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The Contribution of Robo-Advisors as a Key Factor in Commercial Banks' Performance After the Global Financial Crisis

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Abstract: In several countries, digital financial advisory services, particularly those supported by robo-advisors, are becoming increasingly popular in retail banking. These tools assist users with financial decisions such as risk assessment, portfolio selection, and rebalancing—all at a reduced cost. Recent studies suggest that, over time, robo-advisors could complement human financial advisors. Building on this research, which evaluates robo-advisors' effectiveness in asset allocation, this study aims to assess the impact of this strategic shift on retail banks' profitability. It compares the Canadian and French banking sectors, where robo-advisors were introduced in the 2010s. Results indicate that implementing robo-advisors enhances profitability in non-interest activities, with this effect being more pronounced in France than in Canada.

Keywords: robo-advisor; retail banking; profitability; portfolio management; non-interest margin

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1. Introduction

Since 2012, financial technologies (fintechs) have experienced significant growth, continuously introducing new services and tools. Among the most notable innovations are 'robo-advisors', which represent the culmination of nearly two decades of technological advancements in the banking sector. These digital financial advisory services, including those powered by robo-advisors, are gaining popularity in retail banking across many countries. They support users in making financial decisions, including risk assessment, portfolio selection, and rebalancing, all at a lower cost. Recent studies indicate that, in the long term, robo-advisors could complement human financial advice.

Over the past decade, the growth of fintech has reshaped banking operations and customer interactions. Robo-advisors have emerged as a flagship innovation in this domain, offering low-cost, algorithm-driven financial advisory services. In Canada and France, major banks have adopted these tools to diversify revenue streams, reduce operating costs, and better serve tech-savvy customers. This dual-country approach allows for a comparative analysis of how different regulatory and market structures influence the adoption and impact of robo-advisors.

In Canada, even the major banks have embarked on the adventure to take advantage of this innovation. The National Bank of Canada created Invest Cube, and the Bank of Montreal developed the Smart Portfolio. On the other side of the Atlantic, in France,

BNP Paribas and Society General, to name but a few, have also taken up the challenge of artificial intelligence. Designing an investment portfolio in the comfort of their own home or between appointments gives clients more latitude in terms of availability. The development of exchange-traded funds (ETFs) has made it possible to advance this type of solution. ETFs make it possible to recreate the effect of stock market indices within an investment portfolio. They are less costly at the base since they involve less human intervention and rely on algorithms that track the effects of the stock market and the components of the indices.

If the implementation of robo-advisors requires large investments, it could be beneficial in the long term because it should significantly reduce the payroll and structural costs of financial institutions. It then becomes interesting to examine the impact of the adoption of this fintech tool on the performance of financial institutions.

In addition to work that evaluates the effectiveness of such a device for allocating financial assets or that examines the benefit of these platforms for investors, the objective of this article is to measure the impact of such a strategic orientation on the profitability of financial institutions. This exploratory study compares the Canadian and French banking sectors, where robo-advisors have been deployed since the 2010 decade. This allows us to compare the effect of these robo-advisors in two types of financial systems, across two countries that have adopted this tool in comparable proportions.

Specifically, the study aims to evaluate how the adoption of robo-advisors affects the profitability of commercial banks, with a specific focus on non-interest activities. By comparing the experiences of the Canadian and French banking systems, this research identifies key operational and strategic levers for improving bank performance. The results provide actionable insights for financial institutions, regulators, and fintech developers regarding the integration of robo-advisors into their business models.

The choice of the Canadian and French banking systems is motivated by the diversity of their financial approaches. Canada represents a market-based financial system, while France illustrates a bank-based system. These differences allow for a relevant comparative analysis of the effect of robo-advisors. Moreover, both systems apply IFRS standards and Basel III agreements, thereby ensuring the comparability of financial performance indicators.

The remainder of this article is structured as follows: Section 2 introduces the concept of robo-advisors and their functioning. Section 3 provides a literature review and an analysis of the current situation regarding the adoption of robo-advisors in Canada and France. Section 4 outlines the research methodology and the data used. The results are presented and analyzed in Section 5, and the article concludes by highlighting the main contributions of this study and suggesting avenues for future research.

2. The Robo-Advisor

The concept of a robo-advisor may seem abstract at first glance. However, it is a concrete and practical innovative tool aimed at automating a process that is sometimes biased by emotions and human error. The robo-advisor is designed to answer a question that is sometimes complex for some advisors: what is the best investment for me?

It is therefore a market analysis tool governed by an algorithm that acts on the markets according to certain signals and modifies the investments made in the client's portfolio. Sometimes it is composed solely of ETFs that attempt to replicate one of the major known stock market indices such as the S&P/TSX. An ETF that tracks this index would allow the investor to obtain a return that is very close to the performance of the New York, Paris, or Toronto stock exchanges. Of course, commission fees are withdrawn by the manufacturer of the product as well as by the distributor.

Initially, the robo-advisor serves as a neutral decision support tool for clients who wish to choose a solution that suits them. The client fills out an online questionnaire to determine his risk tolerance and at the end of the process, the system recommends that he can accept or refuse. Once the administrative formality is in place, the client can integrate the solution, and investments are then executed according to his investment policy. However, a human advisor who will validate the questionnaire completed by the client and validate whether the investment choice made corresponds to his investor profile must analyze his investment choices. In most cases, a diversified portfolio of ETFs is put in place, since this solution is of the passive management type and management fees are then lower for the client. Passive management results from the fact that an investment fund attempts to copy the composition of a stock market index in order to replicate the associated return. The robo-advisor, therefore, uses various algorithms to track these indices and rebalance the portfolio periodically.

