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Abstract

Commercial aircraft sales are typically associated with long-term financing in a highly volatile sector. This is mainly due to structural reasons – such as the price of aviation fuel and currency fluctuation against the US dollar – as well as the risk of events that are difficult to predict, such as natural phenomena, geopolitical conflicts or terrorist attacks. For these reasons, and also due to institutional attribution, it proved to be imperative to carry out a continuous and thorough monitoring of aircraft financing operations, their guaranties and their debtors. Such activity includes monitoring the borrower's compliance with all contractual obligations throughout the life of the loans. This text reviews the scope of the aircraft finance portfolio management work at BNDES in light of its characteristics and specific processes that have been prepared and refined by the Aircraft Export Finance Portfolio Management team, Foreign Trade Department, in the Industry, Services and Foreign Trade Division for the past ten years.

Keywords: Aircraft. Aviation. Export finance. Management. Monitoring.

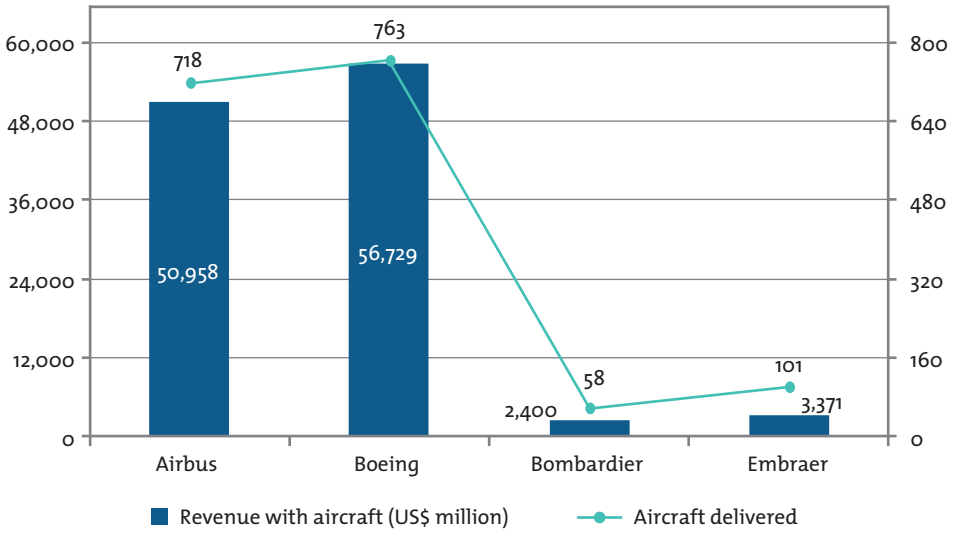
Contents

Alan Uzêda de Souza is an accountant in the Industry, Services and Foreign Division of BNDES. Gian Carlos Moreira Ferreira is a lawyer and manager at the Foreign Trade Department of the Industry, Services and Foreign Trade Division of BNDES; he holds a Master of Laws in International Law from the State University of Rio de Janeiro (Uerj) and also a Master's Degree in Business Administration from Getulio Vargas Foundation (FGV). Marcelo Dias Ferreira is an engineer at the Industry, Services and Foreign Trade Division of BNDES; he holds a Master of Science degree in Aeronautical and Mechanical Engineering from the Technological Institute of Aeronautics (ITA), and a Master's Degree in Business Administration from Coppead (UFRJ). Rodrigo Ludwig Schneider is an engineer at the Industry, Services and Foreign Trade Division of BNDES and holds a Master of Science degree in Business Administration from the Pontifical Catholic University of Rio de Janeiro (PUC-Rio). The authors thank Marcio Nobre Migon for the support and guidance given to the portfolio management work, and trainees Amanda Chousa Ferreira and Raquel Ramos Santana for their work related to the figures and tables presented. This text is the sole responsibility of the authors, not necessarily reflecting BNDES's opinion.

1. Introduction

Financing for commercial aircraft acquisition is a business that moves high figures in the scope of international finance. In 2016, 1,640 new aircraft were delivered to the global market by the main manufacturers,[1] totaling US$ 113,458 million in sales. Graph 1 presents the data per manufacturer.

Graph 1. Main manufacturers' aircraft and revenue in 2016 (US$ million)



Source: Prepared by the authors based on data from the four main aircraft manufactures' financial demonstrations (AIRBUS, 2017; BOEING, 2017; BOMBARDIER, 2017; EMBRAER, 2017).

These sales are made primarily through private financing, capital markets or government financial institutions – the latter all universally known by the acronym ECA (export credit agency). Since 1997, BNDES Exim has been conducting exports financing operations for Brazilian aircraft. BNDES Exim is an ECA, and it has been conducting Brazilian aircraft exports financing operations for over twenty years. Since 2002, in many of these financing operations, BNDES relies on the Export Credit Insurance (SCE), issued by the Union through the Special Secretariat for Foreign Trade and International Affairs (Secint) of the Ministry of Economy. The insurance is backed by the Export Guarantee Fund (FGE) and acts as a risk mitigator.

The Brazilian aircraft exports support model therefore has BNDES Exim as its main financier and FGE as its guarantor in operations where this mitigator is required by BNDES Credit Committee. This set of institutions is aircraft finance portfolio known as Brazilian ECA "system".

[1] Essentially Airbus (Europe), Boeing (USA), Bombardier (Canada), and Embraer S.A. (Brazil).

By definition, aircraft exports financing operations are large and long-term operations, and often involve complex structures governed by foreign law. Therefore, it was necessary to develop specific expertise not only in the structuring and origination of operations, but also in monitoring and managing the aircraft finance portfolio after execution of the finance agreements and relevant disbursements. Due to this need, a system was built by BNDES to manage and minimize the risks of the aircraft finance portfolio.

This text aims to present the management system implemented by the BNDES exports division to monitor the aircraft finance portfolio, describing and contextualizing its motivations, its evolution over the twenty years of support for the aeronautics sector, and its current scope.

The next section discusses the importance of aircraft exports, followed by the third section, which explains the transition between origination and monitoring/management of financing operations. In the fourth section, the monitoring structure is divided into four pillars. The following section discusses the management of financial and nonfinancial obligations of operations, and finally the conclusions are presented.

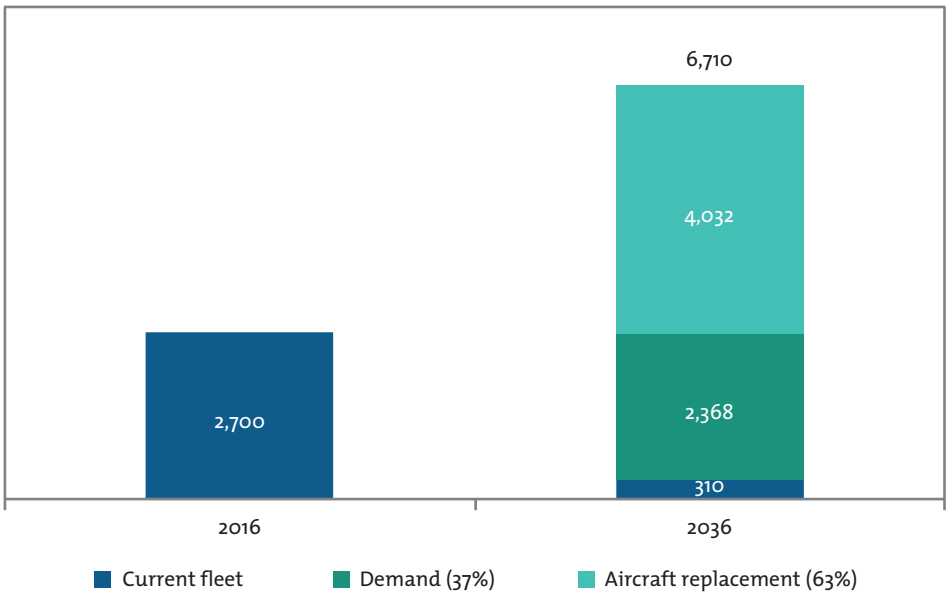
2. The importance of aircraft exports operations and BNDES's support

The importance of the aeronautics sector is highlighted by: (i) strong growth potential, as shown in Graph 2; (ii) relevant technological content; (iii) high added value; and (iv) significant contribution to the Brazilian trade balance. This view is not exclusive to Brazil, but, according to Vasigh (2012, p. 2) generalized:

> Aircraft producers wish to boost export sales and their customers have a need to finance their purchases. National governments, recognizing the ability of aircraft manufacturing to increase high-value exports and to create Jobs at home, have used their governmental export credit agencies (ECAs) to provide financing support in these cases.

BNDES played a significant role in Embraer's success, especially after privatization, when Brazil's aircraft manufacturing model underwent a major transformation. Government procurement was reduced, and the regional jet project, ERJ-145, gave the company access to the world's large aviation markets.

Graph 2. Market growth projections for 70 to 130-seat aircraft



Source: Adapted from Guedes (2015).

Initially, BNDES supported Embraer S.A. with loans and capital, and then through a sales financing program, supplemented by federal budget resources allocated under the Proex-Equalization program. This support was decisive both in the second half of the 1990s, when Embraer's regional jets were still a bet on a market whose production was concentrated in developed countries, as well as in the years following the terrorist attack of September 11, 2011, in the United States of America (USA), when there was a large reduction in liquidity and private financing for airlines. On this occasion, the FGE played a key role.

Sales of commercial aircraft are usually associated with long-term financing (12 to 15 years), due to the high acquisition cost of each asset and the fact that the useful life of such equipment is over 25 years. Absence of financing or its offer at high interest rates significantly affects the value of installments, the net present value (NPV) of the aircraft and, therefore, its competitiveness.

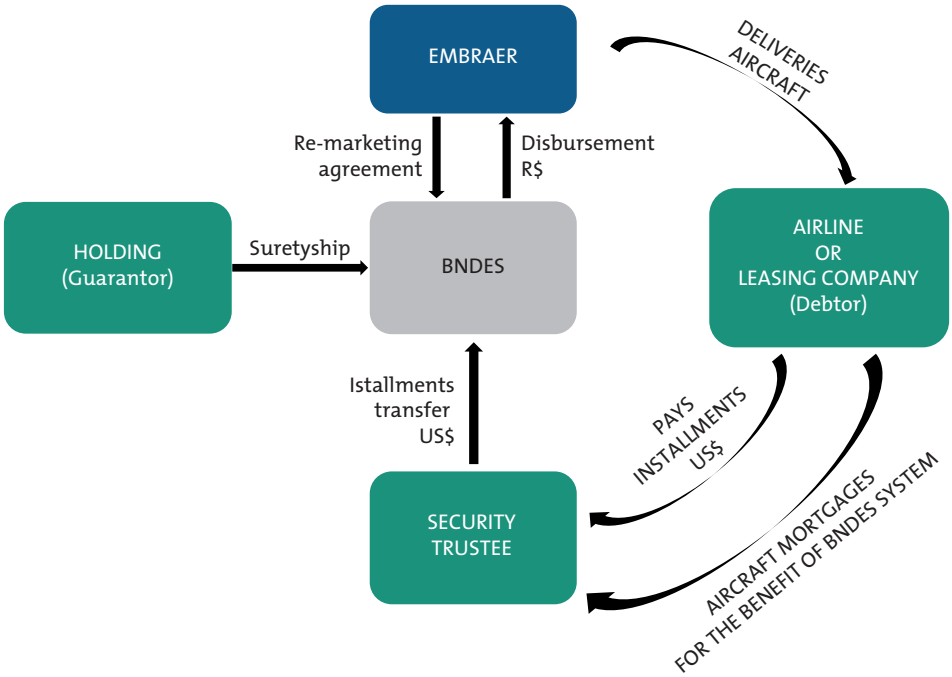
The Brazilian government created a financing and exports support structure for aeronautical products, as the major market manufacturers had their government ECAs fully functioning and structured.[2]

This exports financing structure was created within the BNDES System, which has been supporting Embraer S.A. from the ERJ-145 family to the new projects of the ERJ-170 and ERJ-190 families and, more recently, E2 family. Financing

[2] Bombardier, a Canadian company that competes directly with Embraer S.A. for operating in the same regional jet niche, was supported by the Export Development Bank (EDC), while Boeing was supported by the US Exim Bank, and Airbus, by Euler Hermes (Germany), ECGD (United Kingdom) and Coface (France).

operations vary in structure depending on factors such as debtor risk rating and jurisdictional risk in the country of aircraft registration. Figure 1 is an example of the basic structure of a direct financing operation with holding's guarantee.

