INSTITUTO
UNIVERSITÁRIO
DE LISBOA

Exchange Rate Dynamics and Sectoral Performance: Exploring International Transmission in the French Financial Market

Margaux Lahitette

Master in Finance

Supervisor:
PhD, Szabolcs Sebestyén, Assistant Professor, Iscte-IUL

September 2025

BUSINESS
SCHOOL

Department of Finance

Exchange Rate Dynamics and Sectoral Performance: Exploring International Transmission in the French Financial Market

Margaux Lahitette

Master in Finance

Supervisor:
PhD, Szabolcs Sebestyén, Assistant Professor, Iscte-IUL

September 2025

Acknowledgements

This thesis represents the final step in completing this Master's program and I couldn't be prouder today than to submit this piece. In addition to selecting a topic that truly interested me, I am grateful for the intellectual challenge it has given me.

To my supervisor, Professor Szabolcs, I would like to thank you for motivating me to follow through with this topic and guiding me on how to tackle it.

To my family members, Armelle, Guillaume, Joséphine, Luc and Frédéric, thank you all for your moral support and reviewing skills, you definitely helped me get back up on the saddle when the work would be overwhelming.

To my Thomas, thank you for your kind patience and advice when conducting the quantitative study. I know for a fact my GitHub repository wouldn't look the same without your help.

Lastly, thank you to my good friend Maria for making sure my Portuguese abstract could make Iscte pleased of the work presented today. I wish you all my luck for this following two years, I know you will enjoy every minute of the Master's program.

Resumo

As flutuações cambiais representam um canal de transmissão fundamental que liga os mercados internacionais ao desempenho das ações domésticas. Para a França, uma economia altamente integrada com redes comerciais globais, as variações na taxa USD/EUR podem afetar significativamente os retornos das ações. Como a exposição cambial (FX) varia entre setores, esta tese analisa o grau em que ela é capturada pelos índices setoriais franceses.

Os retornos das ações não são impulsionados apenas pelo desempenho das empresas, mas também por choques macroeconómicos, dinâmica de mercado, política monetária e inflação. Para isolar o papel do câmbio, diferentes modelos econométricos são aplicados aos retornos e à volatilidade dos preços setoriais. O primeiro recorre a regressões OLS ao nível setorial para captar sensibilidades básicas. O segundo aplica métodos de dados em painel para avaliar exposições médias, considerando heterogeneidade não observada. Terceiramente, um modelo TVP explora como as sensibilidades evoluem ao longo do tempo, destacando episódios de influência cambial acentuada. Por último, um modelo GARCH examina se choques cambiais se propagam para a volatilidade setorial, identificando a intensidade e a persistência das reações.

Os resultados indicam que, embora os Betas de mercado estejam fortemente correlacionados, setores como Saúde e Bens de Consumo apresentam exposição positiva e significativa às variações do USD/EUR, em consonância com suas receitas internacionais. Em contrapartida, o setor Financeiro mostrou correlação significativamente negativa. O modelo TVP revela que a sensibilidade cambial se concentra em períodos de tensão macroeconómica ou geopolítica, enquanto o GARCH confirma que choques cambiais geram efeitos persistentes em setores cíclicos, como Indústria e Tecnologia. En termos gerais, as evidências apoiam a visão de que a dinâmica cambial molda o desempenho das ações setoriais francesas.

Palavras-chave: Dinâmica das Taxas de Câmbio, Retornos Seitorais das Ações, Exposição Cambial, Transmissão da Volatilidade, Mercados Financeiros Francês

JEL Classification System: E44, F31

Abstract

Exchange rate fluctuations represent a key transmission channel linking international markets to domestic equity performance. For France, a highly integrated economy with global trade networks, movements in the USD/EUR rate may significantly affect its stocks' returns. As foreign exchange (FX) exposure varies across sectors, this thesis aims to analyze the degree at which it is captured through French sectoral indices.

Equity returns are not only driven by firm performance but also by macroeconomic shocks, market dynamics, monetary policy and inflation. To isolate the role of FX, a framework of econometric models is applied to sectoral price returns and volatility. The first employs sector-level OLS regressions to capture baseline sensitivities. The second applies panel data methods to evaluate average exposures while accounting for unobserved heterogeneity. Third, a TVP model explores how sensitivities evolve dynamically, highlighting episodes of heightened FX influence. Lastly, a GARCH model examines whether FX shocks propagate into sectoral volatility, identifying the intensity and persistence of reactions.

The findings indicate that while market Betas are strongly correlated, certain sectors such as Health Care and Consumer Goods experience positive and significant exposure to USD/EUR movements, consistent with their international revenue shares. In contrast, the Financials sector prevailed a significantly negative correlation. The TVP model reveals that FX sensitivity is concentrated in periods of macroeconomic or geopolitical stress, while GARCH results confirm that FX shocks generate persistent effects in cyclical sectors such as Industrials and Technology. Overall, the evidence supports the view that exchange rate dynamics materially shape French sectoral equity performance.