In theory, the robo-advisor thus significantly reduces the payroll, which is costly for financial institutions. Few, if any, humans interact with the client since they switch to online investment management mode independently. In Europe, where legislation is different from that in Canada, a human advisor does not have to revalidate client questionnaires and transactions. This considerably reduces the cost of the advisor-boot option and makes it possible to tangibly notice the positive effects of the savings generated for the financial institution.

In addition, this means fewer costly assets for the financial institution. In fact, since it is no longer necessary to go to the office to meet with someone, certain points of business are no longer required. The implementation of a virtual platform, a computerized management system, and excellent servers is only required for this type of operation. The client, therefore, sees himself in the hands of a machine whose emotional biases related to the markets are less than those of a traditional portfolio manager—and all at a lower cost to him.

However, the client does not receive financial advice from an expert in the field. The investor is left to his own devices and in some cases, he may miss out on interesting market opportunities, not know about tax issues that would allow him to save significant amounts of money, or have an expert follow up on a retirement plan through a well-detailed project. Most financial institutions offer this service free of charge for their clients who have a dedicated advisor. However, if the client becomes self-employed, this type of service is not necessarily included, and the client will have to pay significant amounts for a consultation with a private firm. Without having a business relationship with a human, it would also be likely that the client would then be less loyal, and in the case of a better offer, he would be freer to leave for another institution. Knowing that customer retention is already an issue, banks do not want to multiply the chances of losing market share to their competitors. In short, while this type of strategy may have advantages, it also has drawbacks.

The table below presents the particularities of the main robo-advisors used by financial institutions.

Table 1 highlights the variability in fees associated with robo-advisors. Notably, fee structures vary significantly depending on the balance threshold, with lower fees for larger portfolios. This variability may influence the customer segments targeted by financial institutions.

Table 1. Service fees for robo-advisor (in USD).

Robo-Advisors	Balance Minimum	$5000	$10,000	$50,000	$100,000	$1,000,000	$10,000,000
Acorns	$0	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%
Betterment	$0	0.35%	0.25%	0.25%	0.25%	0.15%	0.15%

Table 1. *Cont.*

Robo-Advisors	Balance Minimum	$5000	$10,000	$50,000	$100,000	$1,000,000	$10,000,000
Hedgeable	$0	0.75%	0.75%	0.7%	0.65%	0.3%	0.3%
WiseBanyan	$10	0%	0%	0%	0%	0%	0%
Wealthfront	$500	0%	0%	0.25%	0.25%	0.25%	0.25%
TradeKing Advisors Core	$500	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%
SigFig	$2000	0%	0%	0.25%	0.25%	0.25%	0.25%
Schwab Intelligent Portfolios	$5000	0%	0%	0%	0%	0%	0%
Liftoff	$5000	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
TradeKing Advisors Momentum	$5000	0.5%	0.5%	0.5%	0.5%	0.5%	0.5%
FutureAdvisor	$10,000	X	0.5%	0.5%	0.5%	0.5%	0.5%
Personal Capital	$25,000	X	X	0.89%	0.89%	0.89%	0.59%
Vanguard VPAS	$50,000	X	X	0.3%	0.3%	0.3%	0.3%
AssetBuilder	$50,000	X	X	0.45%	0.45%	0.3%	0.25%
Rebalance IRA	$100,000	X	X	X	0.5%	0.5%	0.5%

Source: Business Insider Magazine. Website accessed on 13 November 2024. https://www.businessinsider.com/bis-robo-investing-reviews-performance-and-fees-comparison-2017-1?r=DE&IR=T?r=US&IR=T.

3. Implementation of Robo-Advisors: A Review of the Current Situation and Literature

The first robo-advisors were introduced after the global financial crisis of 2008. These tools primarily served as passive and automated asset allocation and portfolio management instruments, designed to automatically rebalance a client's portfolio in response to significant market fluctuations. Their emergence coincided with a period when investors exhibited a preference for low-risk portfolios, reflecting their apprehension after the adverse effects of the global financial crisis.

Thanks to aggressive marketing efforts, robo-advisors rapidly gained popularity in the United States. However, growth in the adoption of these tools was comparatively slower in France and Canada. Notably, Investors Group was among the first financial institutions to introduce this alternative. The implementation of its robo-advisor, Wealthsimple, required a significant investment of approximately CAD 30 million [1]. In response, several major Canadian banks followed suit, introducing exchange-traded fund (ETF) solutions with lower management fees. For instance, the National Bank of Canada and the Bank of Montreal launched portfolio management solutions powered by robo-advisors. The Bank of Montreal developed two distinct offerings: one for investments ranging from CAD 1000 to CAD 49,999 and another for amounts exceeding CAD 50,000. For its part, the National Bank set an investment floor of CAD 10,000 for its robo-advisor platform [2].

As the market for robo-advisors expands, investors have increasingly welcomed these innovations. Growing awareness of the fee structures of mutual funds and turnkey portfolios provided by most financial institutions has driven demand for cost-effective alternatives. Consequently, financial institutions have embraced robo-advisors as a means of demonstrating a competitive advantage and highlighting substantial savings opportunities for investors. For example, Wealthsimple, a prominent robo-advisor in Canada, has transformed the investment landscape by offering accessible, low-fee digital portfolio management. Similarly, BMO's 'SmartFolio' allows Canadian retail investors to create customized ETF portfolios, demonstrating the strategic role of robo-advisors in diversifying bank offerings.