Figure 1. Basic structure of a direct financing operation



Source: Prepared by the authors.

Additionally, other structures are used in many operations, depending on the country of the airline, the special purpose companies and the trustees (fiduciary agents) in order to isolate the asset risk in the event of airline bankruptcy. Regardless of the structure of the operation, the focus of monitoring will always be the asset given as collateral and the airline or leasing company from which the resources to meet the financing installments come. Continued and detailed monitoring of aircraft finance operations is part of the effort to mitigate the risks associated with such operations and to ensure their low loss given default (LGD),[3] sustaining the long-term exports support for Embraer S.A.

2.1 Aircraft financing operations context

Aircraft financing is mainly outlined by some features such as:

- Long-term operations: generally, over ten years, most commonly ranging from 12 to 15 years.

[3] LGD of the aircraft finance portfolio for the base date of September 30, 2017 is 2.95%, below BNDES average.

- Large amounts: the unit value of the Embraer 175, which concentrates current disbursements, is over US$ 25 million.

- Asset-backed transactions mostly.

- Concentration: about 90% of the current active portfolio is related to private clients, which end up with greater exposure to the typical aviation sector risk compared to debtors relying on government entities.

The aviation sector is highly volatile, mainly due to structural reasons, such as the price of aviation kerosene (the main direct cost component of airlines) and the exchange rate fluctuation against the US dollar (reference for the aviation industry) as well as the risk of events that are difficult to predict, such as natural (volcano or snow), geopolitical (war) or terrorist phenomena. An example is the closure of US airspace for a week after the Twin Towers attack on September 11, 2001.

The BNDES System's exports financing portfolio accumulated 68 operations, totaling financing of 1,193 aircraft manufactured by Embraer S.A. from 1997 to 2018.

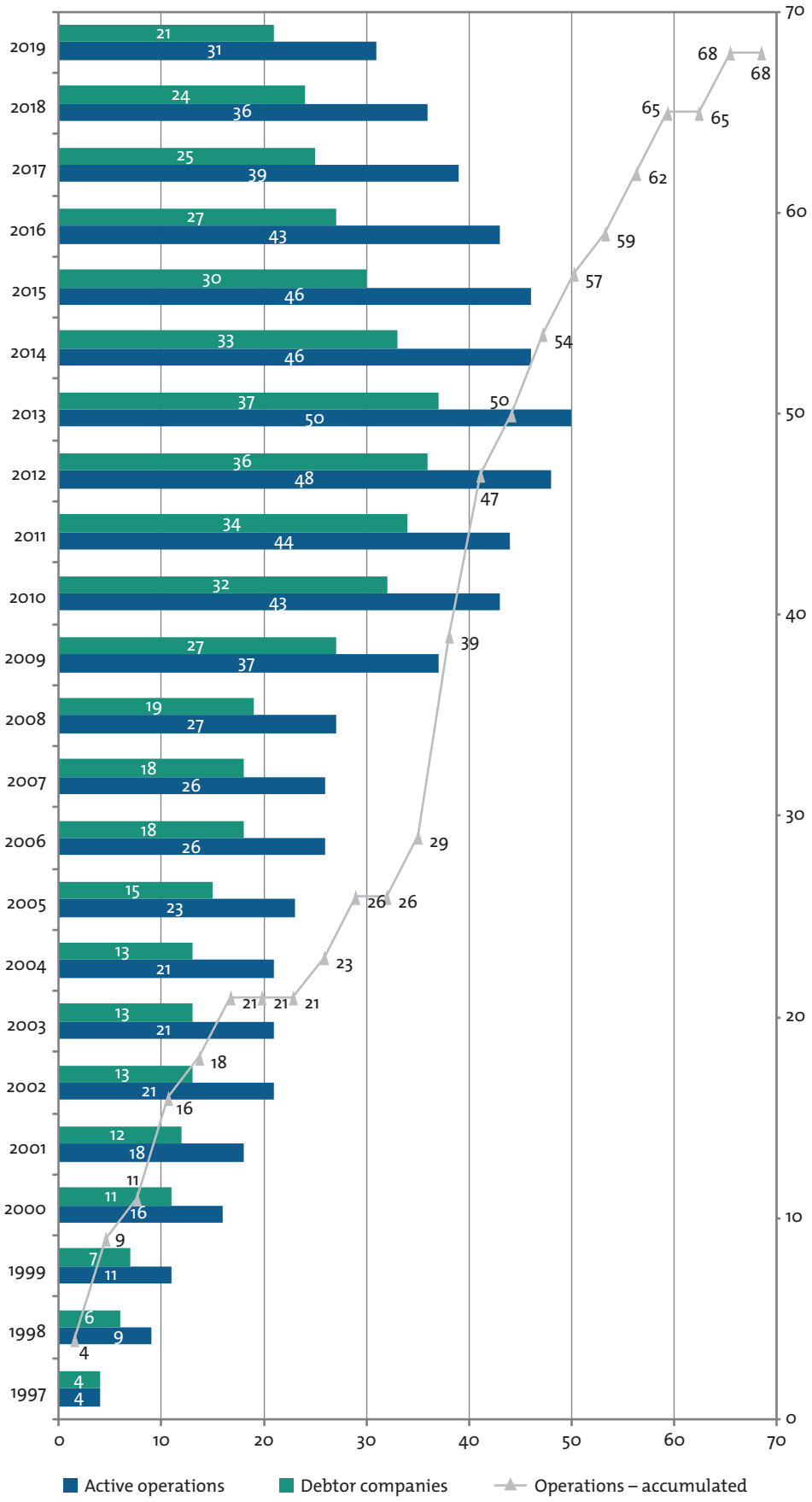
At the end of the fourth quarter of 2018, the portfolio had 36 active operations corresponding to 24 airlines, as shown in Graph 3, with 471 active aircraft financed.

As shown in Graph 3, the aircraft finance portfolio is scattered in number of supported companies, which increases the complexity of continuous monitoring of operations.

2.2 What is the role of the monitoring of aircraft finance operations?

Given the characteristics highlighted above, and in view of an institutional assignment, BNDES exports division considered it imperative to carry out a more detailed, in-depth and continuous monitoring of debtors related to aircraft finance operations, the operations themselves and their respective guaranties by means of a team dedicated exclusively to this task.

Graph 3. Portfolio operations history (base date: Dec. 2018)



Source: Prepared by the authors.

According to BNDES internal regulations, the portfolio management team is responsible for monitoring the operations of support for beneficiaries from contracting to settlement of all debtor obligations, even those made through financial agents, in addition to feeding BNDES managerial information systems in relation to the beneficiaries under its responsibility. This monitoring generally includes not only the period of credit utilization but also the debtor's compliance with all contractual, financial and nonfinancial obligations throughout the financing term.

Thus, their mission and vision on this attribution were developed as follows: Mission:

To respond in a timely manner to post-origination demands in aircraft finance operations and continuously monitor the customer portfolio, monitoring the four pillars – exposure, economic and financial indicators, collateral, and financial and nonfinancial obligations – in order to have management instruments to be unfolded into applicable actions.

Vision

To help the work developed in the aircraft finance portfolio to be a benchmark in monitoring structured operations within BNDES.

With regard to aircraft finance operations, their monitoring can be divided into three major groups of tasks:

- Aircraft finance portfolio risk monitoring from the perspective of the four pillars (see Figure 4): portfolio exposure, airlines' operating, economic and financial situation, aircraft condition, and financial and nonfinancial obligations.

- Demands after the end of the period of use, which refer, for example, to credit recoveries, early settlements and contractual changes.

- Routines such as management of the monthly and annual disbursement budget, releasing guaranties from settled operations, reimbursing attorney's fees and meeting audit demands, as well as the transitions of operations.

The three groups of tasks will not be addressed in this text, either because there is no need to delve into all routines (many of them are related to what is done in other BNDES's operational divisions), or because the demands at the end of the period of use, especially judicial recovery, deserve a special paper given the complexity and peculiarities of each case. Therefore, this text aims to discuss the risk monitoring (understood here in a broad sense), which demands about 50% of the available time of the group currently dedicated to monitoring.

In addition, there will be description of the operation transition between the origination team and the monitoring team, which creates a check point for the origination team, in which all the obligations and guaranties of the operation are mapped as the first compliance analysis.

The monitoring work from the perspective of its four pillars is triggered by the disbursement related to an aircraft finance operation aircraft.[4] From this moment, the monitoring team is notified by the origination team through submission of a copy of the contract summary sheet (FRC), and that aircraft/operation is added to the BNDES's monitoring database systems. The operation starts being monitored by the monitoring team from the perspective of the four pillars, as detailed below.

3. Operation transition: from origination to monitoring

The aerospace and defense structure counts on an origination operation team, a sector monitoring team, and a portfolio management team dedicated to contract monitoring. It is a structure specifically designed to deal with the complexities already described.

Origination teams are responsible for prospecting, analyzing, and executing operations, besides managing their disbursements.[5] Once the period of use is over, operations are formally transferred to the aircraft finance portfolio management team, which then manages the operation until the date of settlement and release of guaranties associated, as the case may be.

The efficiency and effectiveness of the monitoring work can be impacted by the quality of the organization of physical and digital documents (on the BNDES corporate network directories) of the operation and the accuracy of the information that fed the various BNDES corporate systems.

As an example, Figure 2 illustrates the main stages of an aircraft finance operation through SCE/FGE, with emphasis on the operation transition, which is formalized after all disbursements are released.

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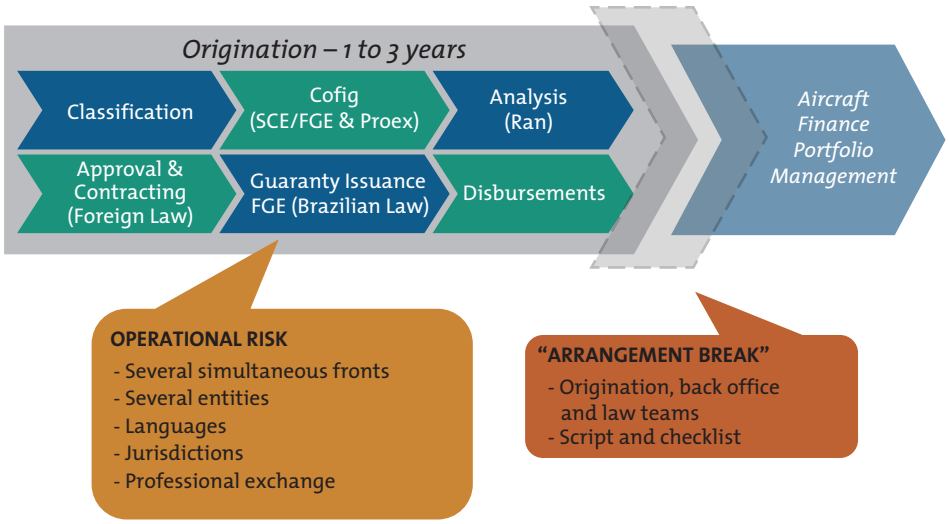
[4] Contracted operations may provide for one or more aircraft to be financed. Each aircraft, however, represents a single disbursement, in the full amount of the portion financed (up to 85% of exports value), upon delivery (exports) of the good. The aircraft serial number will identify the disbursement in the departmental control, generating a specific payment flow (sub-credit) to be monitored.

[5] Since the disbursement occurs in a single cash movement upon aircraft delivery, usually shortly after operation contracting, the practice of separating disbursements from the scope of origination work was not adopted.

