. If the odds ratio is greater than 1, it measures the increase in the probability of default (PD) associated with a level of late payments. It is also possible to calculate the degree to which the PD is linked to each of the main indicators of companies' financial soundness also expressed in categories, such as the equity ratio, the margin rate, and the liquidity ratio, and compare it with the degree to which default is linked to late payments (see Appendix 2 for the model specification).

T2 Odds ratio showing the relation between business failure and late payments

| Odds ratio	95% confidence interval	One-year failure rate (in%)
1.24	[1.19 – 1.29]	0.94

Scope: see Table 1.
Source: Banque de France, FIBEN database (data at end-October 2019 and estimate in November 2019).
Note: Odds ratios are measured for all late payments, regardless of how late, over the entire period 2004-17. The 95% Wald confidence interval means that if a large enough number of samples were available to repeat the odds ratio calculation, the values obtained would in 95% of the cases fall within the range of values determined by the model estimation procedure. This would lead to the conclusion, with a risk of error of 5%, that the "real" value of the odds ratio is greater than 1. An odds ratio is statistically and significantly different from 1 when this interval does not contain the value 1.

By comparing the odds ratios associated with late payments with those associated with other determinants of business failure, it appears that failure is more related to a deterioration in solvency, liquidity or profitability than to the length of days sales outstanding (see chart). For deteriorated states of these factors, the odds ratio is often greater than 4, well above the value of 1.24 reached for late payments. This reflects the usual ranking of the causes of a company's difficulties.

Companies' probability of default and main predictive factors
(odds ratio)
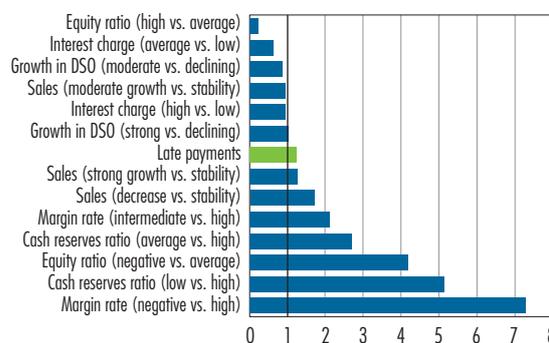
Scope: Non-financial corporations within the meaning of the Economic Modernisation Act (LME), excluding the agricultural sector.
Source: Banque de France, FIBEN database (data at end-October 2019 and estimate in November 2019).
Note: See calculation method in Box 2: an odds ratio greater than 1 indicates a higher probability of default.

Bulletin
de la Banque de France
227/8 - JANUARY-FEBRUARY 2020

Companies

BANQUE DE FRANCE
EUROSYSTÈME

5

The increase in days sales outstanding is not related to the probability of default

Finally, the PD is not related to the annual growth in days sales outstanding, even though it is related to late payments. The increase in days sales outstanding may reflect the influence of two distinct factors: either the existence of payment difficulties among customers, or the use of payment delays to boost sales, as part of the business strategy. The absence of a relation between the increase in days sales outstanding and the PD suggests that it is not the first factor that outweighs the second. This finding supports the observation that, as their customers' difficulties emerge, suppliers often shorten payment delays.

3 The relation between business failure and late payments is higher for late payments over 30 days

Very late payments harm all suppliers

We now distinguish the increase in the PD associated with late payments of less than 30 days or more than 30 days relative to the 60-day legal limit.

The extent to which business failure is associated with late payments differs significantly according to how late payments are (see Table 3). In the population as a whole, the risk of the PD increasing does not appear to be really acute when payments are no more than 30 days late: the odds ratio is very close to 1. On the other hand, late payments over 30 days are an aggravating factor of the PD: they raise the PD by more than 40% on average (odds ratio equal to 1.42).

The finding is almost identical if we take into account the age and size of companies. In most age or size classes, the assumption of an impact of late payments below 30 days on the PD is ruled out, the odds ratios being within a confidence interval that includes the value 1, or with a lower bound of 1. On the other hand,

late payments over one month increase the PD by more than 40%, which is the same percentage as in the general population. However, this impact is somewhat mitigated above a size threshold of EUR 7.5 million in turnover (odds ratio of 1.26). Moreover, surprisingly, it is almost non-existent for the youngest companies (less than 5 years old).