Keywords: Exchange Rate Dynamics, Sectoral Equity Returns, FX Exposure, Volatility Transmission, French Financial Markets

JEL Classification System: E44, F31

Table of Contents

Acknowledgements i
Resumo iii
Abstract v
Table Index ix
Figure Index xi
Appendix Index xiii
1 Introduction 1
2 Literature Review 4
2.1 Why Study Foreign Exchange Rate Exposure in French Sectors 4
2.2 France's Integration in Global Markets 4
2.3 Measuring Globalization 5
2.4 Transmission Channels of Foreign Exchange Shocks 6
2.4.1 Trade Channels 6
2.4.2 Financial Channels 7
2.5 Exchange Rate Pass-Through and Sectoral Effects 8
2.6 Monetary Policy and Global Liquidity 9
2.7 Synthesis and Research Gaps 10
3 Conceptual Model and Research Hypothesis 11
3.1 The Oil and Gas sector 11
3.2 The Health Care sector 12
3.3 The Utilities sector 13
3.4 The Consumer Service sector 13
3.5 The Financials sector 14
3.6 The Technology sector 15
3.7 The Basic Materials sector 15
3.8 The Industrials sector 16
3.9 The Consumer Goods sector 17
4 Contextualization 18
4.1 Collected Data 18
4.2 Data and Descriptive Statistics 21
5 Methodology 22
5.1 Baseline OLS Regression Model 23

5.2 Panel Data Model 24
5.3 Time-Varying Parameter Model 24
5.4 Volatility Transmission GARCH Model 25
6 Obtained Results, Findings and Discussion 26
6.1 Baseline OLS Regression Model 27
6.1.1 Baseline Regression Model Without Control Variables 27
6.1.2 Baseline Regression Model With Control Variables 28
6.2 Panel Data Model 29
6.2.1 Panel Data Model Without Control Variables 29
6.2.2 Panel Data Model With Control Variables 29
6.3 Time-Varying Parameter (TVP) Model 30
6.3.1 TVP Model Without Control Variables 30
6.3.2 TVP Model With Control Variables 34
6.4 Volatility Transmission GARCH Model 37
6.4.1 Volatility Transmission GARCH Model Without Control Variables 37
6.4.2 Volatility Transmission GARCH Model With Control Variables 39
7 Summary of Obtained Results 40
7.1 Summary for Each Sector 41
7.1.1 CAC Oil and Gas (FROG) 41
7.1.2 CAC Health Care (FRHC) 42
7.1.3 CAC Utilities (FRUT) 42
7.1.4 CAC Consumer Service (FRCS) 43
7.1.5 CAC Financials (FRFIN) 43
7.1.6 CAC Technology (FRTEC) 43
7.1.7 CAC Basic Materials (FRBM) 44
7.1.8 CAC Industrials (FRIN) 44
7.1.9 CAC Consumer Goods (FRCG) 45
7.2 Summary Table 45
8 Conclusion and Recommendations 46
8.1 Conclusion 46
8.2 Limitations and Recommendations 47
9 Bibliographical References 51
10 Appendixes 57

Table Index

Table 1: Baseline OLS Model Results Without Control Variables 27
Table 2: Baseline OLS Model Results With Control Variables 28
Table 3: Panel Model Results Without Control Variables 29
Table 4: Panel Model Results With Control Variables 30
Table 5: TVP Model Results Without Control Variables 30
Table 6: TVP Model Results Significant Dates Without Control Variables 32
Table 7: TVP Model Results With Control Variables 34
Table 8: TVP Model Results Significant Dates With Control Variables 35
Table 9: GARCH Model Results Without Control Variables 37
Table 10: GARCH Model Results With Control Variables 39
Table 11: Summary of Results 45

Figure Index

Figure 1: Line Plots of Sectoral Indices Prices.....19
Figure 2: Line Plots of the Market Rate Index Price Level and LOG Returns 19
Figure 3: Line Plot of USD/EUR Foreign Exchange Rate Level.....20
Figure 4: Line Plots of Control Variables 21

Appendix Index

Appendix A - Timeline of France's History 57
Appendix B - Index Company Breakdown 58
Appendix C - Line Plots of Sectoral Indices LOG Returns 60
Appendix D - Line Plot of the Market Index and Average Sector Volatility 61
Appendix E - Line Plot of USD/EUR Foreign Exchange Rate Volatility 62
Appendix F - Statistic Data Descriptions 63
Appendix G - Panel Model Time Fixed and Two Way Fixed 64
Appendix H - TVP Model Results Graphs Without Control Variables 65
Appendix I - TVP Model Results Complete Table With Control Variables 67
Appendix J - TVP Model Results Graphs With Control Variables 68

1 Introduction

The modern financial environment of the 21st century is the result of centuries of growing interconnection between global economies. As emphasized by the International Monetary Fund (IMF), globalization has largely been driven by technological advancements, which have largely reduced transportation and communication costs, which in turn has facilitated cross-border capital flows (IMF, 2015). Today, capital markets such as Euronext, the pan-European market home to over 1.800 listed issuers, host 6,3 billion Euros of market capitalization (Euronext, 2025). These substantial flows dictate the growing integration of national financial markets into global systems, where domestic dynamics are increasingly shaped by international.

