

# Bidding for the Rio de Janeiro International Airport: A Case of Option Overvaluation?

IX Semana da Qualidade da  
Informação ANAC 2024

Opções Reais no setor aeroportuário  
Prof. Rafael Igrejas



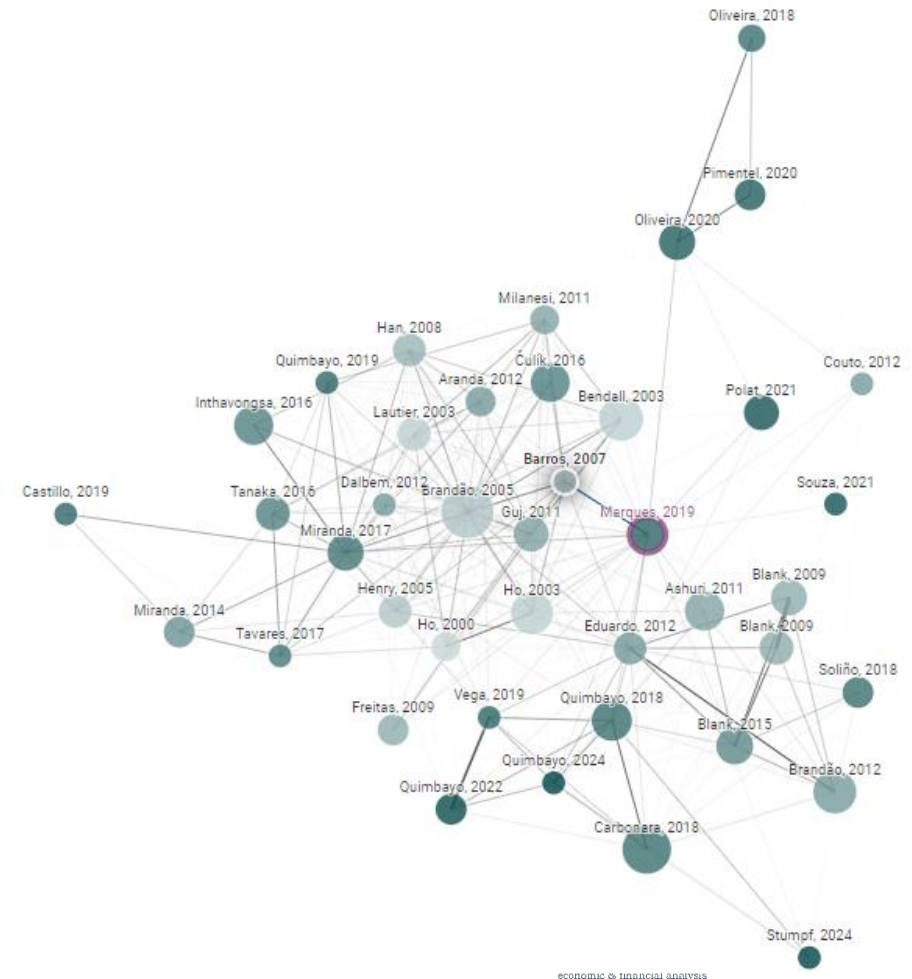
# AGENDA

- Context
- Problem
- Objective
- Government Valuation
- Real Option Valuation



# INTRODUCTION

- Real Options theory has been widely used in the aviation sector
- The privatization of the Rio de Janeiro International Airport has raised concerns about overbidding, particularly following its record-high auction bid premium. This situation has led to significant financial challenges for the airport post-privatization.



# INTRODUCTION

- Improvement of the study....



Latin American Business Review



ISSN: 1097-8526 (Print) 1528-6932 (Online) Journal homepage: <https://www.tandfonline.com/loi/wlab20>

## The Rio De Janeiro international airport privatization: a problem of overbidding?

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To cite this article: Naielly Lopes Marques, Luiz Eduardo Teixeira Brandão & Leonardo Lima Gomes (2019) The Rio De Janeiro international airport privatization: a problem of overbidding?, *Latin American Business Review*, 20:3, 249-268, DOI: [10.1080/10978526.2019.1624562](https://doi.org/10.1080/10978526.2019.1624562)