Figure 2. Operation transition



Source: Prepared by the authors.

One metaphor that allows a better understanding of what motivated the creation of this process is the "arrangement break," that is, a moment used to verify the good order of the actions and documents of a financing operation.

As already mentioned, financing operations supported by the Brazilian exports system present considerable complexity due to:

- large number of Brazilian players: BNDES, National Treasury, Bank of Brazil, Brazilian Guarantees and Fund Managements Agency, Secretariat of Foreign Affairs of the Ministry of Economy, among others;
- number of foreign players: debtor, security trustee,[6] consultants (depending on the operation), owner trustee[7](depending on the structure) and foreign law firms representing the parties;
- term, usually longer than one year between initial claim and contracting, and ten to 15 years of amortization, which most likely results in the shift of liable agents in the financing course; and
- volume of documents: in addition to the complexity inherent in the support for the Brazilian exports support system, the aviation segment is characterized by being document intensive due to strong regulation.

Therefore, there is real operational risk resulting from the complexity described above. This risk is observed to the extent that problems may arise in the operation management, specifically regarding the fulfillment of financial and nonfinancial

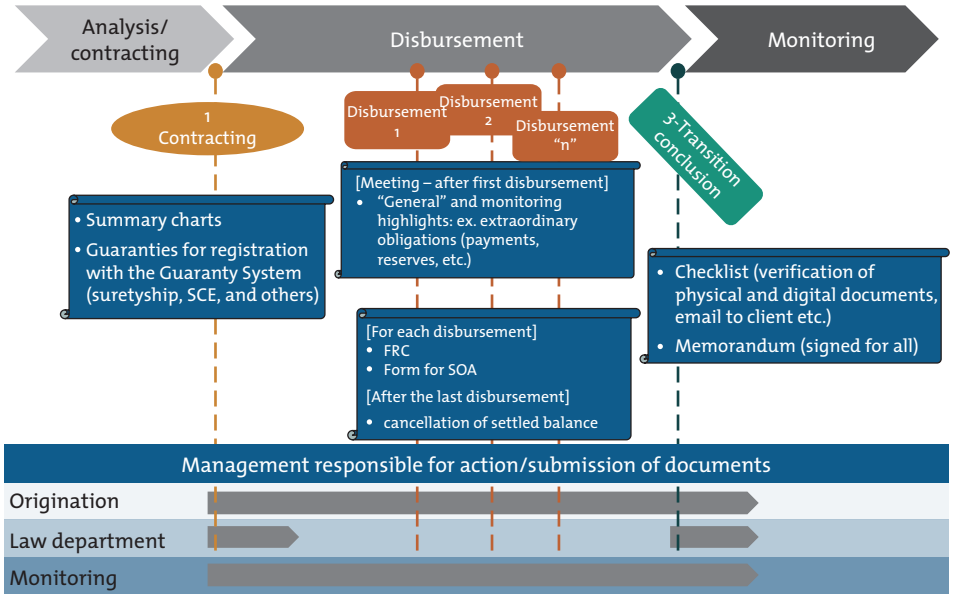
[6] Security trustee is a specific figure of US law; it is a financial institution that acts as the creditor's trustee and holds collateral set up for the benefit of the creditor.

[7] Owner trustee is a specific figure of US law and is a financial institution that acts as the "fiduciary owner" of the aircraft for the benefit of the airline in order to insulate the legal risk of the asset in the event of bankruptcy.

obligations, either by the debtor or by BNDES as SCE/FGE beneficiary in the case of operations that rely on this coverage.

During the process mapping to discipline the operation transition, it was found that, in practice, before the formal[8] and definitive transition to the portfolio management team, there are two other times when work fronts are initiated and result in transfer of responsibility for some assignments from the origination team to monitoring team: (i) after contracting; and (ii) after each disbursement associated with each aircraft financed. In short, there are three moments that act as control points prior to "changing the guard" in an operation, as simplified in Figure 3.

Figure 3. Three-moment transition process



Source: Prepared by the authors.

Therefore, although there is a formal transition process after the last disbursement, there are a number of monitoring activities initiated prior to the actual transfer of the transaction between the origination and the monitoring teams. For example, asset monitoring, financial and nonfinancial obligations monitoring and the companies' operating and financial situation monitoring are made from the moment BNDES is exposed to a given client, even though the formal transition, with exchange of the team in charge, only occurs after the last disbursement. Briefly, it can be stated that adding an operation (here understood as an aircraft disbursement) to the monitoring process from the perspective of the four pillars occurs at the first moment described above.

Formal transition is a process built on actions, such as verifying the memorandum of conditions preceding disbursements and the debtor's performance

[8] Formal and definitive transition is understood as the exchange of responsible team after the last disbursement of operation.

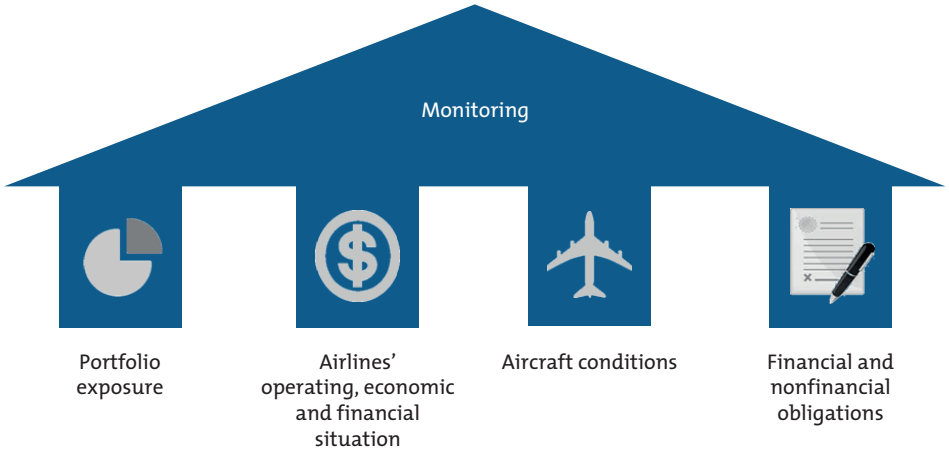
with nonfinancial obligations, such as expenses related to external lawyers and communication with contacts of external entities about exchanging the teams in charge (focal points) within BNDES. In addition to the steps taken to conduct the process, there is a checklist of financial obligations, nonfinancial obligations, physical list of documents, and list of digital documents. The formalization takes place by issuing a memorandum signed by all responsible parties: origination, aircraft finance portfolio management, resource disbursement and legal analysis teams.

4. The four pillars of monitoring

The division of monitoring work into four pillars (as shown in Figure 4) is solely and exclusively aimed at aggregating in each pillar similar aspects of the complex activity of managing an aircraft financing portfolio of nearly US$ 6.0 billion (data from December 2018). Therefore, the option was to monitor the following aspects:

- Portfolio exposure: it aims to monitor the operations to which BNDES is financially exposed, with multiple configurations, in order to allow performing aggregate, segregated and comparative analyzes by aircraft model, country of operation and risk level, among others.
- Airlines' operating, economic and financial situation: it aims to monitor the company's financial health and, when combined with exposure, measures the risk to which BNDES is exposed.
- Aircraft conditions: it aims to monitor the technical, operational and value preservation conditions of the aircraft, as this is the main credit guaranty to the BNDES System,
- Financial and nonfinancial obligations: it aims to monitor, among other obligations, ordinary and extraordinary payments, ancillary obligations, covenants and aviation insurance.

Figure 4. The four pillars of monitoring



Source: Prepared by the authors.

The construction of this four-pillar model for monitoring of aircraft finance operations was inspired by the combination of internal mechanisms and practices already adopted by BNDES, based on its Monitoring Guidelines and Instructions, as well as by the Bank's practical and theoretical knowledge accumulated for more than twenty years supporting the sector. It is understood that the same criteria and elements of analysis of the operation in its origination should be monitored and reevaluated over the financing term with high tickets and frequent rework resulting from volatility, which is the case in the aeronautics sector.

Vasigh (2012, p. 45) teaches that the lender's analysis must consider the airline's historical and projected financial performance – "is the airline going to be able to generate enough income from the asset and from other sources to repay the loan over the span financing tenor?". However, this analysis should be enhanced with the following: (i) aspects relating to legal, tax and logistical risks and the potential value in the repossession and aircraft mortgage foreclosure; (ii) geopolitical aspects related to the place of operation of the aircraft, risks of natural disasters, armed conflicts, terrorism, among others, and (iii) marketing and sectoral aspects.

Although this further analysis is the focus of large projects funded by government or private banks, the understanding built about the aircraft finance portfolio was that the various aspects and assumptions raised at this stage can and should be monitored permanently, which is why there is a team specialized in monitoring contracts and operations, and another dedicated to monitoring the industry. The same aspects taught by Vasigh (2012) for operations analysis are reference to the pillars of monitoring.

Finally, before starting a more detailed analysis of each pillar, it is worth highlighting the volatility that accompanies the sector: 60 US airlines have filed for bankruptcy protection from 1979 to 2017. These include the three current majors of that country (with the respective bankruptcy filing years): United Continental Holdings (1986 and 2002), American Airlines Group Inc. (2011), and Delta Air Lines Inc. (2005), and the three have emerged stronger and more competitive from restructuring (MORRELL, 2007). In BNDES aircraft finance portfolio, there were three cases of bankruptcy in the USA (Mesa Air Group Inc., American Airlines Group Inc., and Republic Airways Holdings Inc.), one in Brazil (Rio Sul Linhas Aéreas SA), and one in Japan (Japan Airlines). Despite these situations, the aircraft finance portfolio maintains LGD very low – 2.95%, as calculated by the BNDES Integrity, Risk Management and Controllership Division, on the base date of September 30, 2017.

If, on the one hand, reality shows the need for continuous and detailed monitoring of airlines and the aeronautics sector, on the other, the numbers show that, with the correct structuring and monitoring of operations, it is possible to maintain the financial health of the aircraft finance portfolio above BNDES average.

4.1 BNDES's exposure to the aviation sector

Exposure, the first pillar of monitoring, has its name inspired by the financial perspective that refers to the debt position of each member of the aircraft finance portfolio In other words, exposure monitoring is the first element to indicate to the monitoring team how resources should be prioritized for debtor companies – the greater the financial exposure, the more frequent is the monitoring. However, this is not the only dimension observed by this team, which adopts multiple perspectives to allow aggregate, segregated and comparative analyzes, such as by aircraft model, country of operation and risk level, among other aspects, as necessary variables for a more complete understanding of the "portfolio inventory." The materialization of this pillar occurs mainly as a report entitled *Boletim Mensal do Portfólio Aeronáutico (Monthly Aeronautical Portfolio Bulletin)*.

The aircraft finance portfolio inventory is the result of the sub-credit inflows and outflows of each aircraft exported. Since each aircraft has independent financial flows, with start and end dates set at the time of disbursement, this is the fundamental unit of monitoring. Thus, disbursements made in the period represent "inflows" and result in increased aircraft finance portfolio. Similarly, portfolio "outflows" are defined by: (i) settlements at the end of the regular financing period; and (ii) voluntary prepayments (or advanced settlements).

Some tools have been developed internally to provide data from the perspective used by aircraft export support contracts. One of the main adaptations was the implementation of data by aircraft – in this case, the parameter is the manufacturer's serial number, which is not available in other BNDES's corporate systems. These changes were mirrored in export division's systems as a whole to ensure data integrity. Once the export disbursement of each aircraft has been made, the sub-credits are added to the division's systems and databases. The monthly process was mapped to optimize the actions of this periodic routine in order to reduce the execution time and minimize errors and, consequently, rework.