Moreover, the use of financial algorithms, as opposed to the subjective judgement of fund managers, offers a more cost-effective and error-resistant solution. Robo-advisors rely on predefined algorithms that swiftly analyze market fluctuations and execute large-scale transactions to capitalize on emerging opportunities. This approach also supports the implementation of passive ETF solutions, whereby the robo-advisor tracks and adjusts holdings in accordance with predetermined stock market indices, thereby reducing costs and limiting human intervention.

However, regulatory standards vary across regions. In Canada, for instance, regulations mandate that a human advisor must assess the client's risk tolerance and validate the suitability of the transaction to ensure regulatory compliance. This step introduces an additional layer of human involvement, which imposes an operational cost on financial institutions [3]. For comparison, European regulations are less stringent, allowing for a more automated process [4]. This regulatory divergence explains part of the cost differences observed between European and Canadian financial institutions using robo-advisors.

In the United States, where robo-advisors have seen record levels of adoption, the Securities and Exchange Commission (SEC) has raised concerns. The SEC has warned that robo-advisors may sometimes issue investment recommendations based on incorrect assumptions, incomplete information, or irrelevant circumstances for individual investors. This underscores the importance of the oversight and continuous refinement of these algorithms to protect investors and enhance the reliability of the recommendations they receive.

According to Phoon and Koh (2018) [5], the introduction of such retail platforms has not only improved efficiency but also inclusiveness, giving a higher percentage of the US population the opportunity to participate in the economy as shareholders. Active investment strategies are often costly and do not, on average, provide real added value to investors in the context of diversified market exposure. Uhl and Rohner (2018) [6] empirically show that these robo-advisor investors save more than 4% per year in direct and indirect costs compared to traditional solutions, such as advisory fund solutions in banks or asset managers, because robo-advisors offer more efficient solutions on three key levels: passive access to the active market, profitability, and possible investor behavioural biases.

While approximately one-third of the outstanding shares are now held by passive investors, the authors predict that passive investors, through the use of robo-advisors, should control half of the US stock market by 2021. They conclude that robo-advisors will not only become the preferred investment solution for retail clients but will also become an increasingly important device for traditional banks and wealth managers.

Tertilt and Scholz (2018) [7] analyze how robo-advisors determine the risk tolerance of their users and what equity exposure is derived from the individual risk profile. Their results indicate significant differences in the quality of the investment advice offered. Robo-advisors generally ask relatively few questions in assessing the risk profile of their users, and it is particularly surprising that some of the questions asked do not seem to influence risk categorization. In addition, the recommended exposure to equities is relatively conservative.

There is little empirical literature on this relatively new tool, which is often based on its practicality, effectiveness, or benefit to users. Conversely, this study aims to examine the extent to which the adoption of such a tool influences the profitability of a financial institution. We make the general hypothesis that, given the strategic dimension of the decision to switch to automated teller robots and the size of the investment required, financial institutions will only adopt this innovation if it allows them to make substantial savings or gives them access to an additional clientele.

4. Methodology

The purpose of this study is to examine the contribution of robo-advisors to the profitability of financial institutions. This is carried out in a comparative approach between two countries that have adopted the use of robo-advisors in the last decade: Canada and France. As the banking sector is not as important within the financial system in continental Europe as it is in North America (Zogning, 2017) [8], this comparison is essential to ensure that the observed effects of the use of robo-advisors are not solely an American reality. We hypothesize that the adoption of robo-advisors enhances the profitability of banks through improved revenue diversification and operational efficiency. This impact is expected to be more pronounced in bank-based systems (France) than in market-based systems (Canada) due to differences in regulatory structures and business models.

4.1. Sampling and Data

Financial institutions include custodian institutions such as banks and non-depository institutions such as mutual funds, asset management companies, and pension funds, to name but a few. Since regulation in this second category is markedly different on both sides of the Atlantic, we focus here only on banks, whose prudential and accounting standards are international. We, therefore, include two countries that apply IFRS and subscribe to the Basel III agreements, in order to make their performance indicators comparable. We selected banks based on their asset size, market share, and availability of data on robo-advisor adoption from annual reports and public sources.

Although asset management or investment in securities is not a bank's core business, most large commercial banks are highly diversified, with a division or subsidiary dedicated to portfolio management. Therefore, we will further analyze the results of these non-core activities of banks.

In Canada, although there are more than eighty banks, 90% of assets are managed by the seven largest banks, leaving very small market shares for the dozens of banks that follow them, most of which are not publicly traded. We will focus on these seven banks that have national coverage, which we will compare to the seven largest French banks, which also concentrate the bulk of banking assets. In each of the two countries, the sample is split into two sub-groups: banks that have adopted robo-advisors and those that did not use them over the observed period. Data on the adoption of robo-advisors by these banks are available in their annual reports.

Canadian Financial Institutions		French Financial Institutions	
Without robo-advisor	With robo-advisor	Without robo-advisor	With robo-advisor
Royal Bank CIBC Scotiabank Laurentian Bank of Canada TD Bank	Bank of Montreal National Bank	CM-CIC Postal Bank BCPE Group Crédit Agricole	BNP Paribas Society General CM-ARKEA

The financial indicators and ratios of all the banks in our sample were obtained through the Bloomberg database. French financial institutions have been using robo-advisors since 2012 and Canadian institutions since 2014. The data collected therefore cover the period 2012–2019 for French banks and 2014–2019 for Canadian banks. Due to the small sample size, we covered all years from the introduction of robo-advisors to the time of the study.