To link to this article: <https://doi.org/10.1080/10978526.2019.1624562>

# INTRODUCTION

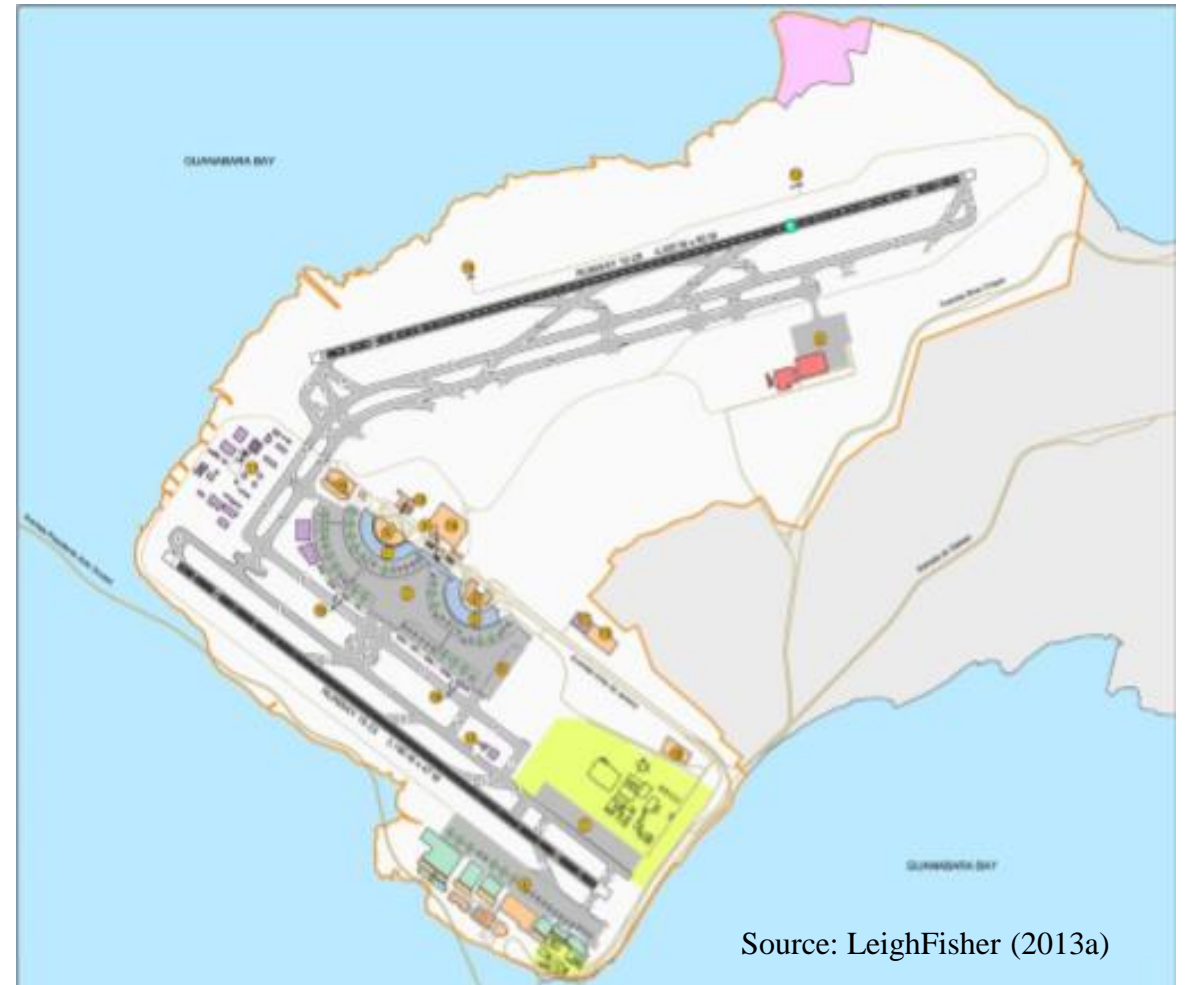
- The Rio airport's concession was marked by the highest bid premium during the 2011–2013 auction period, which has been linked to subsequent financial difficulties (Marques et al., 2019).
- High initial bids can lead to unsustainable financial models, as operators may struggle to meet the expected returns on investment, resulting in operational inefficiencies (Toledo et al., 2021).
- Studies on airport privatization globally indicate mixed outcomes, with some airports experiencing improved efficiency and others facing challenges similar to Rio's (Poole, 1990) (Resende & Caldeira, 2019).
- The Brazilian context shows that only 40% of privatized airports demonstrated efficiency post-privatization, suggesting that overbidding may not be an isolated issue but part of a broader trend of mismanagement (Toledo et al., 2021).
- While privatization can lead to increased investment and operational improvements, the case of Rio de Janeiro highlights the risks associated with overbidding, which can undermine the intended benefits of privatization.

# INTRODUCTION

- The Rio de Janeiro International Airport is the second largest in Brazil and is conveniently located only 13 km from the city center.
- The airport serves origin and destination passengers, as well as passengers that are simply connecting between flights.
- The airport occupies 18 million m<sup>2</sup> making it the largest in area in the country.
- In May 2013, the Brazilian Federal Government announced the intention to bid a 25-year contract to expand, operate and maintain the Rio de Janeiro International Airport.
- In April 2014, the contract was awarded to the concessionaire RIOgaleão, which offered a bid of R\$19,019 million (US\$ 8,846 million), which was 294% above the established R\$ 4,828.0 million (US\$ 2,246 million) minimum bid.