This dissertation's objective is to explore the role of international factors in shaping the domestic equity market of France, focusing on the impact of the USD/EUR foreign exchange rate. By disaggregating the French market into nine key sectors, the study explores whether specific industries are more exposed to foreign exchange (FX) fluctuations, and whether the volatility of these exposures is stable or time-varying. To capture these dynamics, a comprehensive econometric framework analysis is employed with four underlying models. Baseline OLS regressions are first run at the sector level followed by an aggregate panel data model combining cross-sectional and time decisions. The central analysis is conducted with a time-varying parameter (TVP) model to account for observe shifting FX sensitivities and lastly the GARCH model assesses the volatility transmission of FX to equity returns. In order to improve the explanatory quality of the models' results three variables of control were included: a market rate representing the French economy as a whole, an inflationary control variable and a monetary policy variable to control for movements in the ECB's key rate. Collectively, the models provide complementary views of how exchange rate movements influence both the observed price levels and the risk profile of French sectoral equity markets.

Central to the impact the USD/EUR FX rate holds on this market is the process of globalization, defined by the IMF as the "aggregate concept that refers to increasing global linages created through cross-border financial flows" (Prasad et al., 2003). French economist Henri Bourguinat further emphasized this process with his theory on the three D's: Deregulation, Decompartmentalization and Disintermediation (Lepeltier, 2004). The first can be understood as limiting regulations which would restrict the movement of capital flows. Decompartmentalization refers to breaking down the segmentation between national markets. The final D restricts the presence of traditional financial intermediaries to allow investors to directly invest or borrow capital. Together, these forces have created an environment in which domestic financial markets are inseparable from global dynamics.

Closely related to globalization is the concept of financial integration, which the IMF defines as being “an individual country’s linkages to international capital markets” (Prasad et al., 2003). Globalization captures the global connections at an overarching economic standpoint while financial integration emphasizes the extent to which a specific country (in this context France) is exposed to and participates in international flows of capital and financial risk.

Another term which must be defined is economic integration and its diverse levels as they are fundamental to understand as they define the different formal “agreements between countries that include the elimination of trade barriers [such as taxes, limits, rules and laws] and aligning monetary and fiscal policies” (Corporate Finance Institute, 2024). Different levels of economic integration, ranging from free trade areas to complete monetary unions, shape how exchange rate movements transmit into national economies. All three concepts work jointly in explaining the interconnectedness of today’s financial markets.

In the context of the multitude of factors influencing global economies, exchange rates are one of the most significant channels through which this interconnectedness translates into domestic financial markets. The USD/EUR currency pair, as the most traded currency pair globally with a year over year increase in 2025 of 97.1 billion US Dollars (Foreign Exchange Commitee, 2025), is particularly relevant for France given its strong commercial and financial ties with both the Eurozone and the United States. Previous research has demonstrated equity markets to experience exchange rate exposure, however the net impact varies on the country, sector and period of time studied (Jorion, 1990) (Bartram & Bodnar, 2005). When studying this problematic, evidence at the sectoral level in France is unfortunately limited. The gap in the literature is important to fill as a sectoral level study allows to observe differences in industries’ pricing power, internalization levels and FX hedging practices.

A number of micro and macro-level mechanisms sway exchange-rate movements to domestic revenues, stock prices and asset returns. First, the Exchange Rate Pass Through (ERPT) represents the extent to which changes in an exchange rate are reflected in import or consumer prices and how they cascade down to firm revenues and profits (Campa & Goldberg, 2004). Empirically, ERPT is typically partial and differs across countries, underlying consumer goods and services as well as time horizons. Second, a company or sector’s Pricing-to-Market (PTM) ability determines how strongly it will be impacted by exchange rate movements when preserving profits or market share (Krugman, 1986). By contrast, the Dominant Currency Pricing (DCP) paradigm emphasizes that the US Dollar, among a small pool of leader currencies, is commonly used to invoice international transactions and therefore influence global prices and quantities together with co-movements in trade and asset prices (Gopinath et al., 2020). Related to the DCP mechanism is the global Dollar cycle tendency in which the US Dollar dictates global financing conditions through multi-year cycles. This in turn provides a macro-financial channel by which the US Dollar can

propagate shocks beyond pure trade effects (Bruno & Shin, 2014) . The final mechanism which summarizes them all is the presence of Global Value Chains (GVC) which increase cross-border trade relationships and categorize countries and sectors by type of activity (Timmer et al., 2014). A given firm's position inside a GVC, from the provider of raw materials to the final exporter, affects how exchange rate movements transits into costs and revenues.