Some graphs and tables will be presented in this section in a nonexhaustive way, taken from the above mentioned *Boletim Mensal do Portfólio Aeronáutico.* with names and values intentionally modified for confidentiality reasons. Table 1 shows the breakdown of the portfolio by debtor with its respective debt coverage ratio, as a result of the ratio of estimated market value of the financed aircraft to the financial exposure, and number of aircraft financed. The number of aircraft financed is a complementary but relevant dimension to be monitored, because, in a mortgage foreclosure scenario, the number of aircraft available for re-sale tends to affect the sale price and, therefore, the effective recovery of credit and the LGD of the portfolio.[9]

[9] Such a statement cannot and should not be generalized to the conclusion that any concentration in airlines and/or aircraft models may be negative from the lender's perspective. Concentration in one model in the same company may end up leveraging BNDES's bargaining power, since, as operations have a cross-maturity clause, delinquency may result in repossession of the entire fleet that BNDES financed, making this airline's operation unfeasible, as the monitoring team experienced regarding the judicial recovery of American Airlines Inc., between 2011 and 2013, involving 216 ERJ-145 family aircraft financed by BNDES – credit recovery that resulted in no loss to the BNDES System.

Table 1. Exposure by debtor (US$ million, IG* and number of aircraft – Dec. 2018)

	Debtor	Payable in the future (US$ million)	V%	Total appraiser (US$) million)	V%	IG%	Number of aircraft	V%	Risk
	With mortgage	**4,977**	**86**	**7,027**		**141**	**380**	**81**	
1	Company A	2,671	46	3,485	50	130	139	30	Direct/FGE
2	Company B	895	15	1,339	19	150	65	14	FGE
3	Company C	371	6	532	8	143	27	6	Direct/FGE
4	Company D	455	8	631	9	139	95	20	Direct.
5	Company E	126	2	210	3	166	10	2	FGE
6	Company F	95	2	148	2	155	8	2	Direct
7	Company G	80	1	103	1	130	6	1	FGE
8	Company H	78	1	106	2	137	3	1	FGE
9	Company I	66	1	116	2	177	6	1	Direct
10	Company K	50	1	110	2	221	5	1	Direct
11	Company L	47	1	172	2	364	12	3	FGE
12	Company M	17	0	23	0	133	1	0	Jan.
13	Company N	13	0	18	0	144	1	0	FGE
14	Company O	10	0	26	0	259	1	0	Direct
15	Company P	3	0	7	0	251	1	0	FGE
	No mortgage	**831**	**14**				**91**	**19**	
1	Company Q	314	5	*	*	*	20	4	FGE/Sovereign (CCR)
2	Company R	212	4	*	*	*	12	3	Securities
3	Company S	147	3	*	*	*	41	9	FGE/Sovereign (CCR)
4	Company T	69	1	*	*	*	3	1	Banks
5	Company U	34	1	*	*	*	8	2	FGE/Sovereign (CCR)
6	Company V	33	1	*	*	*	6	1	FGE/Sovereign
7	Company W	22	0	*	*	*	1	0	Banks
	Total	**5,808**					**471**		

Source: Prepared by the authors.

* IG = guaranty ratio, it is also possible to use Debt Coverage Ratio (ICD).

The seven companies (Q to W, in the lower group of Table 1 – no mortgage) do not have aircraft as collateral – their guaranties are of a different nature (e.g., sovereign risk or pledge of securities) and therefore have no appraiser value to compose a guaranty ratio (column IG).

Table 1 shows that 69% of the financial exposure is concentrated in three airlines, with 50% of the financed aircraft (and 78% of the approximate market value of aircraft), indicating that the companies with the largest financial exposure have lower proportion of number of aircraft in relation to the total portfolio.

Company D concentrates the second largest exposure in number of aircraft (20%) with a financial exposure of only 8%, since a good portion of its aircraft (86 out of 98 aircraft) are of Embraer 145 family, previous generation of commercial jets with 1990 technology, whose average value is substantially lower than the average of the current generation of E-jet family (more economical and with greater capacity and autonomy). This debtor is part of a group of a few that have contracted several operations with BNDES over these two decades of support. Table 2 presents the debtor's stratification by operation, that is, a "second level of portfolio opening," which allows understanding, for example, the disparity of the IG of different operations of the same debtor.

Table 2. Operations with the same debtor (US$ million, IG and number of aircraft – Dec. 2018)

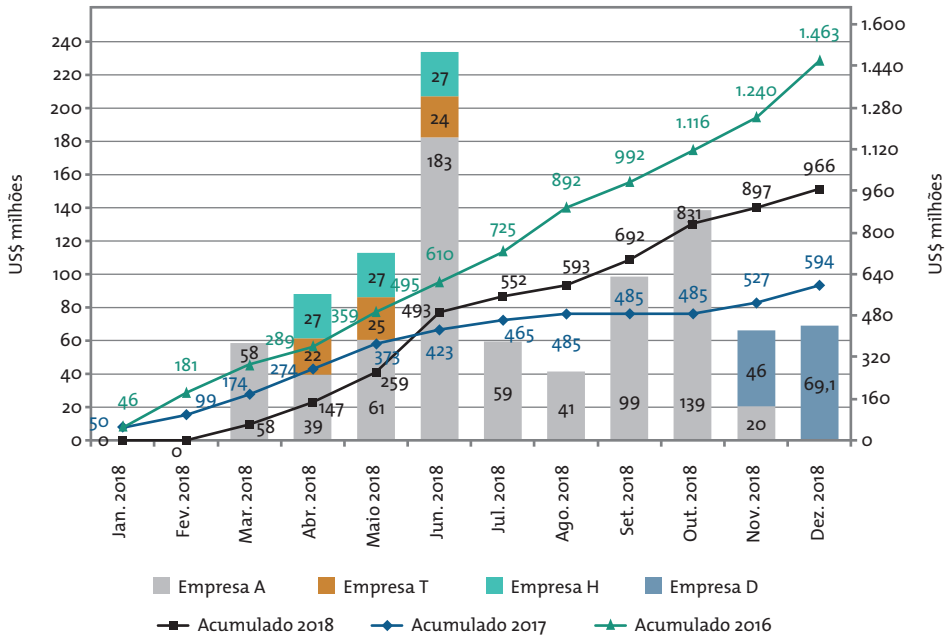
Debtor	Main payable in the future (US$ million)	Total appraiser (US$ million)	IG%	Number of aircraft	Risk	Last due date
Company A	**2,671**	**3,485**	**130**	**139**		**Oct. 30**
Operation A1	654	928	142	40	Direct	Jul. 27
Operation A2	126	170	135	7	Direct	Jan. 28
Operation A3	161	202	126	8	FGE	Jun. 28
Operation A4	1,047	1,264	121	49	FGE	Dec. 29
Operation A5	684	921	135	35	Direct	Oct. 30
Company B	**895**	**1,339**	**150**	**65**		**Feb. 28**
Operation B1	99	151	152	11	FGE	Feb. 24
Operation B2	669	1,015	152	47	FGE	Dec. 26
Operation B3	127	173	136	7	FGE	Feb. 28
Company C	**371**	**532**	**143**	**27**		**Nov. 26**
Operation C1	50	80	161	5	Direct	Mar. 24
Operation C2	49	68	137	4	FGE	Jun. 24
Operation C3	142	178	125	9	FGE	Nov. 26
Operation C4	129	206	159	9	FGE	May 25
Company D	**455**	**631**	**139**	**95**		**Dec. 29**
Operation D1	120	178	148	78	Direct	Jul. 21
Operation D2	335	453	136	17	Direct	Dec. 29
Company K	**50**	**110**	**221**	**5**		**Dec. 22**
Operation K1	38	91	242	4	FGE	Nov. 22
Operation K2	12	19	157	1	FGE	Dec. 22
Total	**4,441**	**6,166**		**331**		

Source: Prepared by the authors.

Addition of aircraft to the portfolio is monitored according to an annual budget based on contracted operations and monitoring of monthly deliveries. Graphs 4

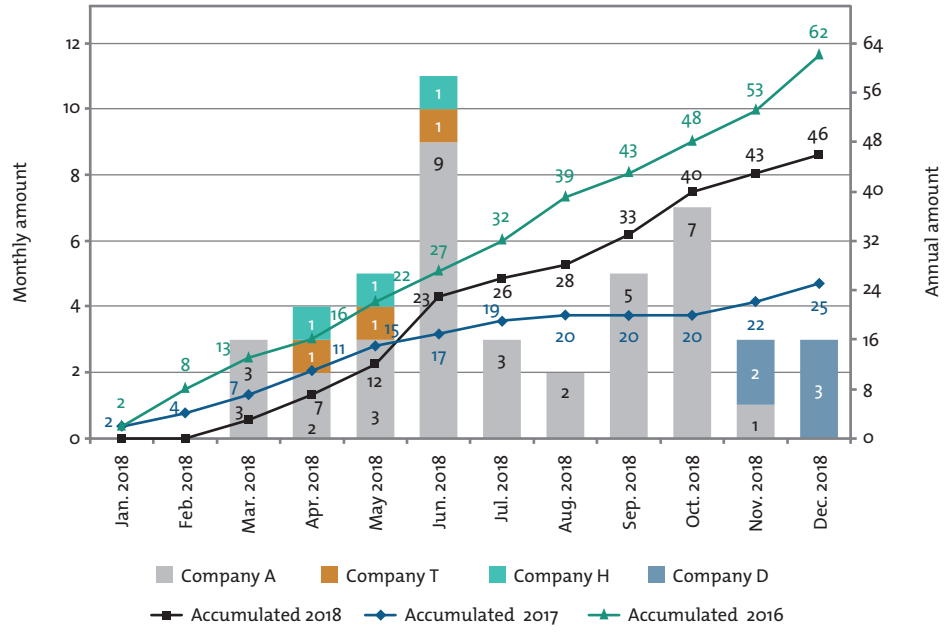
and 5 consolidate the deliveries made in 2018 in financial terms and number of aircraft, respectively, as well as disbursement planning for the remainder of the year.

Graph 4. Disbursements (US$ million – Dec. 2018)



Source: Prepared by the authors.

Graph 5. Disbursements (number of aircraft – Dec. 2018)

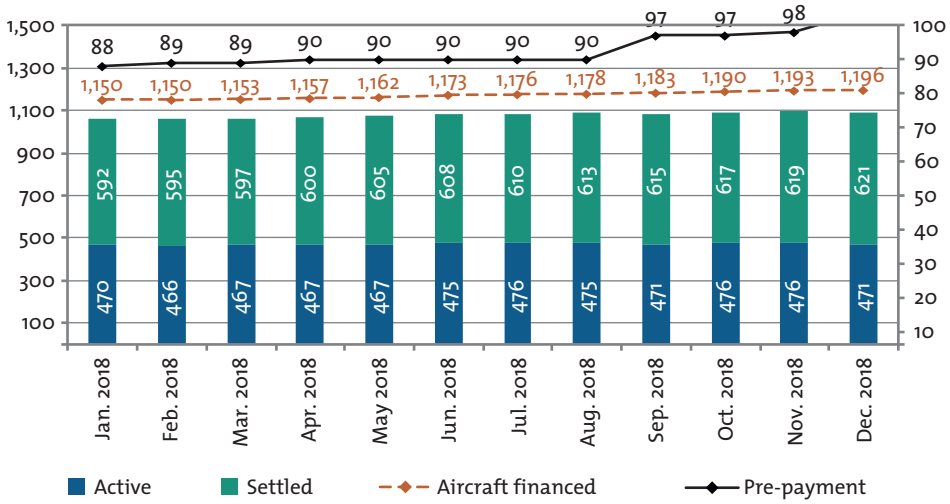


Source: Prepared by the authors

In addition to the total number of active aircraft in the portfolio each month, it is possible to observe the historical dimension of BNDES support for Embraer S.A. exports since the beginning, in 1997. The portfolio management team monits

of the accumulated inventory of aircraft fully paid (in the ordinary term of the operation) and prepaid (voluntary prepayment). According to Graph 6, the number of aircraft exported with BNDES financing from its beginning to December 2018 totals 1,196 aircraft, of which 104 were settled in advance and 621 settled in the ordinary term of the cash flow; 471 active aircraft remain in the portfolio.