# INTRODUCTION

- In 2013, the airport encompassed:
  - 2 runways;
  - Taxing lanes and operational safety zones;
  - 2 buildings for the passenger terminals;
  - Ground transport infrastructure with 2,800 public parking spaces;
  - Cargo zone;
  - Support areas.



Source: LeighFisher (2013a)

# INTRODUCTION



- RIOgaleão at the time was composed by a private group and Infraero.
- The private group included:
  - Odebrecht TransPort
  - Changi Airports



# INTRODUCTION

- **Problem:** The RIOgaleão consortium offered a bid value that largely exceeded the expectation of the government, which was based on traditional static DCF method.
- Considering that this airport has significant potential for expansion, it could be that the consortium saw great value in the flexibility to expand in the future, and adjusted their bid accordingly.
  - If this is correct, then the government may have significantly undervalued the concession project by not capturing the value of these expansion options.
- **Objective:** Determine whether the government underpriced the concession or if the concessionaire offered a bid in excess of its true value.
  - The authors analyzed the concession project under the real options approach, considering the value of all the options embedded in the project available to the concessionaire.

# GOVERNMENT VALUATION

- The Rio de Janeiro International Airport concession is a BOT project.
- In this case, the concessionaire is responsible for the expansion, maintenance and operation of the airport complex for a period of 25 years.
- The concessionaire is also responsible for providing short and long-term infrastructure improvements in the internal and external areas of the airport complex.
- The concessionaire will be reimbursed for the investment, maintenance and operation of the airport by Tariff and Non-Tariff Revenues.

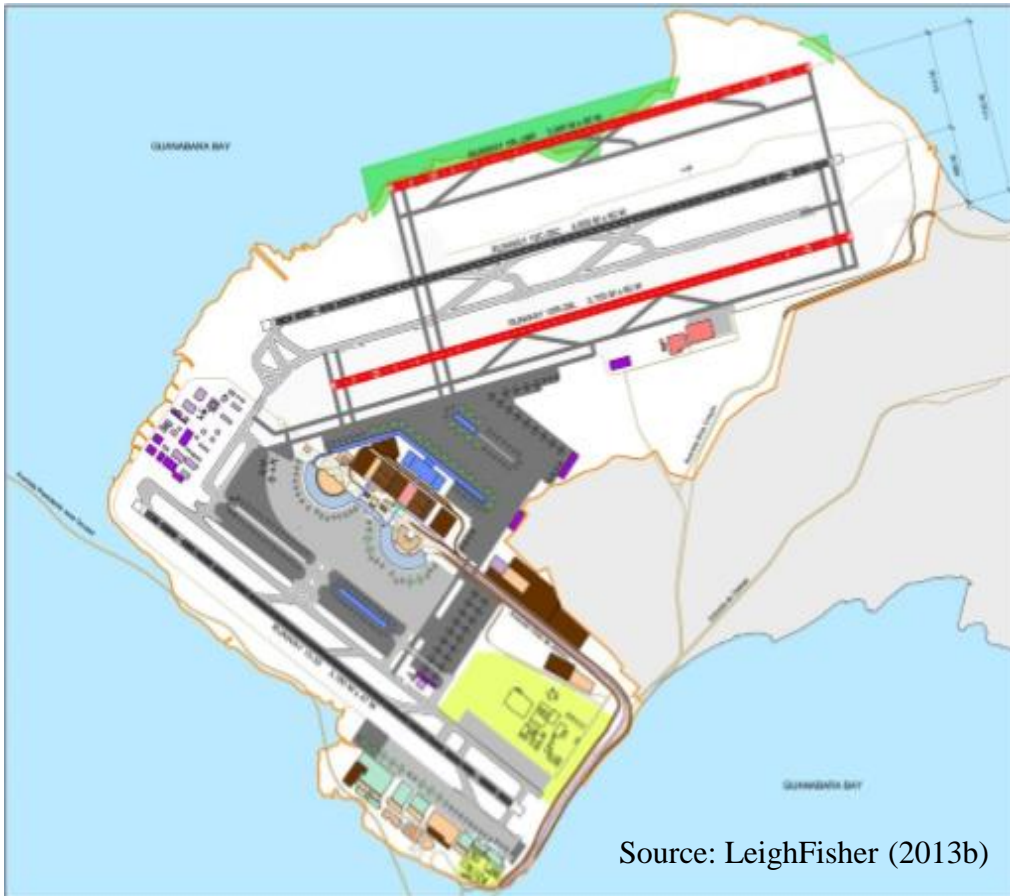
# GOVERNMENT VALUATION

- In order to value this concession project, the IFC, in partnership with EBP, requested the services of LeighFisher consulting firm.
- An economic and financial appraisal report forecasted passenger traffic growth from 17.5 million in 2012 to 60.4 million passengers per year in 2038, when the concession term expires.