The contribution presented today aims to challenge the following research question: How do USD/EUR exchange rat movements transmit into French sectoral equity returns, both in terms of return sensibilities and volatility persistence? The paper answers the problematic both empirically, as it provides new evidence on the heterogenous FX exposure of French sectors, and methodologically, as it utilizes different econometric approaches. The findings are relevant not only for investors managing multi sector portfolios and their global FX risks but also for policymakers concerned with the stability of financial markets when taking decisions, especially in a monetary union like the Eurozone France belongs to.

The work will be organized in the following way. In the subsequent section, the literature review will uncover the context of the proposed research questions well as the previous research conducted on the different impacting mechanisms and empirical studies. Before diving into the data of the study, a bridge between the literature review and the heart of the analysis is presented in the Conceptual Model and Research Hypothesis section, detailing the exchange rate sensibilities sector by sector. Next, the Contextualization section will provide information on the collected data and how it was selected as well as some descriptive statistical information about the data. The Methodology section will explain for each model the reasons why they were selected and the assumptions and formulas they require. These sections all lay the setting for the results and interpretation section which details for each model the results of the analysis both with and without considering the macroeconomic control variables. The quantitative analysis was conducted using Python and the repository of the scripts can be found at the author's GitHub[1]. The final pages present a summary of the obtained results per sector before finally concluding the thesis, identifying the limitations and some recommendations for future works.

[1] Please find the repository of the dissertation's Python code at this following GitHub link: https://github.com/mlahitette/FX-sector-analysis-thesis

2 Literature Review

2.1 Why Study Foreign Exchange Rate Exposure in French Sectors

Exchange rate fluctuations are a central determinant of asset pricing and firm value in economies. Previous literature defines "exposure to currency risk" as the sensitivity of a firm's or underlying asset's value to unexpected exchange rate changes (Adler & Dumas, 1984). Despite the theoretical relevance of foreign exchange rates' impacts on equity markets, an "exchange rate exposure puzzle" persists in which empirical studies often find fewer significant exposure estimates than researchers expected, even in highly globalized economies (Bartram & Bodnar, 2005). Several factors have been examined to explain the discrepancy, of which can be mentioned the heterogeneity of exposures across firms and sectors, the use of currency hedging financial instruments and the episodic nature of FX shocks, as seen in times of crisis or global financial stresses (Dominguez & Tesar, 2005).

Taking on France as the subject to explore how its financial markets interact with foreign exchange movements makes for an interesting case study. France is a highly developed nation that has been an international pillar over several centuries. France acts a global partner for many countries with important international sales in a variety of sectors such as luxury goods, pharmaceuticals and aerospace. It holds several trade and economic agreements ranging from highly economically integrated, as a member of the economic and monetary union of the Euro Zone, to its customs unions with Turkey, Andorra and San Marino, as well as its CETA Free Trade Agreement with Canada. In relation to its exposure to the US Dollar, the US is France's second-largest import partner, and its largest outside of Europe (The Observatory of Economic Complexity, 2023). At the same time, several firms showcase a more important domestically oriented market, with industries in media and utilities. Exploring sector-level FX exposure for France therefore provides valuable insights into understanding how globalization, Euro area economic integration and equity markets performances combine to shape financial currency sensitivities.

2.2 France's Integration in Global Markets

France's international economic integration and commercial trade presence has been predominant in the world since the 19th century. In 1850, it represented 10% of the world's imports, being one of the major actors in international trade at the time (Bécuwe & Blancheton, 2011). As for France's domestic financial trading market, its first stock exchange dates to 1540 in Lyon and the Paris Stock Exchange was legally instituted in 1724 (Ministère de l'économie, n.d.).

Modern integration for France accelerated through European institutions. The Treaty of Rome was signed with the creation of the European Economic Community (EEC) in 1957 which led to several

directives along the way towards the official introduction of the Euro in 1999 and put into active circulation in 2002 (Chagnau et al., 2023). The creation of Euronext in 2000, through the merger of the stock exchanges of Paris, Amsterdam and Brussels, represented another crucial step in the continent's financial integration as the first integrated pan-European stock exchange (see Appendix A). These decisions create the context that reduced intra-EU FX risk, and that help explain why today the USD/EUR exchange rate is the primary FX rate French equity markets are exposed to.