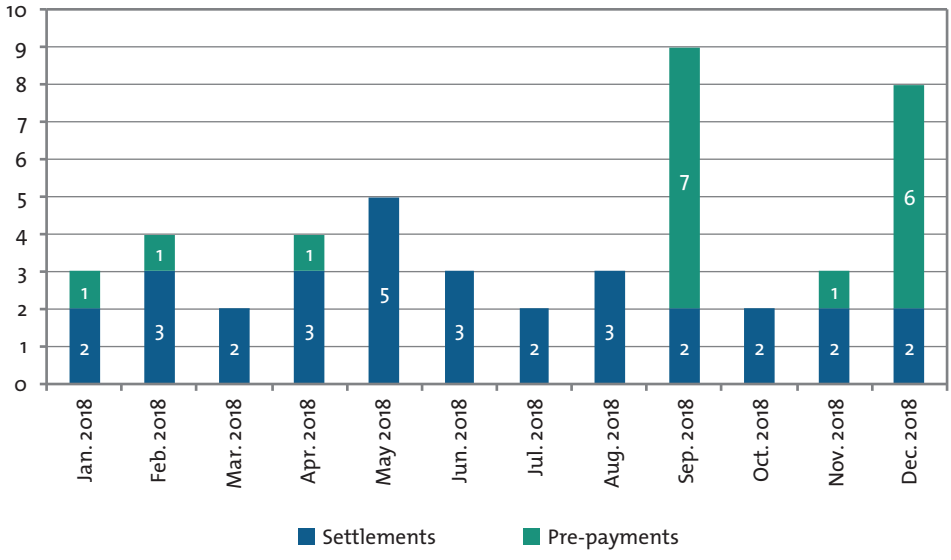
Graph 6. Inventory of financed aircraft by *status* (number of aircraft – Dec. 2018)



Source: Prepared by the authors.

Aircraft releases from the portfolio are observed and consolidated as shown in Graph 7, which separates these exits by type – (i) voluntary pre-payment; or (ii) ordinary amortization. It can be noted that some months present above average volumes, such as December 2017 and September 2018.

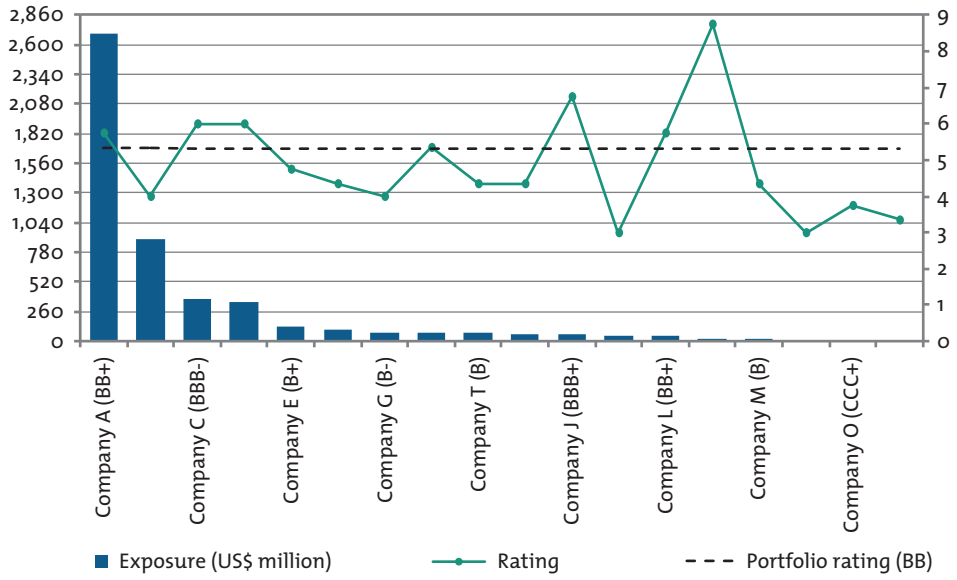
Graph 7. Flow of aircraft settled by type (number of aircraft – Dec. 2018)



Source: Prepared by the authors.

Finally, the risk dimension is also monitored, in the first pillar of monitoring, based on the risk rating of each debtor issued by the BNDES credit division. After the exposure weighting, the average credit risk rating of the portfolio is BB. It can be seen that the greater the exposure, the lower the risk dispersion (with its respective rating in the secondary axis dimension of Graph 8) in relation to the average risk of the portfolio.

Graph 8. Exposure and risk by debtor (US$ million and rating – Dec. 2018)



Source: Prepared by the authors.

4.2 Airlines' operating, economic and financial indicators

The aircraft finance portfolio management team regularly monitors the financial statements of the portfolio airlines in order to monitor economic and financial performance and to signal any situations that require further analysis of companies that have performance below the expected or desirable, or even some measure to protect credit.

Due to the knowledge accumulated over more than two decades supporting the sector, it is known since the origination of the operation that a number of factors affect the airlines' financial results. "Airline financial results are highly sensitive to small changes in either costs or revenues because of the historically high level of operational and gearing that has prevailed" (MORRELL, 2007, p. 135). Lenders are responsible for assessing the following industry attributes (BUNKER, 2005, p. 57) in particular:

- very capital intensive;
- challenge in having access to capital at a reasonable rate;

- demand for air travel is highly volatile due to the cyclical nature of the economy;
- aircraft are costly and, like movable goods, carry legal risks that do not exist in other types of equipment; and
- costs are increased by services without much competition such as catering, ground support and air traffic control.

All these peculiarities of the sector represent a challenge for both granting credit and maintaining portfolio health, which required the creation of specific monitoring procedures: on the one hand, some unpublished in BNDES, as will be seen in the analysis of the third pillar; on the other hand, they complement the Bank's existing contractual monitoring practices, such as the financial and operating monitoring described above.

This analysis is independent of that performed by the BNDES credit division and, although some of the indicators of the aircraft finance portfolio management team are calculated using the same methodological basis as those, they serve to compose an examination field that also includes other methodologies. Evaluation and monitoring of operating indicators are added to this analysis, in order for it to be more complete regarding cash generation and operating performance of portfolio companies.

The financial performance of each company is calculated using the indicators of Moody's methodology, adopted by the credit division to calculate the BNDES official rating. However, the monitoring team uses only the quantitative indexes of the methodology. This rating by performance aims to compare companies against each other, based on a score that was defined by the criterion: "The higher the score, the higher the risk."

The perspective for future performance is calculated by analyzing, Moody's indicators and others used by the market over the past three years, to predict bankruptcy. This classification by perspective seeks to analyze the evolution of the performance of each company, so that a trend can be estimated for the next periods.

In general, the aircraft finance portfolio management team monitors mainly the portfolio companies' cash generation capacity, their debt structure and the quality of their debt, assessing the interest expenses they are subject to, especially on the most leveraged airlines.

Table 3 shows the economic and financial analysis performed by this team, based on the financial statements of one of the portfolio companies.

Table 3. Example of economic and financial analysis

Moody's indicators		Rating
Immediate liquidity (cash and cash equivalents/current liabilities)	21.80%	18
Ebit/interest	56.38	1
Operating cash flow (debt – cash and cash equivalents)	23.52%	12
Debt/Ebitda	3.78	9
Debt/AT	79.80%	15
Ebitda Margin (Ebitda/operating revenue)	24.50%	12
Total		**67**
Average rating		11.2 = BB+

Source: Prepared by the authors.

By analyzing an airline's operating and financial indicators, in addition to the financial and operating indicators described below, the objective is to relate the data with the position of the company in its market and the macroeconomic indicators, enabling a complete analysis of the company's situation.

The economic, financial and operational analysis of a company begins by surveying and analyzing the evolution of the company's operating and financial indicators from the last disbursement to the present date. It can be seen in the example of Table 4.

Table 4. Company's operating, economic and financial indicators

		2011	2012	2013	2014	2015	2016	H% 2016/2011	CAGR 2016/2011
Million	**RPK**	26,368	29,072	31,186	32,602	35,478	38,233	45.00%	7.71%
	ASK	33,136	36,545	38,762	41,052	44,513	47,145	42.28%	7.31%
	Load factor (%)	79.58%	79.55%	80.46%	79.42%	79.70%	81.10%	1.91%	0.38%
US$ cents	**Yield**	14.4	14.7	14.8	14.4	12.3	10.8	(25.00%)	(5.59%)
	RASK	11.5	11.7	11.9	11.5	9.8	8.8	(23.15%)	(5.13%)
	PRASK	9.6	9.7	10.0	9.4	7.8	7.0	(27.08%)	(6.12%)
	CASK	10.9	11.0	10.9	10.8	9.3	8.2	(24.47%)	(5.46%)
	CASK Ex-Fuel	7.5	7.4	7.5	7.5	7.0	6.5	(13.33%)	(2.82%)
	RASK-CASK (margin)	0.58	0.73	0.99	0.71	0.51	0.59	1.55%	0.31%
	Number of passengers transported (million)	20,455	23,093	24,625	26,230	28,290	29,480	44.12%	7.58%
	US$ exchange rate (annual average)	1,868	1,810	1,871	1,987	2,767	3,077	64.76%	10.50%
	Average fuel price (US$ cents) per gallon	299.6	305.7	292.3	269.7	152.5	124.9	(58.31%)	(16.05%)

(Continua)

(Continuação)

US$ million		2011	2012	2013	2014	2015	2016	H% 2016/2011	CAGR[1] 2016/2011
	Operating revenue	3,794	4,270	4,610	4,704	4,361	4,138	9.06%	1.75%
	Fuel	(1,124)	(1,305)	(1,326)	(1,346)	(1,007)	(785)	(30.10%)	(6.91%)
	Total EbitdaR expenses	(3,259)	(3,629)	(3,784)	(3,933)	(3,586)	(3,286)	0.80%	0.16%
	Ebitda	535	640	826	771	776	853	59.43%	9.78%
	EbitdaR margin	*14.10%*	*14.99%*	*17.91%*	*16.39%*	*17.79%*	*20.61%*	*6.51%*	*1.30%*
	Aircraft leasing	(215)	(256)	(274)	(299)	(318)	(315)	46.35%	7.91%
	Ebitda	320	385	552	472	458	538	68.17%	10.96%
	EbitdaR margin	*8.44%*	*9.01%*	*11.98%*	*10.03%*	*10.51%*	*13.01%*	*4.57%*	*0.91%*
	Depreciation and amortization	(127)	(122)	(170)	(199)	(231)	(270)	113.04%	16.33%
	Ebit	194	263	382	273	228	269	38.79%	6.78%
	Ebit margin	*5.10%*	*6.15%*	*8.30%*	*5.80%*	*5.22%*	*6.49%*	*1.39%*	*0.28%*
	Net financial expense	(57)	(97)	(102)	(117)	(150)	(160)	178.85%	22.76%
	Net income	99	35	258	129	(155)	17	(82.81%)	(29.68%)
	Net margin	*2.61%*	*0.82%*	*5.59%*	*2.75%*	*(3.56%)*	*0.41%*	*(2.20%)*	*(0.44%)*

Source: Prepared by the authors.

From the data observed in Table 4, the company's performance can be analyzed over the years, examining the cash generation (operating margin), the cost structure and also the company's expansion and tariff policy by analysis of the load factor[10] and also the yield[11] practiced over the period.