Year	Expected Demand (1,000)
2012	17.496
2013	19.269
2014	22.518
2015	23.149
2016	25.739
2017	26.728
2018	28.278
2023	34.538
2028	41.574
2033	50.138
2038	60.366

Source: LeighFisher (2013c)

# GOVERNMENT VALUATION



Source: LeighFisher (2013b)

- LeighFisher recommended that the investments for the airport expansion should follow the Conceptual Development Plan. This plan is divided into 4 phases:
  - Phase 1 (2014 to 2018);
  - Phase 2 (2019 to 2023);
  - Phase 3 (2024 to 2033);
  - Phase 4 (2034 to 2043).

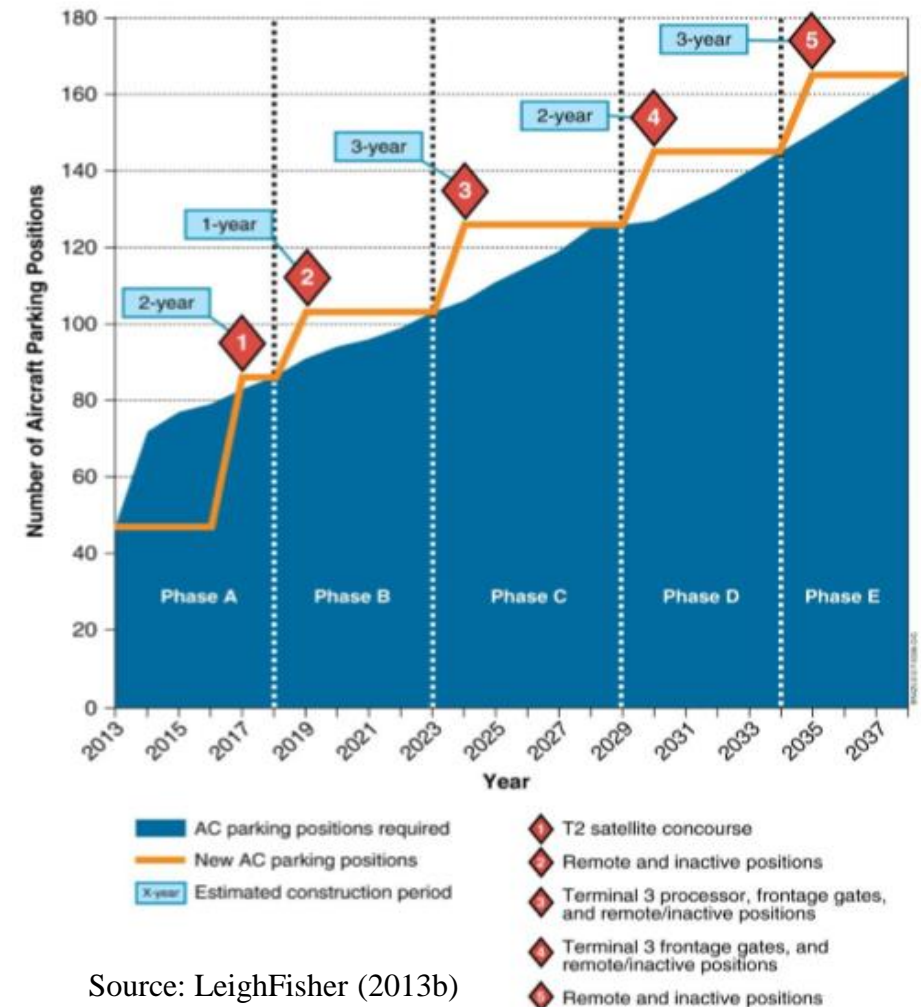


# GOVERNMENT VALUATION

- In addition, LeighFisher recommended that the implementation of this plan take place in 5 phases.