An honorable contribution to understanding France's financial and economic integration is the research provided by prestigious French universities professionals, Le Bris and Hautcœur (2010). They replicated the CAC40 index, the largest index of blue-chip firms from the Paris Stock Exchange, from 1854 to 2007, whose methodology proved to be "more consistent with French financial and economic history". By using several determining factors to recreate the index, they were able to use it to measure France's financial markets performance and compare it to the real CAC40 during the years it existed. Their methodology demonstrated how French equity performance has historically followed major global and domestic cycles, booming during the 19th century but lagging in the 20th, due to wars and inflation.

2.3 Measuring Globalization

Taking globalization into account as a determining factor of capital markets and world economies is one thing, but measuring the multidimensional factors of globalization is a challenge for economists. However, the New Globalization Index (NGI) developed by Vujakovic (2010) expands upon earlier indices, focused on economic, political and social parameters, to also incorporate distance factors to distinguish globalization from regionalization. The principal component analysis methodology demonstrated that financial factors (such as Foreign Direct Investment flows and portfolio stock) majored at 37% of the variation in globalization scores, highlighting the weight of financial openness in measuring globalization. Overall, France ranked as the 15th most globalized country in this index.

Another commonly used benchmark in measuring globalization is the KOF Globalization Index. Gygli and fellow researchers accounted for 43 variables in structuring this revised index, while also distinguishing between "de facto globalization" [which]measures actual international flows and activities, [and] "de jure globalization" [which] measures policies and conditions that, in principle, enable, facilitate and foster flows and activities. France was ranked as the 12th most globalized country in the world, highlighting its high levels of trade, political integration and financial globalization (Gygli et al., 2019).

Measuring quantitively the level of globalization determines the aggregate exposure and economic integration each country has in relation to the rest of the world. Both these studies support the view that

France is a highly globalized nation, especially on the trade and financial axis, providing a strong rationale for examining how exchange rate fluctuations transmit into its equity markets.

2.4 Transmission Channels of Foreign Exchange Shocks

Exchange rate movements affect domestic equity markets through multiple transmission channels, which often operate simultaneously. Theoretical and empirical research generally distinguish between trade channels and financial channels.

2.4.1 Trade Channels

Globalization has reshaped trade and manufacturing mechanisms, reinforcing competitive advantages across different activities and sectors in different countries. The development of GVC has increased inter-dependence on trade partners for different activities. Timmer et al. (2014) explain that "international fragmentation, as measured by foreign value-added content of production, has rapidly increased since the early 1990s" which raises the foreign value-added share of costs and consequently the sensitivity of margins to currency shocks. Since then, developed nations have concentrated their share of activities carried out by high-skilled workers whilst relocating their unskilled-labor-intensive production activities to lower-wage and developing countries. Within GVC, high foreign-value-added goods and imported-input dependence amplify sensitivities to currency movements, with direct implications for pricing and invoicing dynamics (Timmer et al., 2014).

A substantial share of international trade is still priced in US Dollars, even when the US is not a counterparty in a given transaction, a phenomenon known as the dominant currency paradigm (DCP). As Gopinath et al. emphasize, "the dollar exchange rate quantitatively dominates the bilateral exchange rate in driving trade prices and volumes" (Gopinath et al., 2020). Under this paradigm, even when Euro-area firms hedge their currency exposure, US dollar movements propagate into Euro-area prices, quantities, and equity cash flows.

Beyond GVC and DCP, a large body of literature confirms both theoretically and empirically that foreign sales intensity is one of the strongest predictors of exchange rate exposure. Jorion (1990) was among the first to demonstrate US multinationals with larger foreign revenue shares experienced significantly higher sensitivities to exchange rate movements in their stock returns. Subsequent works by Dominguez and Tesar (2005) reinforced this conclusion in a cross-country sample of eight non-US countries, remarking that "exposure is more prevalent in [...] firms engaged in international activities (measured by multinational status, holdings of international assets and foreign sales) (Dominguez & Tesar, 2005). Two studies focusing on Japanese equity markets, one by He and Ng and the other from Douklas, John and Hall, demonstrated

empirically the hypothesis that multinational and high-exporting firms experienced a greater exchange rate exposure effect in comparison to firms focused on domestic markets with low-exports (He & Ng, 1998). Notably, it also went on to confirm the foreign-exchange-rate premium to be a significant component of Japanese stock returns, that with asset pricing tests it showed currency risk could be priced and above all that currency exposure is time varying (Douklas et al., 2003).

Invoicing practices play a crucial role in shaping the degree of pass-through from exchange rates to domestic prices and equity returns. In a given transaction, the currency of invoicing determines how revenues and costs translate into reported earnings, which all impact a firms' stock price. Firms in the Euro area benefit from an important share of invoices priced in Euros, more precisely 51.7% of Extra-euro area imported goods and 61.5% of imported services were invoiced in Euros (Özyurt, 2015). When a higher share of imports is priced in the local currency, it weakens the elasticity of prices to exchange rate movements; However, when contracts are denominated in US Dollars, exposure to the currency is more acute, as potential appreciations raise import costs while leaving Euro-denominated revenues unchanged. Together, this evidence demonstrates that foreign sales exposure, combined with trade intensity and reliance on US Dollar invoicing, are crucial factors determining how firms respond to exchange rate fluctuations, both operationally and in their balance sheets.