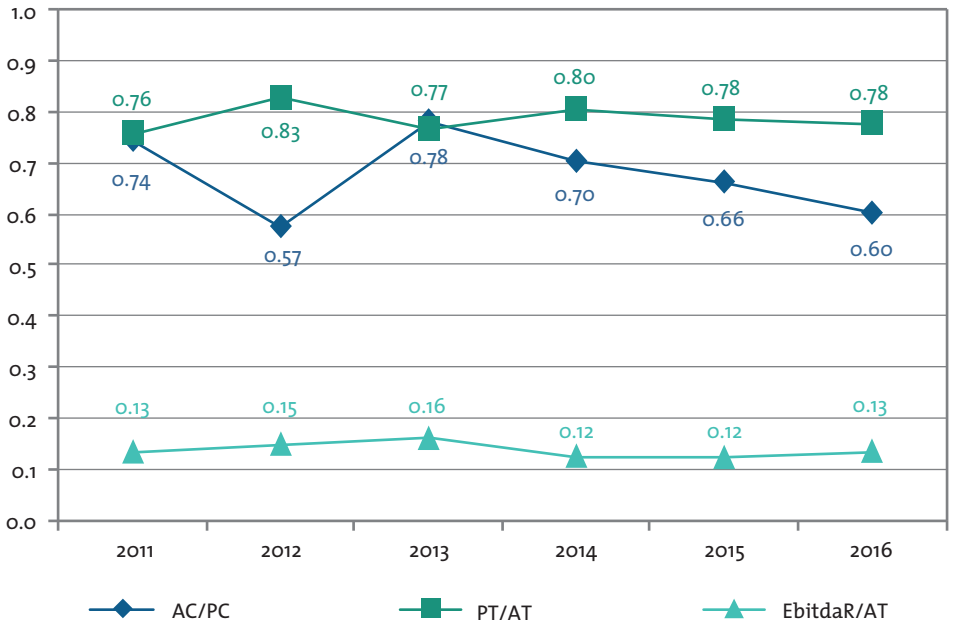
Another aspect of the analysis is examined when comparing the company's indicators with those of its main competitors in the most relevant market for the company. Monitoring operating indicators is very important, as these are the first to show deteriorating behavior when the company is not doing well. Reflections on financial indicators can sometimes take up to two quarters to be noticed. Operating indicators, in turn, show any deterioration almost immediately.

The balance sheet analysis aims to verify the behavior of the main asset accounts and to understand the company's evolution and financial situation over the years. The main equity indicators may be accompanied by graphs such as Graph 9.

[10] Measure between the number of seats occupied by a paying passenger and the number of seats available for use.

[11] This is the difference between the amount paid per kilometer flown and the operating cost per kilometer flown.

Graph 9. Equity indicators



Source: Prepared by the authors.

Based on these data, appropriate analysis and inferences are made to consolidate the second pillar of monitoring. The result allows the team to share a summary of the financial and operating situation of the airlines in the portfolio with the origination and aviationsector research teams, in the form of an operating and financial bulletin, which aims to consolidate its main operating and economic and financial indicators, for each airline supported by BNDES under the BNDES Exim Post-Shipment financing line, based on the annual financial statements received by BNDES.

4.3 Aircraft conditions

Financing for the acquisition of aircraft is usually structured under asset-backed structure, that is, backed by the value retention capacity of the financed asset, given as the main collateral. The essential premise is that the aircraft financed have attributes such as liquidity, useful life, low price volatility and retention of market value over time, which make them effective guaranties for financing granted. Therefore, ensuring that the assets are in maintenance and operating conditions consistent with those provided by the manufacturer and the competent aviation authority becomes paramount, so that, if it is necessary, the value extraction of the financial asset can be maximized.

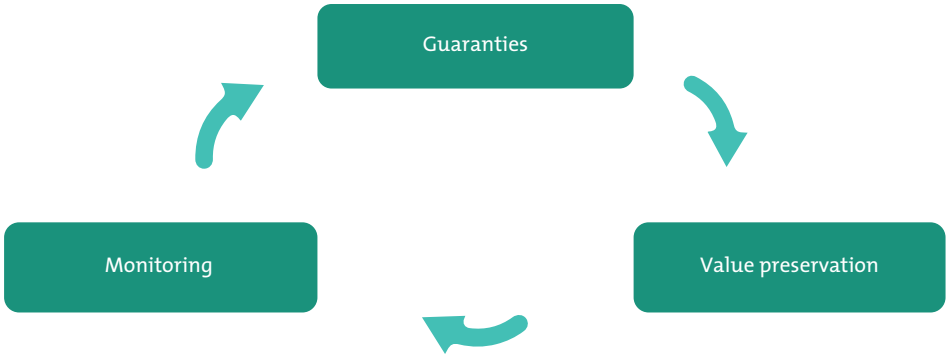
Aircraft maintenance appears to be the exclusive concern of the air operator. However, stakeholders such as lessors and financial institutions that have a guaranty right over the good, are equally impacted and concerned by this subject. Littlejohns (1998, p. 69) teaches:

> The financier will wish to be satisfied that proper maintenance and repair facilities have been arranged for the aircraft, either by reviewing the facilities of the operator itself if it has such facilities, or (in the case of a smaller airline) where there is a maintenance agreement in force between the operator and a third party airline possessing the proper facilities, by reviewing the agreement.

To the extent that these checks and obligations relating to aircraft maintenance and conservation are entered into the contract as obligations at the time of contracting, it is assigned to the financier to have a dedicated structure to monitor their correct compliance in order to mitigate the risks involved in an essentially asset-backed operation. "Obviously, if an aircraft is ever repossessed from an operator, the ultimate beneficiary thereof will want to receive it in top operation condition" (BUNKER, 2005, p. 86).

Figure 5 represents the virtuous cycle of monitoring the collateral, always aiming at preserving its value, in order to ensure the settlement of the full amount of the outstanding balance, in the event of default.

Figure 5. Aircraft monitoring



Source: Prepared by the authors.

Monitoring of aircraft given as collateral to BNDES includes five main activities: (i) control of airworthiness certificates; (ii) control of maintenance reserves and security deposit (liquidity reserves); (iii) control of utilization data; (iv) control of the 'virtual' maintenance reserve; and (v) preparation and execution of the inspection program. These five items will be analyzed below.

4.3.1 Control of airworthiness certificates

All aircraft mortgaged as collateral under BNDES financing agreements must be maintained airworthy. This means that aircraft have to be maintained and operated in accordance with the operating and maintenance programs approved by the aviation authority of the operating airline's country of origin.

A first way to follow this condition is by checking the validity of the airworthiness certificate (CA) issued by the aviation authority of the country where the aircraft is registered. It is the responsibility of the aviation authorities to assess and declare the airworthiness status of the aircraft linked to it, and to this end, the airlines have to demonstrate full compliance with the previously approved operation and maintenance program.

In BNDES transactions, this control is required with CA expiration notices for each aircraft, as each aircraft has a different expiration date and each authority issues CAs for different periods.

Control is done by registering and monitoring all CAs, requesting copies of documents and maintaining this information up to date. In some cases, such as in the US and Brazil, for example, CA compliance can be verified directly on the aviation authority's website.

4.3.2 Control of maintenance reserves and security deposit

In some aircraft finance contracts in the BNDES's portfolio, there are additional guaranties entitled maintenance reserves and/or security deposit. Currently, maintenance reserves are required in two-operation contracts, and security deposit in the same contracts.

Maintenance reserves are deposits made to a secured account in favor of the aircraft mortgage lender, whose amounts are determined based on the aircraft's utilization. The importance of this additional guaranty is in fact to set aside funds by withdrawing them from the airline's cash and placing them in an account controlled by the mortgage creditor to ensure that when the aircraft has to undergo any maintenance event, the resources required to cover such expenses are already available, either for use by the operator itself or for use by the mortgage creditor in the case of aircraft repossession due to financing default.

From the perspective of managing these maintenance reserves, the monitoring team is responsible for participating in the calculation of the amounts to be deposited monthly in the linked account and for eventual release of the account balance to cover scheduled maintenance performed on the aircraft. This control is individual, by aircraft, and generally segmented by asset components (each component or set has its reserve values, such as hull, engines, auxiliary power unit – APU and landing gear).

The calculation is made on a monthly basis, in regular periods of time, deposits are made in these accounts. With shutdown of the aircraft for a maintenance event, the company presents an invoice and any other receipts, as stipulated in the contract,

and the aircraft finance portfolio management team, after auditing the information, forwards an internal document for signature authorizing reimbursement of applicable expenses.

Some operations may have security deposit reserves to be used in the event of default in the payment of financing installments, which would provide BNDES with some debt service coverage and, in this period, financing with the customer is re-negotiated or the aircraft is re-commercialized and then the credit is settled. This mechanism is unusual in strictly asset-backed operations, but exists in two specific operations of the current aircraft finance portfolio.

4.3.3 Control of utilization data

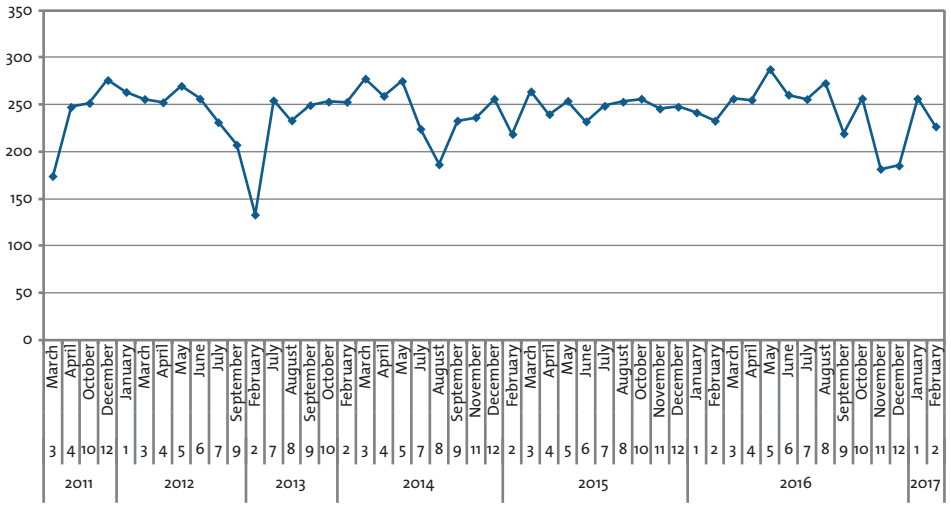
Aircraft manufactured by Embraer S.A. have a typical duty cycle of 7,500 flight hours (FH). This means that after an aircraft has flown this total of hours, it has to undergo maintenance procedures (check C) which re-establish the condition of more than 7,500 FH available to the aircraft (full life).

This amount of flight hours is what is commonly referred to as the normal condition of aircraft usage, which starts at full life aircraft and goes to the heavy check condition, when the aircraft is close to zero available flight hours, thus requiring maintenance procedures.

Controlling aircraft hours flown, as well as the consumption in hours or flight cycles (flight cycle corresponds to one event of taking off and landing of the aircraft) of the aircraft and some subsystems, such as engines, APU and landing gear, is not practice normally adopted by ECAs, but rather by leasing companies, as they own the asset. However, during the construction of the portfolio management procedures set for aircraft finance operations, it was realized that this control could be very useful for portfolio monitoring for the reasons below.

For example, the graphic monitoring allows identifying if there is much below average use (as can be seen in Graph 10, in February 2013 and September 2014), and comparing with maintenance events or, if not, with other causes. In other words, monitoring this data allows the monitoring team to proactively identify eventual low utilization and seek to relate it to normal operating facts or, on the contrary, to identify any abnormalities that may affect the condition of the aircraft as collateral.

Graph 10. Graphic control of aircraft hours flown



Source: Prepared by the authors.

The monitoring team, analyzing the data and observing any breach of standard, seeks clarification with the airline about its causes. Unable to obtain definitive information in this way, one of the available options is to send staff to inspect the aircraft as described in subsection 4.3.5.

In the cases of the previous example, the reduction in February 2013 and March 2016 was due to the shutdown of the aircraft for scheduled maintenance known as check C. In each event, this major maintenance caused the shutdown of the aircraft for periods of two to three weeks. Already in September 2014, there was need to change one of the engines of the aircraft, while the last reduction, in October 2016 and extended until November, was due to a reordering of the company's routes served by the regional aircraft. In all cases, the aircraft finance portfolio management team, when faced with nonstandard data, was able to obtain the appropriate clarifications directly from the airline.

4.3.4 Control of "virtual" maintenance reserve

Normal use of an aircraft produces wear (normal 'wear and tear') on its components and systems, so that the retention of value by the aircraft is altered according to the availability of lifespan of these components and systems. Normally, the lifespan consumed is restored when these components and systems are maintained.