Phases	Period	Investment (R\$ millions)
Phase A	2014 - 2018	1,167.0
Phase B	2019 - 2023	1,699.0
Phase C	2024 - 2029	689.0
Phase D	2030 - 2034	459.0
Phase E	2035 - 2038	276.0

Source: LeighFisher (2013c)



Source: LeighFisher (2013b)

# GOVERNMENT VALUATION

Items	Values
Project Duration	25 years
Taxes on Tariff Revenues	14.25%
Taxes on Non-Tariff Revenues	10.50%
Concession Fee	5.00%
Income Tax	34.00%
WACC ( $\mu$ )	6.63%

Source: LeighFisher (2013c)

- Expected cash flows considered that all five expansions phases would occur exactly as planned.
  - A WACC of 6.63% per year was adopted as determined by the Brazilian Department of the Treasury.
  - In 2013, the NPV was R\$ 1,501.5 million (US\$ 698.4 million).
- Note that the five expansions phases were modeled as obligations.
- Nonetheless, future evolution of passenger demand is uncertain.

# REAL OPTION VALUATION

- The first expansion phase was completed in 2017.
- But by then, passenger demand had fallen significantly below the expected level of 26.728 million passengers.
- As a consequence, the RIOgaleão consortium took Terminal I out of service, rather than make expensive upgrades to the facilities.
- Thus, it is unlikely that the second expansion phase schedule to begin in 2019 will occur in the near future.

Year	Real Demand (1,000)
2012	17.422
2013	16.895
2014	17.443
2015	16.942
2016	16.103
2017	16.224*

\*estimated

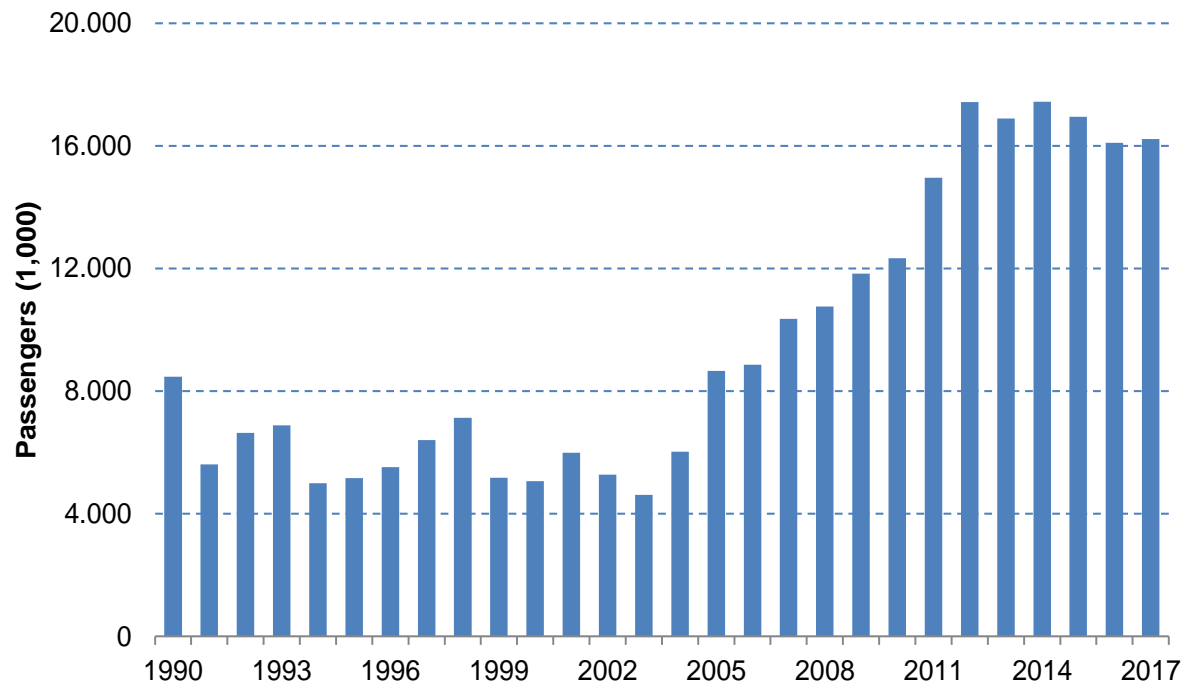
Source: RIOgaleão (2018)

# REAL OPTION VALUATION

- In order to model the expansion opportunities as options, the project cash flows were generated from operations and Phase A expansion.
- The remaining expansion phases were modeled as American type nested options, which will be exercised only if market demand justifies the investment.
- The DCF of the base case without the expansions (except for Phase A) provides a NPV of **R\$ 1,765.6 million** (US\$ 821.2 million).
- The PV of the project is **R\$ 2,932.6 million** (US\$ 1,364.0 million).



# REAL OPTION VALUATION



Source: LeighFisher (2013a) and RIOgaleão (2018)

- We assume that passenger demand follows a Geometric Brownian stochastic diffusion process.
- The volatility of passenger demand ( $\sigma$ ) is equal to 17.49% per year.
- The airport revenues are a linear function of the passenger demand.
- The approach suggested by Brandão, Dyer, and Hahn (2012) was applied to determine the project volatility of 29.7%.