2.4.2 Financial Channels

While trade intensity and invoicing contribute to the operating exposure of firms, financial channels transmit exchange rate movements through balance sheets, hedging activities and funding markets. Research on the exchange rate exposure of French firms following the circulation of the Euro demonstrated a significant number of firms experienced less exchange rate exposure as well as a reduced use of foreign currency derivatives in hedging operations, compared to when the Franc was used (Nguyen et al., 2007). The Euro's currency consolidation resonates indeed with the goal behind the European monetary union: to reduce overall exposure between European trade partners. However, France's exposure to its transatlantic partner remains very relevant to firms' operational and currency risk management, as well as their funding and capital structures.

As previously mentioned, exchange rate movements ripple into companies' asset and liability structures with trade invoices, but they also affect debt obligations or funding inputs when dollar-linked, as a stronger US Dollar increases debt-servicing costs and reduces equity returns. Financial institutions are at risk of balance-sheet mismatches as, demonstrated by Choi, Elyasiani and Kopecky (1992), exchange rates and interest rate risks are significant determinants of bank stock returns. These risks are difficult to fully diversify to protect capital flows and inevitably a structural feature of financial markets, persistent in the

Feldtsein-Horioka paradox where correlation exists between domestic savings and investments despite globalization (Rogoff, 2001).

Despite these challenges, French firms are adamant users of foreign currency derivatives in the goal of mitigating these risks. In their study on 176 large, non-financial French firms, Clark and Meftehb (2007) exposed the use of derivatives as a significant determinant of French firm value, especially for firms with higher levels of exposure reaching over 1.5 times higher usage and 5.5 times higher for firms with exposure to depreciations of the Euro rather than appreciations. The use of these derivative instruments is heavily related to movements of underlying currencies as well as economic and political events.

Funding markets also contribute heavily to the exposure of underlying firms to exchange rate movements. The "global Dollar cycle" as described by Bruno and Shin (2014) explains how low US interest rates encourage international financing and risk taking, while US Dollar appreciations tighten funding conditions abroad. This concept paired with the DCP principle presents the US Dollar as a dominant currency when it comes to cross-border financing and "the importance of gross capital flows between countries in determining financial conditions". This creates vulnerability for French corporations and financial institutions, creating sensitivity to global dollar liquidity through international lending books.

All in all, financial channels complement trade and economic channels in transmitting and determining exchange rate exposure and effects on firms. They shape how strongly FX fluctuations pass through to operational factors, in costs and prices, financial factors, in firms' financial statement and capital flows, and ultimately economic factors, in sectoral or national performance.

2.5 Exchange Rate Pass-Through and Sectoral Effects

ERPT can be referred to as the degree to which exchange rate fluctuations translate into import pricing, producers' pricing and ultimately the pricing of consumer goods and services. ERPT is crucial to understand how flows from transmission channels translate into margins and performances of companies.

The existing literature, with papers from Campa and Goldberg for example, describes ERPT as being incomplete due to the diluting effects between a change of exchange rate and the margins eventually collected by a company. A 10% appreciation of the US Dollar against the Euro would not automatically translate to a 10% increase in import price, the increase would be muted by financial hedging, invoicing practices, pricing-to market behavior and contractual rigidities. ERPT also declines along the pricing chain, reducing its impact the closer it reaches final consumer goods' prices. Campa and Goldberg (2004) estimate the ERPT of "import prices [...] reflect 46% of exchange rate fluctuations in the short run, and nearly 65% over the long run" in OECD countries, compared to US import prices at 23% in the short run and 42% over the long run. More specifically in the Euro area, Ortega and Osbat (2020) demonstrated ERPT to extra-

Euro area import prices having significantly declined since the late 1990s, with total import prices for goods and services levels today for France in the 20 to 30% range and consumer prices estimates close to zero. The downward trend of ERPT can be explained by the implementation of the Euro and firms' abilities to insulate prices through PTM practices, which both mitigate the average sensitivity to FX fluctuations. The PTM phenomenon can be defined as "foreign firms maintaining or even increasing their export prices to the US when the [US Dollar] rises" and it provides "evidence on the role of market structure in international trade" (Krugman, 1996). Under DCP, sticky prices in the invoicing currency support PTM in mitigating short run ERPT.

Empirical literature demonstrates ERPT to have substantial heterogeneity. Hahn (2007) finds that "the combined output and price sensitivity to an exchange rate shock differs across sectors and seems to be above average for instance in the [main industrial groupings'] capital and intermediate goods sectors and below average in the consumer goods sector". This would explain how manufacturing sectors like basic materials or automobiles are significantly more exposed to shifts in the USD/EUR than the utilities or consumer services sectors, which tend to be more domestically oriented. Additionally, Berman, Martin and Mayer (Berman et al., 2012) demonstrated in their study on French firms how firms with higher market shares exhibited lower ERPT in their export prices as well as increasing their price markups and reducing output volumes in reaction to a currency depreciation, which was consistent with PTM behavior.