Under lease agreements, leasing companies usually impose on airlines the obligation to make periodic financial deposits based on flight hours or flight cycles. This financial reserve – called the maintenance reserve – serves to ensure the correct maintenance of components and systems, restoring their initial useful life.

Table 5. Usage data

Aircraft	Date last record	Month	Year	Flight hours since new	Date of last maintenance check	Flight Hours at the time of last check	Flight Hours for the next maintenance check	Date of next maintenance check	Number of original engine 1	Cycles since new	Number of original engine 2	Cycles since new	Hours accumulated after check
1	June 2017	6	2017	18,273.62	8.12.2016	16,590.20	24,090.20	20.10.2022	AS3	11,561	AS5	13,159	1,683.42
2	June 2017	6	2017	17,110.98	8.12.2016	11,202.50	18,702.50	20.10.2022	AS4	11,561	AS6	12,209	5,908.48

Source: Prepared by the authors.

Table 6. Virtual maintenance reserve

Aircraft	Fuselage	APU	Disbursement date	LG N	LG L and R	Engine 1	Engine 2	Engine (1+2)	Total
1	89,221.08	50,502.50	3/1/2011	66,690.00	200,460.00	2,000,000.00	2,000,000.00	4,000,000.00	**4,406,873.58**
2	313,149.62	177,254.50	8/5/2011	62,215.50	187,010.33	2,000,000.00	2,000,000.00	4,000,000.00	**4,739,629.95**

Source: Prepared by the authors.

BNDES aircraft finance agreements, this type of clause is not common – it is present only in contracts with two airlines of the current active portfolio.

It is evident that if there is need of maintenance amounting to thousands of dollars, the value of the aircraft as collateral is at least the value of the appraiser[12] discounted from the value of outstanding maintenance, which would restore its useful life.

BNDES financing agreements contain clauses that require the provision of usage data (such as hours flown, flight cycles, time consumption and engine cycles, landing gear and APU), in addition to the dates when C checks were performed. With these data, it is possible for the aircraft finance portfolio management team (based on the average cost of each maintenance event according to data obtained when negotiating maintenance reserves in the two operations that provide them) to estimate how much would be needed to remodel each foreclosed aircraft in its portfolio and return it to full life. This could therefore be what is commonly referred to as a virtual maintenance reserve for each aircraft in the portfolio and thus can be used to estimate the market value of the aircraft based on the theoretical value of the aircraft, according to Avac or Ascend market value appraisals, as appropriate (see subsection 4.4). Table 5 shows an example of the data that are required from the company to constitute a virtual maintenance reserve, and Table 6 shows the values based on the data submitted.

4.3.5 Preparation and implementation of the inspection program

In asset-backed operations, given the importance of assets as a means of mitigating credit risk, it is natural that BNDES will closely monitor aircraft maintenance, conservation and airworthiness conditions. The mere inclusion of maintenance obligation and standards clauses does not assure BNDES that the airline will comply with its obligations, notably in scenarios of underutilization of assets (due, for example, to sector volatility) or financial difficulties faced by the operator. The Bank's accumulated expertise associated with the best specialized literature demonstrates that monitoring should therefore include regular sampling inspection of the fleet financed for each airline in order to assess, the due compliance with the contractual asset maintenance obligations based on the analysis of the aircraft documents and the physical survey.

> Properly stated maintenance provisions set out in the lease or other financing document will go a long way to protecting an interested party if the agreement runs its full term. However, in the case of a default termination, it may be difficult if not impossible to enforce provisions. There is no absolute protection against such exigencies, but

[12] BNDES uses two international appraisal publications for the purpose of updating the value of those given as collateral.

> regular technical monitoring of compliance by professional auditors specialized in such activities can minimize such risks (BUNKER, 2005, p. 96).

According to Ferreira (2016), a fleet of aircraft of the same model submitted to the same maintenance program constitutes a homogeneous population of aircraft, even though they were manufactured in different years.

Also according to Ferreira (2016), this homogeneous population can be faithfully represented by a sample of 3% to 5%. However, the sample inspected per year in BNDES financing contracts is agreed in negotiation during contract discussions, providing samples ranging from 3% to 100% per contract (on average 15% of the portfolio is inspected annually).

BNDES designed an inspection system composed of three types of inspection, described below:

- Inspections outsourced by BNDES: these inspections are mandatory in agreements celebrated prior to 2009. BNDES has a company contracted to provide appraisers who survey these companies' aircraft.

- Inspections contracted by the airlines: from 2009, BNDES began to include a provision in its financing agreements requiring the operator to contract an independent appraiser, approved by BNDES, to inspect the percentage of aircraft defined in the contract.

- Performed by BNDES: after four years of training by following the surveys performed by the company outsourced by BNDES, BNDES's in-house inspectors qualified to carry out surveys, starting this routine in 2016, so that whenever BNDES uses its contracted company, these technicians survey additional aircraft.

The distribution of inspections for the year is defined as follows:

- surveys made by independent appraisers contracted by airlines;

- inspections by BNDES's in-house inspectors and companies with contracts prior to 2009;

- inspections by BNDES's in-house inspectors in airlines with financial, maintenance or management issues;

- inspections by BNDES's in-house inspectors in airlines whose previous year's inspection, whether performed by third parties or by BNDES, presented negative technical notes; and

- inspections by BNDES's in-house inspectors at random.

Thus, it is believed that the inspection planning procedure is comprehensive and provides a broad spectrum of aircraft finance portfolio surveys that allows the construction of an overview of the technical conditions of the portfolio. This scenario is the foundation of the guaranty monitoring pillar, providing all the information to be used to support the analysis in this area.

4.4 Adjustment of the guaranty ratio

The guaranty ratio (IG) is basically the inverse of the loan to value, that is, the market value of the guaranty divided by the outstanding balance of the operation. The BNDES System, in aircraft finance operations, adopts the minimum value of 1.1 for the guaranty ratio at the origin of the operation, according to internal regulations.

Over the life of the loan, although there are no requirements regarding the minimum acceptable for the IG, it is most desirable that it should be greater than 1.0. BNDESr ules state that the aircraft market value is the model value published on *The Aircraft Value Reference* (Avac) or, in its absence, on the *Ascend* (Flight Global).

The Avac value refers to a theoretical aircraft whose existence is almost unlikely in the real world. It works as a reference for an aircraft in half life condition, that is, with half of its available flight hours. Therefore, the calculated IG is theoretical and mostly larger than the real one. On the other hand, the actual IG is totally unknown and only ascertained in case of the aircraft being taken back and resold.

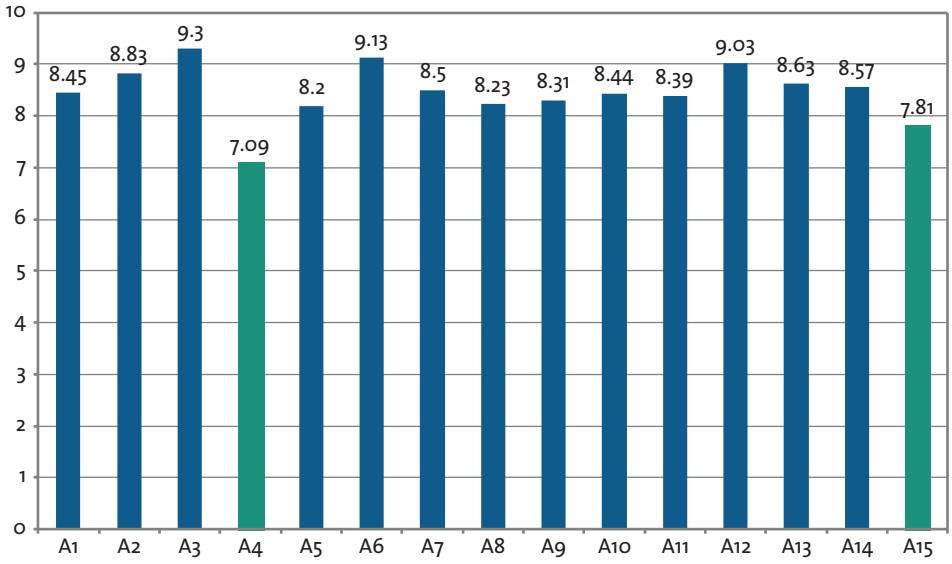
An adjustment to the aircraft market value would be necessary and beneficial for a more realistic IG calculation. The whole problem is how to make the adjustment. The aircraft finance portfolio management team has developed two types of adjustments.

The first adjustment derives from a method proposed by Ferreira (2016), which uses the aircraft inspection rating as a deflator for the Avac value, and it is applied as follows: the rating attributable to a half-life aircraft, as presented by Avac, is 9.05; the aircraft inspection rating is a deflator, if less than 9.05, or appreciator, if greater.

The results obtained can be represented by figures 17 and 18. The first represents the average of the marks obtained by the aircraft inspected by each company. The second compares the IG used by BNDES and the adjustment proposed by Ferreira (2016), hereafter called Adjusted IG (A).

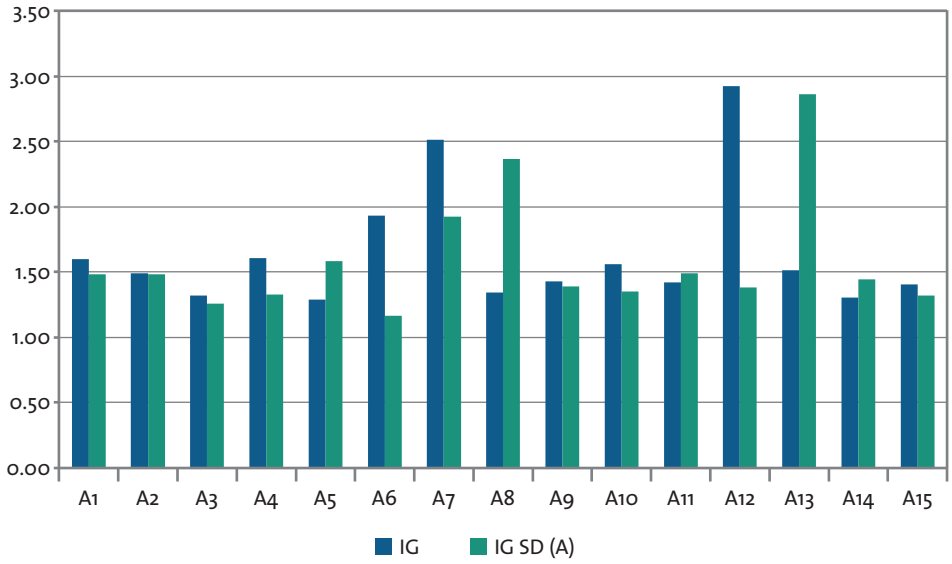
This adjustment methodology is currently being standardized at BNDES.

Graph 11. Average aircraft inspection ratings by companies



Source: Prepared by the authors.

Graph 12. Comparison between BNDES guaranty ratio (IG) and adjusted IG (A)



Source: Prepared by the authors.

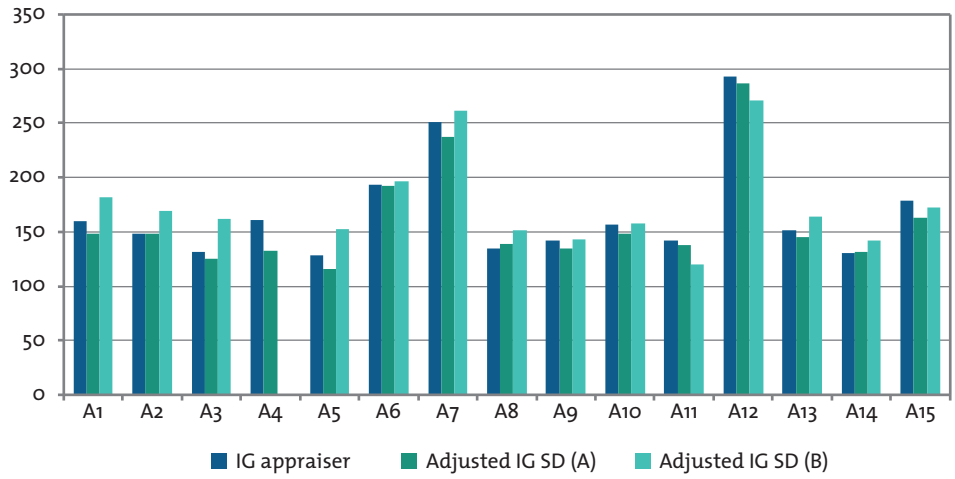
Another way to adjust the market value of aircraft developed in the aircraft finance portfolio management team is to discount the virtual maintenance reserve set up to restore the aircraft to full life condition from the Avac value, as already mentioned in this subsection.