# REAL OPTION VALUATION

- In order to model the stochastic project value, we adopt the discrete binomial lattice model proposed by Cox, Ross, and Rubinstein (1979). The parameters are:

$u$	$d$	$p$
11.953	0.8366	0.6178

- Adding the expansion options to the lattice transforms it into a binomial tree where the options can be priced under the martingale measure and thus discounted at the risk free rate.
- For this, the adopted risk-free rate were 5.82% per year.

# REAL OPTION VALUATION

- The base case project was modeled in a binomial tree using the DPL software, which provide a PV of **R\$ 2,932.6 million** (US\$ 1,364.0 million).
- According to the Conceptual Development Plan, this project has five planned expansion phases.
- Since the expansion Phase A, included in the base case, has been already executed, this option no longer exists, so it was ignored.
- Thus, it could be model the remaining four expansion phases as flexible managerial options.

Parameters	Expansion Options			
	Phase B	Phase C	Phase D	Phase E
Expansion Cost (R\$ millions)	1,699.0	689.0	459.0	276.0
Expansion Year	2019	2024	2030	2035
Expansion Factor	103.16%	20.37%	20.60%	20.40%

# REAL OPTION VALUATION

- To determine the parameters for the expansion options, the following assumptions were made:
  - We assume that passenger demand in 2018 will be 17.0 million, which is approximately the average demand of the last five years. This is consistent with the expected growth of the Brazilian GDP in 2018.
  - We assume that demand will recover and that only by 2023 will return to the levels predicted by LeighFisher.
- From this, we calculate demand growth from one year to the next and assume that this would be the expansion factor.

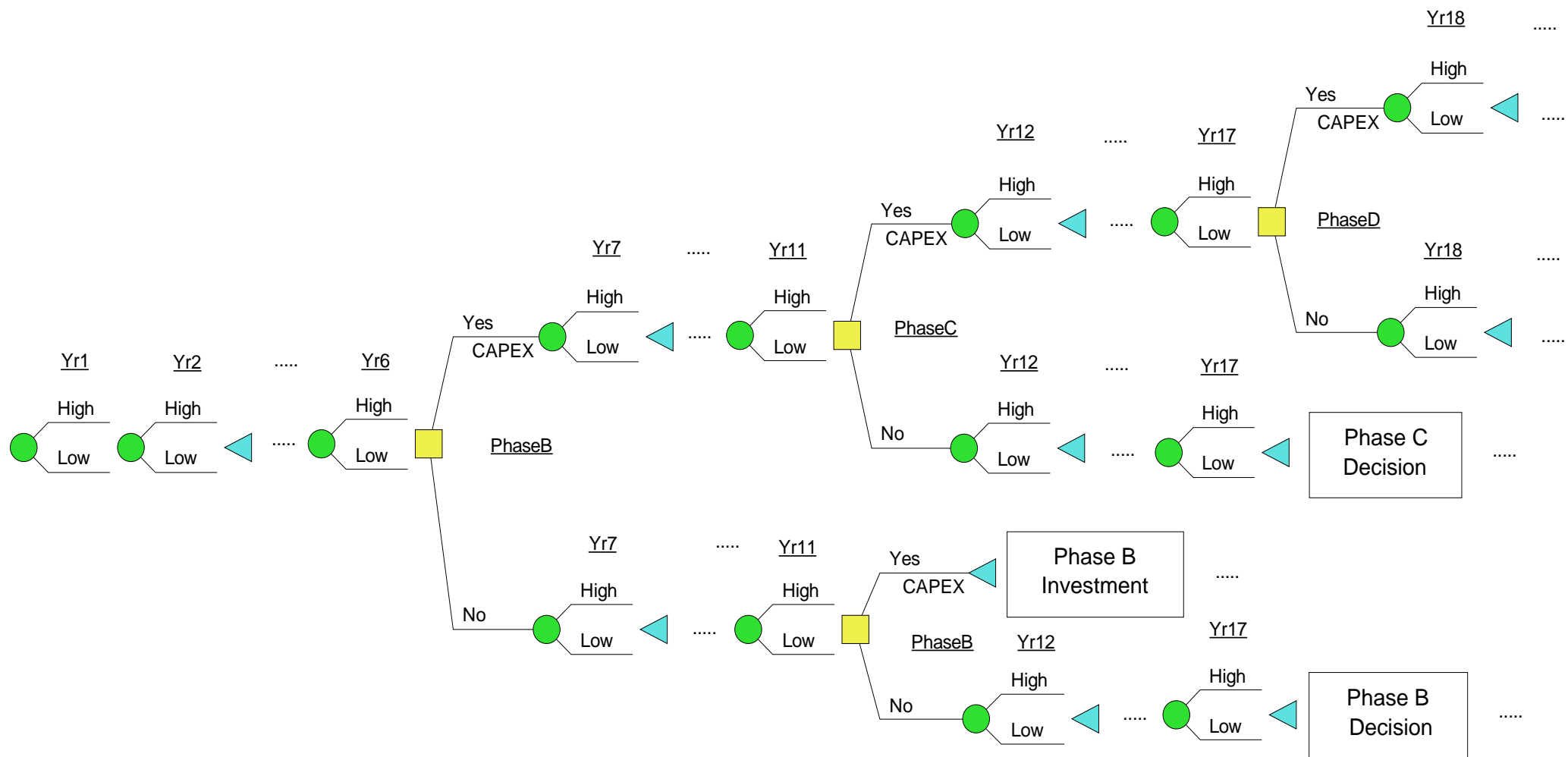
Year	Expected Demand (1,000)	Expansion Factor
2018	17.000	-
2023	34.538	103.16%
2028	41.574	20.37%
2033	50.138	20.60%
2038	60.366	20.40%