Very late payments also affect the strongest suppliers

By taking into account companies' financial soundness[6] it is possible to quantify the impact of late payments according to their distance to default, measured by their rating. The impact of late payments below 30 days on the PD is hardly or not significant, depending on the rating grade. Nevertheless, the PD increases slightly for companies whose credit risk is less well rated by the Banque de France. The increase in the PD associated with late payments over 90 days also appears to be relatively unrelated to the a priori distance to default. Paradoxically, it tends to be slightly higher for the best-rated companies. In any event, in the most fragile companies, late payments cannot be considered a major factor underlying the risk of failure, since these companies are already experiencing difficulties. In fact, as mentioned above, the risk of failure is essentially related to the state of financial structures or income.

Ultimately, the relation between business failure and late payments is likely to affect all firms, regardless of their age, size, and financial situation when payments become increasingly late.

On the basis of these results, it is not possible to determine with accuracy the number of companies that have been placed in receivership because of late payments. However, it is possible to identify those firms in the population of firms in receivership that are exposed to the risk of their probability of default increasing due to late payments. The number of additional failures depends on the observed annual failure rate and the rise in the PD associated with late payments. It is calculated for 2017 by distinguishing

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6 Firms' financial health is measured here by the credit rating assigned by the Banque de France. Three risk categories have been established: the "low risk" category includes ratings from 3++ to 4, the "medium risk" category includes ratings from 5+ to 5, and the "high risk" category includes ratings from 6 to 9. For a given year, a company's rating is the rating "in effect" at 31 December.

Bulletin
de la Banque de France
227/8 - JANUARY-FEBRUARY 2020

Companies

BANQUE DE FRANCE
EUROSYSTÈME

6

T3 Odds ratios associated with the length of days sales outstanding

		Point estimate	Point estimate	95% confidence interval		One-year average failure rate (in%)
Total population						
	< 30 days	1.094	1.042	1.149		0.94
	> 30 days	1.424	1.355	1.495		
According to company age (in years)						
≤ 5 years	< 30 days	1.118	1	1.25		1.59
	> 30 days	1.184	1.052	1.334		
> 5 and ≤ 25 years	< 30 days	1.102	1.036	1.171		0.93
	> 30 days	1.516	1.427	1.611		
> 25 years	< 30 days	1.058	0.943	1.186		0.67
	> 30 days	1.385	1.227	1.563		
According to company size (turnover in EUR millions)						
≤ 1,5	< 30 days	1.131	1.053	1.215		1.18
	> 30 days	1.348	1.254	1.45		
> 1,5 and ≤ 7,5	< 30 days	1.061	0.988	1.138		0.89
	> 30 days	1.494	1.39	1.606		
> 7,5	< 30 days	1.038	0.861	1.252		0.47
	> 30 days	1.266	1.037	1.545		
According to company rating (Banque de France rating)						
Low risk	< 30 days	1.078	0.961	1.209		0.23
	> 30 days	1.456	1.296	1.637		
Confirmed risk	< 30 days	1.13	1.057	1.207		1.72
	> 30 days	1.389	1.297	1.487		
High risk	< 30 days	1.195	1.09	1.31		7.14
	> 30 days	1.335	1.218	1.462		

Scope: See Table 1.
Source: Banque de France, FIBEN database (data at end-October 2019 and estimate in November 2019).

firms by size. It is estimated that about 8 in 100 firms run such a risk, with three-quarters of them experiencing late payments over 30 days.[7] A strong relation between failure and late payments is therefore a fairly rare event, but, as we have just seen, it can affect all companies.

4 The length of days sales outstanding is linked to companies' position in the supply chain

Previous results show that late payments over 30 days affect companies' probability of default, but also that shorter payment delays have little or no impact on companies' probability of default. In reality, not all

companies are equally exposed to late payments. Factors other than financial ones determine the length of days sales outstanding.