4.2. Variables and Design

The variables used to represent the banks' profitability include ROE and ROA, which are the main profitability ratios in all business sectors, to which we add the non-interest margin, the proportion of non-interest income to total income, and non-interest expenses, which are more relevant indicators here. This choice to invest in non-interest income and expenses is so as not to contaminate the results by the performance of the banks' financial intermediation activity, which is little or not affected by the use of a robo-advisor.

Our results are based on two series of analyses: an analysis of variance and a multivariate model.

The chosen methodology combines analysis of variance (ANOVA) and multivariate regression to account for the distinct effects of robo-advisors on bank profitability. This dual approach allows for a comprehensive assessment of both direct and indirect relationships, which are essential for capturing the nuanced role of technology adoption in bank performance.

The first series involves an analysis of variance between the performance of robo and non-robo banks. This analysis is first performed at the level of the total sample and then within each country. For fourteen banks and over a period of 8 years, the number of observations fulfils the requirements for a one-factor analysis of variance. Then, a correlation analysis is performed to confirm the effect of the digitalization of financial services and to decipher the country's effect on this relationship.

The second set of analyses consists of developing an explanatory model of the profitability of commercial banks. To the traditional determinants of this performance, we add our variable of interest, which is the use of a robot.

Previous work has shown that commercial bank profitability is affected by both macroeconomic and bank-specific factors. Schepens et al. (2016) [9] test GDP growth, the inflation rate, the US dollar exchange rate, and the presence of a financial crisis as macroeconomic variables. These indicators are of little relevance to this study, as banks in comparison within each country are subject to the same economic reality. They all have national coverage, experience the same rate of inflation, and did not experience any financial crisis in the period considered by the study. However, since the economic reality is different between Canada and France, we include the country in our model as a control variable.

At the level of variables specific to the financial institution, we find size (Singh and Sharma, 2019) [10], level of deposits (Naeem et al., 2017) [11], capital adequacy (Salike and Ao, 2017) [12], asset quality (Anbar and Alper, 2011) [13], liquidity (Francis, 2013) [14], operational efficiency (Rashid and Jabeen, 2016) [15], financial risk (Almaqtari et al., 2019) [16], and asset management (Yahya et al., 2017) [17].

The level of deposits, the capital adequacy ratio (regulatory capital/total risk-weighted assets), the quality of assets (total loans or performing assets/total assets), and the degree of liquidity (liquid assets/total assets) are variables that directly affect the performance of the bank's financial intermediation activity. While they are relevant in explaining ROE and ROA, which are two indicators of overall profitability, they are much less relevant in explaining the profitability associated with the bank's asset management activities. This is why we focus here on operational efficiency (operating expenses/total income), asset management efficiency (total income/total assets), financial risk (total liabilities/total assets), and the size of the bank (logarithm of total assets). To these variables, we add the country control variable and our variable of interest, the use of a robo-advisor. The robo-advisor variable is a binary dummy variable where '1' indicates that the bank has adopted robo-advisor technology, and '0' indicates otherwise.

The model adopted is therefore as follows:

$$Non\ interest\ margin = \alpha + \beta_1 EP + \beta_2 GA + \beta_3 Risk + \beta_4 Size + \beta_5 Country + \beta_6 Robot + \varepsilon$$

$$\frac{Non\ interest\ income}{Total\ income} = \alpha + \beta_1 EP + \beta_2 GA + \beta_3 Risk + \beta_4 Size + \beta_5 \text{Country} + \beta_6 Robot + \varepsilon$$

$$\frac{Non\ interest\ expenses}{Total\ assets} = \alpha + \beta_1 EP + \beta_2 GA + \beta_3 Risk + \beta_4 Size + \beta_5 Country + \beta_6 Robot + \varepsilon$$

where

EP = operational efficiency;

GA = Asset management effectiveness;

Risk = financial risk.

The non-interest margin is calculated as follows $= \frac{(Non\ interest\ income - Non\ interest\ expenses)}{Total\ assets}$

The country variable is a dichotomous variable (1 for Canada or 0 for France).

The assumptions of normality and homogeneity were tested using the Shapiro–Wilk and Levene tests, respectively, to ensure the validity of the ANOVA and multivariate models.

5. Results

5.1. Descriptive Statistics

A comparative analysis of the profitability of Canadian and French banks according to their adoption robots shows the following picture (see Table 2):

Table 2. Description of the sample.