# REAL OPTION VALUATION

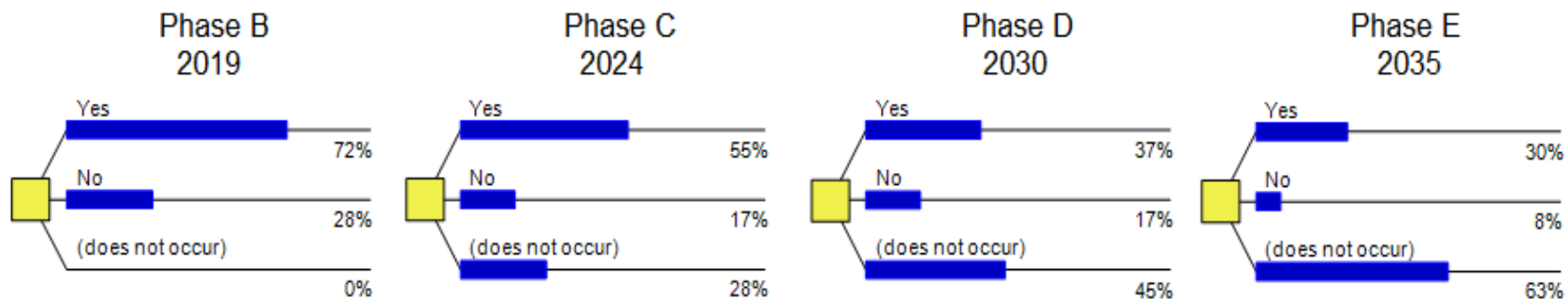
- In order to simplify the model it has been assumed that if Phase B expansion option is not exercised in 2019, it can be exercised again only in 2024, and if it is not exercised in 2024, it can be exercised only in 2029.
- The same occurs to all other options.
- These options are sequential, in the sense that the subsequent option can only be exercised if the previous option was exercised.
- Even with this simplification this results in a fairly complex tree with hundreds of millions end nodes.