In accordance with the DCP, ERPT is impacted more by US Dollar movements than bilateral exchange rates. Boz et al. (2020) state that "countries invoicing more in US Dollars tend to experience greater [USD/EUR ERPT] to their import prices" (Boz et al., 2020). Strong effects of pass-through are observed in margins and profitability more than in quantities and volume, which explains why average sector Betas tend to be modest but significant during crises or when US Dollar commodity cycles amplify input costs, especially in commodity-dependent markets like Oil and Gas (Hofmann et al., 2023). However, in the short to medium term operating cycle, "international prices, in their currency of invoicing, are not very sensitive to exchange rates at horizons up to two years" (Gopinath, Handbook of International Economics, 2015), leaving enough room for companies to adapt to these currency movements. Therefore, exposure to exchange rates and its pass-through differs vastly across sectors due to trade intensity, market share, PTM capabilities and hedging practices.

2.6 Monetary Policy and Global Liquidity

FX exposure to equity markets cannot be fully understood without considering global monetary policy decisions and geopolitical factors, which both amplify the volatility of these markets.

Central banks such as the ECB and Fed determine policies which shape the global financial landscape. Rey (2015) describes a "global financial cycle" in which US monetary decisions, especially Federal Reserve decisions, dictate capital flows and risk premia on a worldwide scale, regardless of countries' exchange rate regimes. Euro area policies also contribute to global financial dynamics with their monetary policies, especially when the proposals are unconventional, such as negative interest rates or quantitative easing measures. Quantitative research on the effects of the 2015 quantitative easing program launched by the ECB demonstrates the impact of the asset purchase program on European asset prices and credit conditions, lowering sovereign yields, with spillover effects beyond the intended targeted assets of sovereign bond yields. Notably, French financial markets experienced dramatic reactions at each announcement date of the program, with the 10-year sovereign yield rate OAT ("Obligations Assimilables du Trésor") dropping from 0.75 to 0.6 on the 22nd of January 2015 (Altavilla et al., 2015). These studies support the fact that broader cycles of global liquidity and monetary policy decisions impact exchange rate movements.

Geopolitical shocks transmit risks to markets and contribute immensely in international relations. The Geopolitical Risk Index developed by Caldara and Iacoviello (2022) demonstrated that "higher geopolitical risk foreshadows lower investment and is associated with higher disaster probability and larger downside risks to GDP growth" in addition to increasing markets' volatility and lowering stocks' returns. Recent global conflict such as the war in Ukraine and tensions in the Middle East have had drastic effects on the financial market and disrupted energy supplies of oil, gas, and other raw materials (Gallant, 2023). Back in 2022, three major banks of France (BNP Paribas, Société Générale and Credit Agricole) lost many Russian clients, resulting in immediate share price declines (Sadgui, 2022). These consequences demonstrate how geopolitical shocks can trigger risk spillover into equity markets.

All in all, both monetary policy and geopolitical actions act as nonlinear amplifiers of ERPT to financial markets and create conditions under which FX exposure becomes episodic and crisis driven. These factors contribute to understanding how exposures can appear muted on average yet spike sharply in periods of global stress, paving the way to examining how such dynamics unfold across France's economic sectors.

2.7 Synthesis and Research Gaps

The theoretical and empirical evidence highlight several consistent findings. Firstly, it defines France as a highly globalized economy, thanks to its ties to its European partners but also other international markets. As part of the Euro monetary union, France's primary external FX driver is the USD/EUR exchange rate, in part due to its direct and positive trade relationship with the US, but also due to the ripple effect of the US Dollar acting as a DCP. Secondly, exchange rate exposure affects economies through different

transmission channels regrouped by trade channels (including GVCs, invoicing practices and foreign sales intensity) and financial channels (including balance sheet effects, hedging strategies and global US Dollar funding). Thirdly, ERPT was described as incomplete, diluting pass through by PTM behavior and invoicing practices, yet still highly relevant in commodity-dependent sectors. Finally, monetary policy decisions and geopolitical events were demonstrated as FX exposure amplifiers, producing episodic volatility.

Despite the existence of a large body of literature, some important gaps seem to emerge. Many studies focused on aggregate indices isolate their scope on either US, Asian or European markets, with limited systematic work isolating French sectoral equity markets. Sectoral heterogeneity is often masked by aggregation, and while some studies account for firm-level sensitivities, rare are the papers focused on sector-level equity dynamics. Moreover, few contributions to literature use a multi-model approach with time-varying parameter models and GARCH frameworks to French markets.