Total Sample						
		N	Minimum	Maximum	Average	Standard Deviation
ROE		98	−16.3856	19.7843	9.681099	5.532078
ROA		98	−0.3825	0.9898	0.480578	0.2885229
Non-int income/total income		98	0.2913	1	0.546341	0.1376793
Non-interest margin		98	0.0038	0.067	0.01586	0.0122449
Non-int expenses/total assets		98	0.007	0.066	0.01847	0.0116958
Statistics by Country						
Country		N	Minimum	Maximum	Average	Standard Deviation
Canada	ROE	42	6.8986	19.7843	14.685888	3.22064
	ROA	42	0.2692	0.9898	0.766333	0.179145
	Non-int income/total income	42	0.2913	0.5861	0.467055	0.0757846
	Non-interest margin	42	0.0064	0.0213	0.013566	0.0034173
	Non-int expenses/total assets	42	0.0148	0.0226	0.017886	0.0021295
France	ROE	56	−16.3856	9.524	5.927507	3.5733404
	ROA	56	−0.3825	0.4052	0.266261	0.1173384
	Non-int income/total income	56	0.2921	1	0.605806	0.1440435
	Non-interest margin	56	0.0038	0.067	0.017581	0.0157701
	Non-int expenses/total assets	56	0.007	0.066	0.018908	0.0154082

Table 2. *Cont.*

Robotized Banks vs. Non-robotized Banks						
	Robot	N	Minimum	Maximum	Average	Standard Deviation
NO	ROE	62	−16.3856	19.7843	10.278882	5.7665477
	ROA	62	−0.3825	0.9898	0.511044	0.310762
	Non-int income/total income	62	0.2913	1	0.504052	0.1148178
	Non-interest margin	62	0.0038	0.0213	0.012588	0.0038626
	Non-int expenses/total assets	62	0.007	0.0262	0.015793	0.0047622
YES	ROE	36	−0.1014	18.3569	8.651583	5.0137745
	ROA	36	0.0081	0.844	0.428108	0.2406657
	Non-int income/total income	36	0.4801	0.9295	0.619173	0.1446848
	Non-interest margin	36	0.0112	0.067	0.021495	0.0183825
	Non-int expenses/total assets	36	0.0112	0.066	0.02308	0.017465

It is therefore possible to note at the outset that all Canadian banks stand out with higher ROE and ROA over the period considered. They, therefore, appear to have better returns on equity invested and even more optimal asset management. In both cases, this effect can be explained by the fact that there is less competition in the Canadian market compared to the French market, which is flooded with European competitors, given the mobility of capital in the European Union's economic area. The fact that the Canadian government has put in place stricter rules governing the activities of financial institutions and some protectionism with respect to the activities of foreign banks means that the market is mainly dominated by the seven large banks that we have selected for this study (Banking Act, https://laws-lois.justice.gc.ca/fra/lois/b-1.01/, accessed on 14 November 2024) [18].

French banks have a higher net margin excluding interest and higher non-interest expenses, both in absolute and relative terms. There is therefore every reason to believe that other non-banking financial activities have a more important place within French banks.

In light of the last segment of this table, we realize that banks operating a robo-advisor have a lower average ROE and ROA than non-robotized banks. Conversely, non-interest margin and non-interest expenses are higher for financial institutions that have chosen to integrate robo-advisors. This finding suggests that banks with low overall profitability or limited profitability with their intermediation activity are more likely to turn to digital solutions in order to obtain additional revenues or reduce their costs and improve profitability for shareholders.

5.2. Analysis of Variance

The analysis of variances allows us to determine whether there is a significant difference in profitability indicators between banks that invest in the robo-advisor and those that do not.

For the entire sample selected, the above Tables 3 and 4 show a significant difference in the non-interest margin, the share of non-interest income in total income, and non-interest expenses in relation to the level of assets. It is therefore presumed at this stage that robo banks have different profitability than non-robot banks.

Table 3. Analysis of Variance (Robotized Banks vs. Non-Robotized Banks).

1 Factor ANOVA						
		Sum of Squares	**ddl**	**Average of Squares**	**F**	**Sig.**
ROE	Inter-groups	60.312	1	60.312	1.991	0.161
	Intra-groups	2908.265	96	30.294		
	Total	2968.577	97			
ROA	Inter-groups	0.157	1	0.157	1.899	0.171
	Intra-groups	7.918	96	0.082		
	Total	8.075	97			
Non-int income/total income	Inter-groups	0.302	1	0.302	18.855	0.000
	Intra-groups	1.537	96	0.016		
	Total	1.839	97			
Non-interest margin	Inter-groups	0.002	1	0.002	13.618	0.000
	Intra-groups	0.013	96	0		
	Total	0.015	97			
Non-int expenses/total assets	Inter-groups	0.001	1	0.001	9.627	0.003
	Intra-groups	0.012	96	0		
	Total	0.013	97			

Table 4. Analysis of Variance by Country (Robo Banks vs. Non-Robo Banks).

1 Factor ANOVA							
Country			**Sum of Squares**	**ddl**	**Average of Squares**	**F**	**Sig.**
Canada	ROE	Inter-groups	0.475	1	0.475	0.045	0.834
		Intra-groups	424.799	40	10.62		
		Total	425.273	41			
	ROA	Inter-groups	0.013	1	0.013	0.385	0.539
		Intra-groups	1.303	40	0.033		
		Total	1.316	41			
	Non-int income/total income	Inter-groups	0.047	1	0.047	10.021	0.003
		Intra-groups	0.188	40	0.005		
		Total	0.235	41			
	Non-interest margin	Inter-groups	0	1	0	2.367	0.132
		Intra-groups	0	40	0		
		Total	0	41			
	Non-int expenses/total assets	Inter-groups	0	1	0	0.846	0.363
		Intra-groups	0	40	0		
		Total	0	41			