# REAL OPTION VALUATION

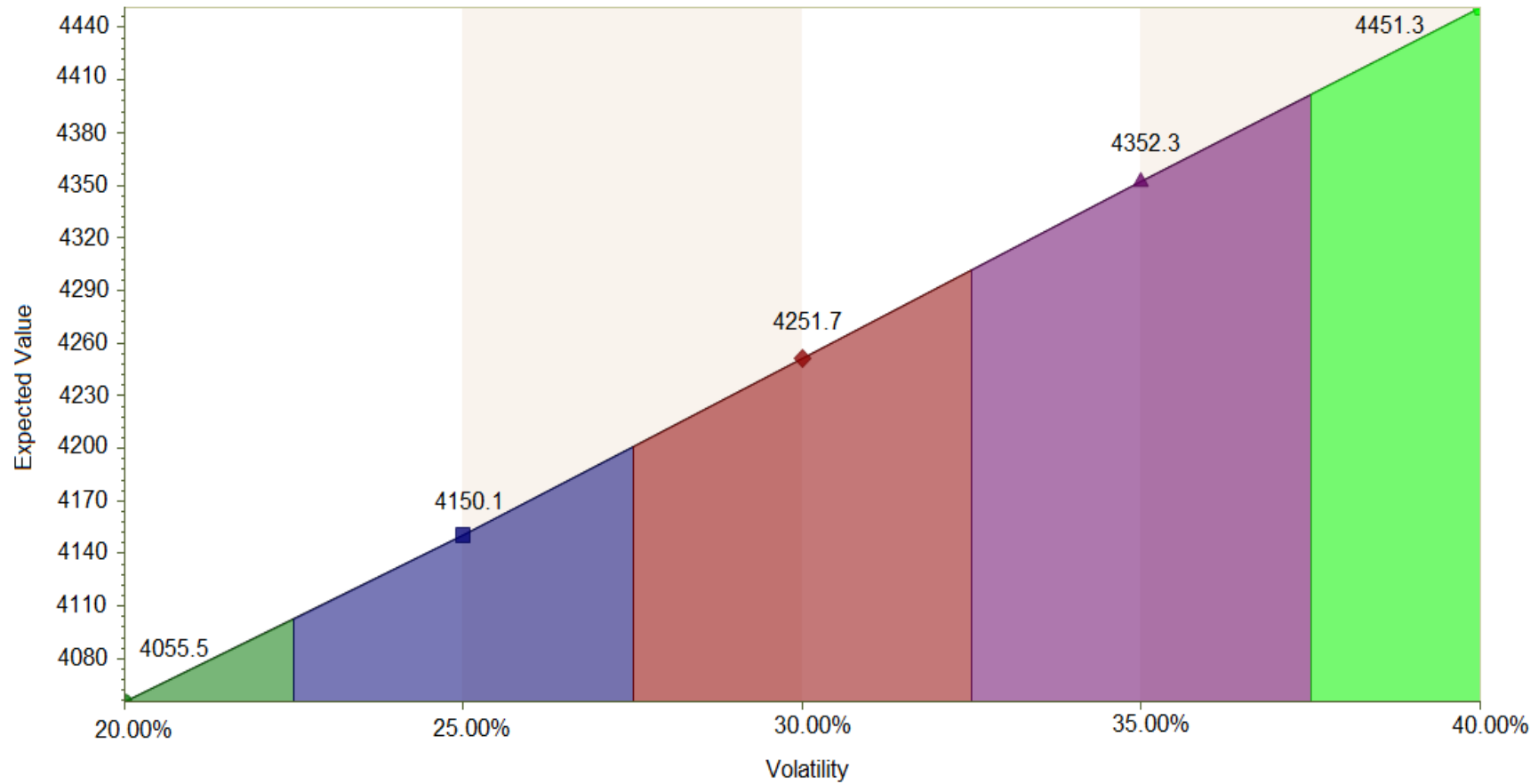


# REAL OPTION VALUATION

- When all the expansion phases are incorporated into the model, the project value increases to **R\$ 4,245.6 million** (US\$ 1,974.7 million). This shows that the options adds **R\$ 1,313.0 million** (US\$ 610.7 million) to the project value, an increase of **44.77%**.
- Analyzing the optimal decision policy we can see that the timing of the expansion phases will differ significantly from the timing established in the Conceptual Development Plan.
- Contrary to the LeighFisher model, all expansion phases presented less than 100% probability of exercise, which suggests that the model with fixed expansion dates is not realistic.



# SENSITIVITY ANALYSIS





# CONCLUSION

- The result indicate that the project value is **R\$ 4,245.6 million** (US\$ 1,974.7 million), which is close to the minimum bid value of **R\$ 4,828.0 million** (US\$ 2,246 million) established by the government.
- This suggests that the minimum bid value adequately reflected the value of the concession at the time.
- On the other hand, it is hard to justify the value offered by RIOgaleão, as this represents more than four times the value of the concession determined in our analysis.
- While the model adopted a few simplified assumptions, unlikely that a full model would significantly increase the value of the project to anywhere close to the winning bid.
- We conclude that RIOgaleão significantly overpriced the option value of the future expansion opportunities.

# ADDENDUM

- Facts occurred since the concession was celebrated also suggests that the bid value was too high.
- In 2016, consortium fell behind in their payments to the government, and requested that the bid payment be renegotiated.
- In 2017, Odebrecht Transport sold its stake of 31.0% in the concession to the Chinese group HNA Infrastructure for R\$ 60.0 million. This suggests that the value of the concession was less than R\$ 200 million at that time.
- As of 2018 the entrance of this new partner was awaited by the government so that the RIOgaleão can pay the bid portions in arrears.

# CONTRIBUTIONS & LIMITATIONS

- Simple option pricing methods can reasonably determine the value of projects and concessions where there are significant embedded options that management can explore to create value.
- The main usefulness of this type of analysis is to allow both the government and the private investor to make a better assessment of the investment opportunity and avoid under or overbidding.
- The limitations of this work are related to:
  - The WACC calculated by the Department of the Treasury at the time of bidding document publication.
  - The simplifying assumptions that were used to model the options, which may have undervalued their true price.



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