Adjustment is simple: the Avac value is reduced from the virtual maintenance reserve. This result is used as the aircraft market value and divided by the outstanding balance in order to obtain the adjusted IG, designated IG (B). That is, the amount of the maintenance reserve is deducted directly from the

Avac value and this adjustment number is considered to be the "actual" value of the aircraft.13[13]

Graph 13 compares IG BNDES with IG (A), defined by Ferreira model (FERREIRA, 2016), and IG (B), defined by the virtual maintenance reserve discount.

Graph 13. Comparison of IGs (%)



Source: Prepared by the authors.

After compiling these data, appropriate analysis and possible inferences are made, thus forming the third pillar of monitoring. All items monitored under this pillar are presented monthly in the Asset Bulletin.

5. Management of financial and nonfinancial obligations

By their nature, aircraft export financing operations are structured. Therefore, most of them do not have conditions and mechanisms standardized by the diverse nature of contractual structures[14] and clients, which have multiple jurisdictions, business model and types of guaranties, among other aspects. The absence of corporate support systems developed in compliance with the processes in force in the monitoring of the aircraft finance portfolio is one of the main causes of the challenges encountered by the management team of the aircraft finance portfolio which, in essence, has to manage a portfolio of a diverse and critical nature due to the exposure values of each operation and the types of collateral.

[13] The benchmark for calculating the maintenance reserve value is an aircraft in full-life condition, that is, with 100% of the available hours and cycles, equivalent to score 10 in the applied methodology; on the other hand, the value given by the appraiser for half-life condition, in which the aircraft has hypothetically half of the available hours and cycles of full life condition is equivalent to methodology score 9.05. Thus, a refinement of the adjustments made is necessary to obtain a more accurate pricing of the aircraft.

[14] There are no standard drafts of contractual instruments for the aeronautics sector, as they are governed by foreign law and prepared by external offices contracted by BNDES for each operation.

Roughly speaking, internally developed control tools have three elements:

- Mapped process: made for each type of obligation at the "task-responsible" level.
- Database: adapted based on corporate system(s) and process adherent (specific to each process).
- Management information: stratified aggregate dashboard format, as well as the possibility of analytical unfolding to the individual record level. The goal is to get an overview of the obligations while allowing observation at the event level.

Altogether, there are nine processes controlled with internally developed support tools, six of which are management tools for most portfolio contracts that can be grouped by their financial or nonfinancial nature

- management of financial obligations: ordinary charges and extraordinary charges;
- management of nonfinancial obligations: aviation insurance, financial statements, maintenance reserve and Uniform Commercial Code (UCC) certificates.

In addition to the above, the following processes are also included: (i) reimbursement of foreign office attorney's fees; (ii) process of internalization and release of promissory notes; and (iii) audit circularization of the portfolio airlines.

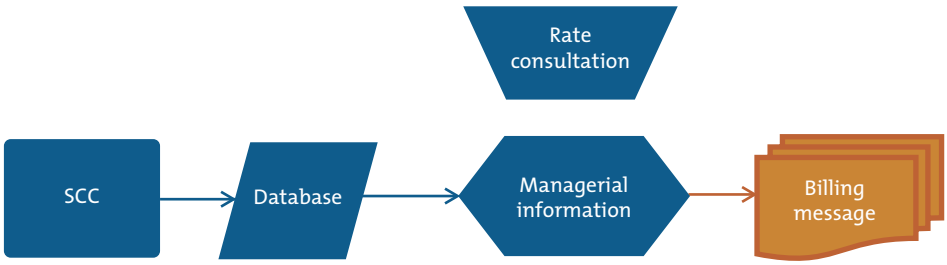
The following are two succinct examples, one for each management process for financial and nonfinancial obligations – ordinary collection (installments) and aviation insurance.

5.1 Ordinary collection of installments

The dynamics of sub-credit installment maturities (associated with aircraft exported with BNDES's financing support) are impacted by the multiplicity of possible types of financial flows in the sector, where flexibility in conditions is a consequence of competition between players (such as banks and multilateral development agencies), whose rules are delimited by the framework of conditions in force in the Aircraft Sector Understanding (ASU). Financial flows (principal and interest schedule) are constructed by combining variables such as: (i) type of amortization (Continuous Amortization System – SAC, or price); (ii) periodicity (monthly, quarterly or semi-annually); (iii) term (ten, 12 or 15 years); and (iv) type of funding rate (fixed or floating).

As summarized in Figure 6, a monthly process was established for a proactive approach with customers who had the highest number of wrong payment occurrences (about one third of the portfolio). The purpose is to inform the customer of the billing parameters for the following month (due date, principal and interest amounts, interest rate and respective contract date). For this purpose, it is necessary to consolidate data available from the corporate system (SCC) so that it can be analyzed and compiled in a "managerial" format, including the period interest rate (not available in the same system). The information should be simple and intuitive to read to ensure that those in charge of the airline understand and can properly schedule the payment. After its implementation, the number of problematic occurrences decreased dramatically, a desirable result not only for team efficiency but also for the "customer relationship" dimension.

Figure 6. Ordinary collection of installments (macro vision)



Source: Prepared by the authors.

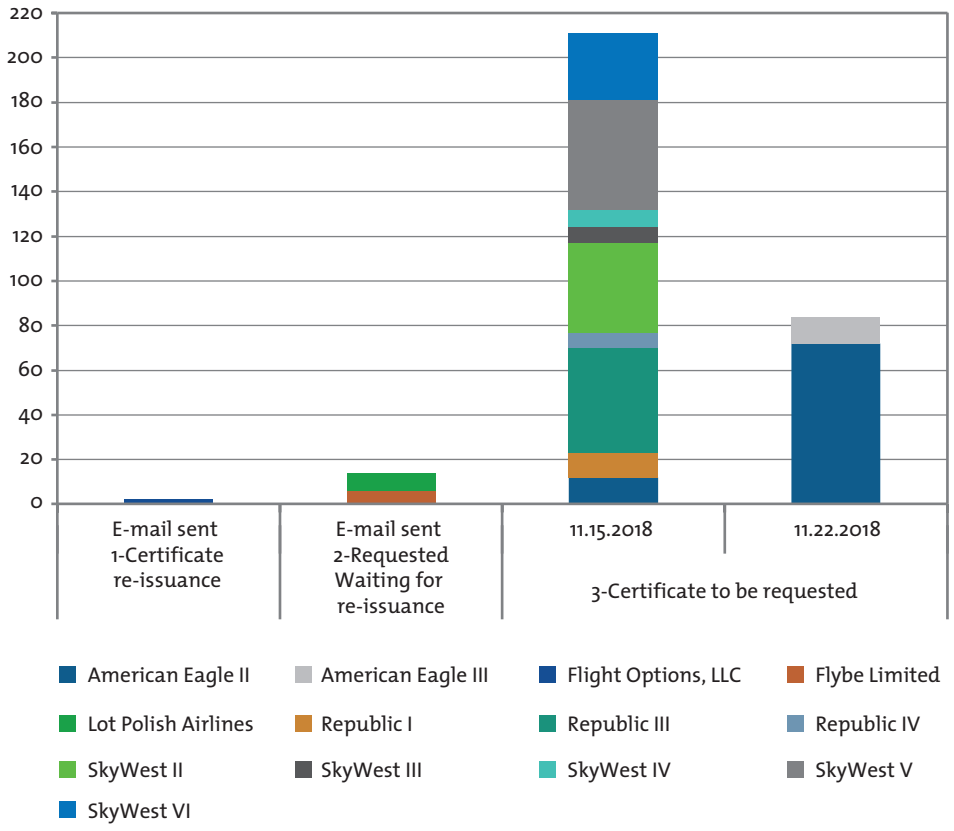
5.2 Aircraft insurance certificates updating

Financing agreements are governed by foreign law, as are the operation guaranties. Similarly, the two types of aviation insurance coverage categories required in industry operations, namely hull and civil liability insurance, are governed by New York or London law, as policies are issued by foreign insurers with a global presence, and are contracted by the debtor or the company operating the aircraft (where the debtor is a separate legal entity from the aircraft operator). The policy encompasses the operator's entire fleet, so that according as new aircraft are acquired, they are included in the policy. This document, however, is not delivered to BNDES. Instead, a certificate containing the main clauses required under the financing agreement shall be issued, including: (i) validity; (ii) coverage amounts, the identification of BNDES or its subsidiary, the Special Agency for Industrial Financing (FINAME), as the case may be, as a beneficiary of the hull insurance in case of total loss, and the types of coverage contracted (hull and civil liability).

It is necessary to ensure that all aircraft given as collateral for the benefit of BNDES are insured and in compliance with contractual provisions. In

addition to the content verification issue, the maturity of all policies, whose validity is 12 months in most of the portfolio fleet, have to be monitored. For this purpose, as already described, an internal control was designed to manage the periodic updating of certificates, which, after a mapped and designed process, has database and management views. Graph 14 is example of *status* – (i) "Certificate to be requested"; (ii) "Requested. Waiting for re-issuance"; e (iii) "Certificate re-issued."

Graph 14. Insurance certificates by *status* of re-issuance request (number of aircraft by *status* and by airline)



Source: Prepared by the authors.

As noted earlier in this brief description of the two processes given as an example, there are operational risks inherent to the control of financial and nonfinancial obligations, in addition to considerable workload mainly as a result

of the large number of aircraft in the portfolio. However, many processes are not easily standardized due to the specificities inherent in the portfolio, based on structured operations. The mapping and systematization of contractual obligations mitigate the risks of failures in the monitoring process that may impact a possible credit recovery in a stress scenario.

6. Conclusions

Aircraft finance portfolio management is intended to be robust monitoring, or, in other words, control and anticipation of possible issues or "complications" in operations. With diligent management, it is intended that it be an early warning system. Despite the challenges mentioned throughout the text, the separation between origination and monitoring activities for almost ten years and the consolidation of the aircraft finance portfolio management work by means of the four pillars have brought solidity, efficiency and reliability to the process and the aircraft finance portfolio in general.

Monitoring certainly does not have the objective of preventing negative financial or nonfinancial episodes in debtor companies, but is aimed at creating conditions for the monitoring team to be able to anticipate them and thus better manage them, minimizing risks and losses for BNDES System portfolio. In other words, it is an issue alert system, where each pillar has its metric and its information compiled, and it is possible to see which operations deserve special attention through their union. It is possible that an operation with low exposure, but with low scores for inspections and unsatisfactory financial and operational results, may require more attention and control than a large-exposure operation that presents good indicators in the other three pillars.

Naturally and obviously, it is not possible to monitor all aspects of all portfolio operations; hence the importance of a system that allows the monitoring team to carefully select which operations will have the closest and most detailed monitoring. This monitoring includes periodic visits to companies in order to strengthen ties with the customer, besides on-site verification of the situation of debtors and/or airlines.

It has been increased every year with new initiatives and enhancements, such as subscribing to industry news and data bases, in partnership with the aircraft finance monitoring team. Timely access to the widest possible information network (intelligence) proved to be an effective means of working for the teams involved in a challenging and volatile sector as the aviation industry is.

The four-pillar portfolio management has been the result of the knowledge and experience accumulated in over twenty years of support for the sector, and it is in constant evolution. Therefore, as you move forward, the pillars can be revised, re-adapted, or enhanced to always improve the portfolio alert system.

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