Table 4. *Cont.*

1 Factor ANOVA							
Country			**Sum of Squares**	**ddl**	**Average of Squares**	**F**	**Sig.**
France	ROE	Inter-groups	5.973	1	5.973	0.463	0.499
		Intra-groups	696.309	54	12.895		
		Total	702.282	55			
	ROA	Inter-groups	0.002	1	0.002	0.123	0.727
		Intra-groups	0.756	54	0.014		
		Total	0.757	55			
	Non-int income/total income	Inter-groups	0.166	1	0.166	9.214	0.004
		Intra-groups	0.975	54	0.018		
		Total	1.141	55			
	Non-interest margin	Inter-groups	0.002	1	0.002	10.386	0.002
		Intra-groups	0.011	54	0		
		Total	0.014	55			
	Non-int expenses/total assets	Inter-groups	0.002	1	0.002	8.583	0.005
		Intra-groups	0.011	54	0		
		Total	0.013	55			

However, when analyzing the two sub-samples separately by country, it should be noted that of all the profitability indicators tested, only the proportion of non-interest income to total income shows a significant difference on the Canadian side. In France, on the other hand, all profitability indicators related to activities other than financial intermediation (non-interest margin, non-interest income/total income, and non-interest expenses/total assets) show a significant difference between robotized and non-robotized banks. ROE and ROA show no significant difference. This can be explained by the fact that these are general profitability indicators, which largely include net interest income from financial intermediation, an activity for which robo-advisors are not used. The latter is more required in the context of the bank's market activities. In addition, the maintenance expenses of such devices are included in the non-interest expense category, while the income from these activities contributes to the non-interest margin.

5.3. Correlation Analysis

Elements other than the arrival of robo-advisors in these banks can influence the profitability indicators we have selected. The correlation analysis here sheds more light on the preliminary results.

This Table 5 reveals a strong and very significant association between the presence of a robo-advisor and the level of non-interest income, non-interest expenses, and non-interest margin. The use of robo-advisors also appears to be related to greater financial risk and low operational efficiency. These results highlight that Canadian banks are significantly more likely to have higher overall profitability than French banks (with higher ROE and ROA) and that non-robotized banks also have higher overall profitability than robotized banks. In addition, the most profitable banks invest less in non-interest activities and consequently have the lowest non-interest margins. Naturally, banks that invest more in robo-advisors have more comfortable non-interest margins, which is also the objective.

Table 5. Correlations.

		1	2	3	4	5	6	7	8	9	10	11
1	ROE	1										
2	ROA	0.947 **	1									
3	Non-int. mg	−0.245 *	−0.258 *	1								
4	Non-int inc/tot inc	−0.075	−0.051	0.775 **	1							
5	Non-int exp/tot ass	−0.016	0.001	0.619 **	0.963 **	1						
6	Assets Manag.	0.147	0.187	0.580 **	0.949 **	0.976 **	1					
7	Fin risk	−0.471 **	−0.534 **	0.567 **	0.647 **	0.621 **	0.493 **	1				
8	Oper eff.	−0.230 *	−0.218 *	0.744 **	0.964 **	0.929 **	0.877 **	0.754 **	1			
9	Size	−0.054	0.049	−0.133	−0.363 **	−0.474 **	−0.396 **	−0.462 **	−0.401 **	1		
10	Robot	−0.143	−0.139	0.405 **	0.352 **	0.302 **	0.274 **	0.309 **	0.362 **	−0.008	1	
11	Country	−0.788 **	−0.862 **	0.501 **	0.163	0.043	−0.098	0.514 **	0.274 **	0.163	0.147	1

* Significant at 0.05 level. ** Significant at 0.01 level.

5.4. Multivariate Analysis

In order to determine the substantial contribution of the use of robo-advisors to bank profitability, we analyze regressions of profitability indicators by adding the robot variable to the traditional determinants of profitability in banks, namely optimal asset management, operational efficiency, and financial risk. All this is controlled for size and country factors (See Table 6).

Table 6. Model results.

	1			2			3		
	Coef.	**T**	***p*-Value**	**Coef.**	**T**	***p*-Value**	**Coef.**	**T**	***p*-Value**
Constant	0.0106302	0.40	0.693	2.398058	1.34	0.184	−0.0207603	−0.87	0.384
Asset management	0.6329441	10.10	0.000	3.016701	1.46	0.148	0.8666632	24.08	0.000
Financial risk	−0.0240928	−2.46	0.363	−2.284565	−1.25	0.213	0.0270216	1.12	0.267
Operational efficiency	0.0022416	2.31	0.000	0.0304644	2.54	0.013	0.0003789	1.77	0.080
Size	0.0022416	−1.74	0.525	−0.0092544	−0.33	0.745	−0.002574	−5.97	0.000
Country	0.0028096	1.77	0.000	0.1399631	4.32	0.000	0.0023876	4.09	0.000
Robot	0.0006856	8.92	0.018	0.0448961	2.97	0.004	0.0003089	1.06	0.294
N		98			98			98	
Significance		0.0000			0.0000			0.0000	
R2 adjusted		0.6833			0.6999			0.7864	

1: Non-interest margin = α + β1EP + β2GA + β3Risk + β1Size + β5Country + β6Robot + ε. 2: Proportion of non-interest income = α + β1EP + β2GA + β3Risk + β1Size + β5Country + β6Robot + ε. 3: Non-interest expenses/total assets = α + β1EP + β2GA + β3Risk + β1Size + β5Country + β6Robot + ε.

The regression carried out on the whole sample shows significance for the robot variable in terms of explaining the non-interest margin and the share of non-interest income in the total income of the banks. However, this variable is not significant for the variable relating to non-interest expenses in relation to the volume of assets. In almost all cases, operational efficiency and effective asset management are important determinants of profitability.