The length of days sales outstanding is related to sectoral factors and business strategies…

Inter-firm disparities in terms of days sales outstanding can be attributed to two main types of factors.

- The first are structural factors, reflected by the sector to which firms belong and their position in the supply chain. The differences are due to the fact that DSO decrease from upstream to downstream.

7 This result is reached by estimating the number of additional failures expected due to late payments for 2017 (by applying the increase in the PD measured by the odds ratio) in the population of companies expected to fail within one year.

Bulletin
de la Banque de France

227/8 - JANUARY-FEBRUARY 2020

Companies

BANQUE DE FRANCE
EUROSYSTÈME

7

- The second are factors associated with business strategies. In this case, the differences are due to the use of longer payment delays, in particular to promote sales growth, share the risk associated with demand uncertainty and cover the cost of product storage. Granting longer payment delays ensures that customers have greater liquidity in the event of cash flow or credit access problems.

... more than to financial disparities between companies

Using a model of variance analysis, it is possible to estimate the extent to which days sales outstanding depend on the above factors and to quantify the relative contribution of structural, strategic and financial factors to differences in DSO.[8]

In the model, the sector and the corporate turnover/purchase ratio indicate companies' position in the supply chain. The growth rates of payment delays and activity reflect companies' growth strategies. The Banque de France company rating summarises their financial position. Finally, the age and size of companies make it possible to control for the potential existence of effects linked to these corporate dimensions.

The variance analysis verifies that the dispersion of DSO is mainly related to sectoral and strategic factors and cannot really be attributed to inter-firm financial disparities. Close to 60% of the variance in DSO is attributable to companies' position in the supply chain (see Table 4). Strategic factors associated with the growth in DSO also account for a significant share of payment delays. On the other hand, the length of payment delays appears unrelated to other factors, in particular financial factors, which are summarised here by companies' credit rating.

In conclusion, the length of days sales outstanding seems to be related more to companies' different positions in the supply chain and to their business dynamism than to their financial situation. This partly determined, idiosyncratic nature of payment terms no doubt explains why their impact on the probability of default is moderate and confined to situations where payments are extremely late.

T4 Relative partial contribution of structural, strategic and financial factors to the variance in days sales outstanding

Factors	Gross contribution	Test statistic	*p-value*	Partial contribution
BDF risk rating	561,487	133	<.0001	0.10%
Sector	447,634,578	35,429	<.0001	56.20%
Turnover/purchases ratio	376,466	60	<.0001	0.05%
Turnover growth	23,544,639	3,727	<.0001	3.00%
Growth in DSO	114,039,912	27,078	<.0001	14.30%
Company age	7,214,559	1,713	<.0001	0.90%
Company size	1,642,720	260	<.0001	0.20%

Scope: See Table 1.
Source: Banque de France, FIBEN database (data at end-October 2019 and estimate in November 2019).
Key: Partial contribution measures the contribution of each factor to the total variance in days sales outstanding (sum of model squares) measured from the gross contributions (i.e., sums of Type III squares). The value of the test statistic is used to calculate the p-value associated with each factor that determines its significance. Low p-values mean that the factor significantly explains the variability of the variable of interest (days sales outstanding in this model).
Note: BDF, Banque de France; DSO, days sales outstanding.

8 The model of variance analysis performs well, with an R^2 equal to 0.21. R^2 measures the explanatory power of the model. Ranging between 0 and 1, it increases with the quality of the adjustment.

Bulletin
de la Banque de France
227/8 - JANUARY-FEBRUARY 2020

Companies

BANQUE DE FRANCE
EUROSYSTÈME

8

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Appendix 1
Data used

The FIBEN company database

The corporate accounts database: the Banque de France collects the financial statements of companies whose turnover exceeds EUR 0.75 million or, until 2012, whose bank debt exceeded EUR 0.38 million. The data are collected from companies resident in France. In 2017, in terms of workforce, the coverage rate was over 85% for companies subject to corporate income tax. In terms of turnover, the coverage rate was over 89%.