In light of these findings, it is clear that there is a relationship between the use of a robo-advisor and the level of non-interest income. This link seems stronger in France than in Canada. It is likely that the fact that these robots have been installed for a slightly longer period of time in France explains why their effect is a little more marked there. In addition to the novelty effect in Canada compared to France, another more important factor could affect these results, namely the distinct environment of the two countries.

The three equations conducted on the total sample clearly show that both Canadian and French banks operate in almost impervious environments. This makes it difficult to compare Canadian banking activity with that of France. This is mainly because of the legislative differentiation in place and the opening of doors to the European Union for

France. Still, on an institutional level, Zogning (2017) [8] shows that France has a financial system strongly influenced by the banking sector, whereas Canada embodies a financial system more focused on financial markets. This state of affairs largely explains why banks in France are major players, even in securities investments where they act as brokers and intermediaries. Whereas in Canada, investment in securities is primarily the preserve of pension funds, mutual funds, and income trusts. Banks access this market because of their financial expertise and the potential it offers in terms of liquidity.

For example, at the end of 2018, there were 632 portfolio management companies in France and 75% of the top 20 players in this market are subsidiaries of commercial banks. These account for 66.2% of assets under management (Report of the Autorité des Marchés Financiers on assets under management by management companies—November 2019). In contrast, Canada had 3535 asset management and investment advisory firms as of the same date. Moreover, in the ranking, only 2 of the top 7 banks included in this study are among the top 40 players in the market. Herein lies an attempt to explain the fact that Canada does not show a significant difference in the comparison of certain profitability indicators between robotized and non-robotized banks. This is because they use the robo-advisor in a segment of activity where they are highly competitive. Although this robot improves their profitability in market activities, the difference with banks without robots, although perceptible, is not yet significant.

Pellerin (2008) [19], who analyzed the effect of off-balance-sheet activities on the volatility of Canadian banks' revenues, highlights the role of the Bank Act, which came into effect in the early 1990s, as an important factor in the diversification of financial institutions' revenues in Canada. Revenues derived from the use of credit cards, group or personal insurance, real estate, and securities commissions are good examples of sectors in which financial institutions have invested in order to increase their revenues. Now that technology and digital technology are becoming ubiquitous in the daily lives of many countries, these institutions are integrating them into their business models.

Robo-advisors are still a recent concept. The first appearances outside the United States took place in 2012. It is therefore likely that more conclusive results as to their influence on financial results, especially on banks' non-interest income, will come after the current investment phase and the running-in of this phase with clients. Indeed, with the process in the start-up phase, the additional market shares that the implementation of the robo-advisors should confer have probably not yet reached the proportions necessary to make a noticeable difference in results.

Moreover, a reading of the financial statements of these banks indicates a rationalization of expenditures and the addition of new activities between 2012 and 2019. Indeed, even the French banks in this study that stood out in terms of non-interest expenses and revenues were clearly engaged in a strategy to develop different avenues for the benefits of financial intermediation. As an example, in 2011, CM-ARKEA set up a venture capital subsidiary that invests in equity in unlisted companies and another subsidiary that operates in securitization (CM-ARKEA, 2012 Registration Document, website: https://www.arkea.com/banque/assurance/credit/upload/docs/application/pdf/2014-01/document-de-reference-credit-mutuel-arkea-31122012.pdf consulted on 3 May 2020). These two areas clearly influence a bank's non-interest activities. Moreover, the fact that financial institutions with lower ROE and ROA performance are diversifying shows that financial intermediation revenues tend to peak and that banks are constantly looking for new activities to improve their profitability. As a result, they are developing a technological watch by investing in fintech. The increase in the performance of robotized banks between 2012 and 2019 may therefore not be due solely to robot-advisors but also to a broader diversification strategy, which relies, among other things, on the use of robo-advisors to rationalize costs.

6. Conclusions

With regard to the previous lines, the arrival of the robo-advisors is a response to the desire of financial institutions to diversify the type of income they have beyond simple intermediation. Long before the 2008 crisis, banks were already seeking to differentiate their activities, by seeking income where they had never done so before.

The integration of digital technologies, in the age of banking automation and artificial intelligence, offers new ways to reach customers and take advantage of growing technology. The robot-advisor fulfils an important task in meeting the needs of bank customers who no longer want to travel but still want advice about their investments and asset management. It manages a series of exchange-traded funds in exchange for a commission for the bank, which is, however, lower than that of a conventional mutual fund. However, in theory, the lack of human interaction means that the costs incurred to manage these funds are lower for the bank.

In order to properly analyze the effect of advisors coming to the banks, fourteen banks were selected from among the largest. Seven were selected in Canada and seven in France.

The results bring out two important observations. Financial institutions with low overall profitability (lower ROE and ROA) are turning to the use of robo-advisors. These banks have higher net non-interest margins and non-interest income per asset than their counterparts that do not invest in robo-advisors. These results show that banks using robo-advisors experienced a 5% increase in non-interest income compared to non-adopters. Two traits appear to be more pronounced in France than in Canada.

This study contributes to the academic literature on digital banking transformation by providing empirical evidence on the role of robo-advisors in bank profitability. It offers insights into the influence of regulatory and operational differences across financial systems. For practitioners, the findings underscore the potential of robo-advisors to optimize operational efficiency and diversify revenue streams, offering a pathway for strategic decision-making.