The scope of the study

All market activities, excluding NAF sectors (French nomenclature of activities) "KZ" (financial activities, excluding holding companies), "OQ" (administration, education, human health and social work) and "AZ" (agriculture, forestry and fishing) for which we consider that we do not have sufficient data. Also excluded are public institutions and semi-public companies.

Financial links

The Banque de France identifies financial links and analyses the percentage of capital held by other companies, depending on whether the holder is itself a non-financial corporation (including holding companies), a financial institution (bank, mutual fund, insurance company), a natural person (individual or employee), the State or a non-resident company. From this analysis, the legal units in the FIBEN company database are grouped into companies on the basis of the statistical criteria set out in Decree 2008-1354 of 18 December 2008, which implements the Economic Modernisation Act (LME).

Business sector allocation

In the case of a company made up of several legal units, the sector is determined by grouping legal units together by sector. The sector chosen is that of the legal units whose weight in the company is the largest in terms of turnover, provided that it exceeds 50%. If this is not the case, the classification by sector of the various "groupings" of legal units is based on the criterion of the workforce, always provided that its weight exceeds 50%. Failing that, one reverts to the classification by turnover, by choosing the sector with the legal units whose weight in the company is the highest in terms of turnover.

The Banque de France rating

The Banque de France rating is an assessment of a company's ability to honour its financial commitments over a period of one to three years. It is composed of a turnover rating and a credit rating. The turnover rating reflects the level of activity; the credit rating positions rated companies on a credit risk scale. A rating of 3++represents the best credit rating, 9 the worst. A rating of P means that the company is the subject of insolvency proceedings.

Days sales outstanding

Expressed in days of sales, the "days sales outstanding" ratio is the ratio of trade receivables, including discounted bills not yet due, to sales including all taxes, multiplied by 360. Trade receivables are calculated after deducting advances and deposits paid on orders (recorded as liabilities on the balance sheet).

Bulletin
de la Banque de France
227/8 - JANUARY-FEBRUARY 2020

Companies

BANQUE DE FRANCE
EUROSYSTÈME

10

Appendix 2
The *logit* model of failure

Ta Variables used

Name	Definition	Categories							Reference
Age	In years	young: ≤ 5 years	intermediate: > 5 and ≤ 25 years	mature: > 25 years					mature
Size	In EUR millions of sales	small: ≤ 1,5	average: > 1,5 and ≤ 7,5	large: > 7,5					large
Sector		Manufacturing industry	Trade and HCR	construction	Real estate	Services to businesses	Services to individuals	transport	Manufacturing industry
DSO	In days of sales	≤ 60 days	]60 – 90] days	> 90 days					≤ 60 days
Equity ratio	Equity/total liabilities in%	Negative	intermediate: [0 – 50%]	high: > 50%					intermediate
Profit margin	profit/sales in%	Negative	intermediate: [0 – 5%]	high: > 5%					High
cash reserves ratio	Cash assets/sales in days	low: < 5	intermediate: [5 – 50]	high: > 50					High
Interest burden	Interest and similar charges/EBITDA in%	low: < 5%	intermediate: [5 – 15%]	high: > 15%					Low
Growth in DSO	Annual in%	Negative	positive: [0 – 20%]	high: > 20%					negative
Growth in sales	Annual in%	1 highly negative: ≤ 5%	2 weak:]- 5 – 3%]	3 moderate:]3 – 12%]	4 strong: > 12%				weak
Year									2009

Source: authors' calculations.
Note: HCR, hotels & restaurants.

Tb Performances of the *logit* model estimate

	Total population	
	Three categories of payment delays	Two categories of payment delays
Max-rescaled R-Square	0.2332	0.2324
Association of predicted probabilities and observed responses		
Percent concordant	88,7	88,6
Somers' D	0.774	0.773

Source: Banque de France, FIBEN database (data at end-October 2019 and estimate in November 2019).
Note: Somers' D measures the level of agreement of the model's reclassifications between healthy and failing firms.