Can we believe that it is only the introduction of robo-advisors that is influencing these changes to the financial statements of these banks? Probably not. In fact, other sectors of activity such as insurance and real estate management, among others, are diversifying banks' revenues. However, the role of robo-advisors seems to be becoming clearer and would be an avenue to watch out for in the longer term.

It is likely that this study was conducted a little early in the process of implementing robo-advisors and that the system has not yet reached cruising speed, particularly among Canadian banks that compete fiercely in this segment of activity against many non-depositary financial institutions, which adopted robo-advisors long before the banks.

This study presents certain limitations, particularly regarding the availability of data on the performance of banks that have adopted robo-advisors. The recent implementation period of robo-advisors does not yet allow for the observation of long-term effects. Therefore, the results should be interpreted with caution, and future studies could extend this research by relying on more recent data and longer observation periods. Future research could extend the observation period and incorporate a larger sample of banking systems from other countries that comply with IFRS and Basel III agreements.

Another investigation will be required once the robo-advisors have taken a greater share of the banks' activities. All in all, there is every reason to believe that the virtualization of banking services will continue at a rapid pace and that these changes will have an impact on the financial statements of financial institutions. In any case, interest in robo-advisors continues to grow. As evidence of this, Canada's two largest banks, the Royal Bank of Canada (RBC) and Toronto Dominion Bank (TD) in turn adopted a robo-advisor in the very last months of the reference period of this study.

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References

1. Les Affaires. Les Robots-Conseillers: Est-ce Pour Vous? 2020. Available online: https://www.lesaffaires.com/dossier/maximiser-ma-retraite-et-mon-patrimoine/les-robots-conseillers-est-ce-pour-vous/595111 (accessed on 14 November 2024).
2. Hard Bacon. Comparez les Robots-Conseillers au Canada. 2020. Available online: https://hardbacon.ca/fr/comparez-les-robots-conseillers-au-canada/ (accessed on 14 November 2024).
3. Mondaq. CSA provides guidance on Canadian robo-advisers. *Mondaq*. 2015. Available online: https://www.mondaq.com/canada/fund-management-reits/434698/csa-provides-guidance-on-canadian-robo-advisers (accessed on 14 November 2024).
4. European Parliament. Robo-advisors in the EU: Market developments and regulatory framework. Policy Department for Economic, Scientific and Quality of Life Policies. 2021. Available online: https://www.europarl.europa.eu/RegData/etudes/STUD/2021/662928/IPOL_STU(2021)662928_EN.pdf (accessed on 14 November 2024).
5. Phoon, K.; Koh, F. Robo-advisors and wealth management. *J. Altern. Invest.* **2018**, *20*, 79–94. [CrossRef]
6. Uhl, M.W.; Rohner, P. Robo-advisors versus traditional investment advisors: An unequal game. *J. Wealth Manag.* **2018**, *21*, 44–50. [CrossRef]
7. Tertilt, M.; Scholz, P. To advise, or not to advise—How robo-advisors evaluate the risk preferences of private investors. *J. Wealth Manag.* **2018**, *21*, 70–84. [CrossRef]
8. Zogning, F. Comparing Financial Systems around the World: Capital Markets, Legal Systems, and Governance Regimes. *Econ. Manag. Financ. Mark.* **2017**, *12*, 43–58.
9. Schepens, G. Taxes and Bank capital structure. *J. Financ. Econ.* **2016**, *120*, 585–600. [CrossRef]
10. Singh, A.; Sharma, A.K. An empirical analysis of macroeconomic and bank-specific factors affecting liquidity of Indian banks. *Future Bus. J.* **2016**, *2*, 40–53. [CrossRef]
11. Naeem, M.; Baloch, Q.B.; Khan, A.W. Factors affecting banks' profitability in Pakistan. *Int. J. Bus. Stud. Rev.* **2017**, *2*, 33–49.
12. Salike, N.; Ao, B. Determinants of bank's profitability: Role of poor asset quality in Asia. *China Financ. Rev. Int.* **2017**, *8*, 216–231. [CrossRef]
13. Anbar, A.; Alper, D. Bank specific and macroeconomic determinants of commercial bank profitability: Empirical evidence from Turkey. *Bus. Econ. Res. J.* **2011**, *2*, 139.
14. Francis, M.E. Determinants of commercial bank profitability in sub-Saharan Africa. *Int. J. Econ. Financ.* **2013**, *5*, 134–147.
15. Rashid, A.; Jabeen, S. Borsa_Istanbul review analyzing performance determinants: Conventional versus Islamic banks in Pakistan. *Borsa Istanb. Rev.* **2016**, *16*, 92–107. [CrossRef]
16. Almaqtari, F.A.; Al-Homaidi, E.A.; Tabash, M.I.; Farhan, N.H. The determinants of profitability of Indian commercial banks: A panel data approach. *Int. J. Financ. Econ.* **2019**, *24*, 168–185. [CrossRef]
17. Yahya, A.T.; Akhtar, A.; Tabash, M.I. The impact of political instability, macroeconomic and bank-specific factors on the profitability of Islamic banks: An empirical evidence. *Invest. Manag. Financ. Innov.* **2017**, *14*, 30–39.
18. Canada, J. Government of Canada. Bank Act. Available online: https://laws-lois.justice.gc.ca/fra/lois/b-1.01/ (accessed on 14 November 2024).
19. Pellerin, N. *The Effect of Off-Balance Sheet Activities on the Profitability and Revenue Volatility of Canadian Banks*; Working paper; Université du Québec en Outaouais: Gatineau, QC, Canada, 2008.