The goal of this thesis aims to address the gaps in literature combining several economic approaches with a sector-level focus on the French CAC indices across a 9-year period. Controlling for the market rate returns, inflation and ECB policy rate changes solidifies the analysis to observe how FX shocks propagate into sector level equity returns, and how exposure evolves over time.

3 Conceptual Model and Research Hypothesis

Now that the existing academic research has been explored, it is important to link the theory to the purpose of this paper before introducing the data and the models. To explore the impact that the USD/EUR FX rate has on France's domestic financial markets, the conceptual model assumptions need to be defined. To have a complete understanding of the different influential sectors in France's economy, nine different sectors can be identified as the following: (1) the Oil and Gas sector, (2) the Health Care sector, (3) the Utilities sector, (4) the Consumer Service sector, (5) the Financials sector, (6) the Technology sector, (7) the Basic Materials sector, (8) the Industrials sector and (9) the Consumer Goods sector. Since each economic sector selected operates distinctive activities, their fundamental and practical exposures to international trade, FX rate dynamics and global pricing power sensitivities vary. This section will explore per sector the different assumptions and research hypothesis.

3.1 The Oil and Gas sector

The French Oil and Gas sector, which includes internationally known companies such as TotalEnergies, is recognized for its petroleum services. France also benefits from alternative energy sources such as nuclear at over 40% of its total energy supply (IAE, 2023) as well as renewable sources such as biofuels, hydraulic,

wind and solar, diversifying its energy sources and mitigating the risk of over-reliance on the Oil and Gas industry. However, oil remains its second-largest source of energy at 29% of total energy consumption and natural gas the third at 13% (IAE, 2023).

As "most commodity prices are denominated in US Dollar" (Rees, 2023) France is therefore exposed to global oil prices and its downstream equity values are sensitive to changes in the USD/EUR exchange rate. This creates the phenomenon called the Dominant Currency Pricing (DCP), in which a stronger US Dollar could raise oils costs and prices in Euros, would compress margins and induce negative FX Beta episodes (Gopinath et al., 2020) (Georgiadis & Schumann, 2021). As explored in Campa and Goldberg's working paper series, exchange-rate fluctuations (USD/EUR) affect Euro-denominated cash flows directly, especially when oil price volatility spills into equity volatility via pricing channels (Campa & Goldberg, 2002). Reactions in stock returns in this sector also "depend on the source of the underlying cause of [...] oil price change" (Kang et al., 2015) whether they stem from supply-side or demand-side shocks, which can cause non-linear effects that can make FX Betas seem muted while producing sharp return spikes.

Given the context of these previous elements, it can be hypothesized that the Oil and Gas's equity index return in France would demonstrate sensitivity to USD/EUR movements, influenced mainly via US Dollar-pricing of crude oil and global commodities (H1).

3.2 The Health Care sector

Due to its large sales outside of France, the Health Care sector stands out as one of the most internationally exposed sectors, with a large distribution from patented drugs, pharmaceuticals and medical goods to skincare and luxury healthcare products. Companies such as Sanofi highlight France's position as a global pharmaceutical leader with more than double the sales in the US than Europe in 2024, at 19,986 million Euros compared to 9,027 million Euros (Sanofi, 2025). Worth mentioning as well in this sector is the vision care company EssilorLuxottica, which bridges a niche dual positioning in both the health care and luxury sector, and acts by far as the global leader in this market (Moody's Ratings, 2024). The activity of producing differentiated products, as many other health care companies with patented drugs for example, allow them to uphold significant margins but also maintain a "pricing-to-market" from its foreign suppliers (Krugman, 1986). This "pricing-to-market" concept can create FX exposure in returns. Consequently, when the US Dollar appreciates against the Euro, revenues earned abroad would translate more favorably in Euros for the Health Care sector, in addition to the benefits of its pricing power in shielding profit margins from potential cost pressures.

Accounting for both strong international presence, large US Dollar revenues and pricing power in this sector, the hypothesis for the French Health Care index returns should show positive exposure to USD/EUR (H2).

3.3 The Utilities sector

Contrary to the higher exchange rate exposure of the previous two sectors, the Utilities sector characterizes itself as a more domestic market focusing itself on its local market. France's electricity balance has been consistently offset its imports with its exports since 2005, with the expectation of the year 2022, demonstrating that it does not rely on other countries to fulfil its electricity needs (RTE, 2025). The lack of competitive imports to supply France's electrical needs demonstrate that "the less competitive the domestic distribution sector [is], the lower the pass-through to consumer prices" (Ortega & Osbat, 2020).

Although, since the Utilities sector presents some of the same exposure faced in the Oil and Gas sector with its underlying raw materials as most of the commodities are traded in USD, some spillage effect can impact commodity price swings in the local currency and can affect the returns of this sector (Hofmann et al., 2023). Still the companies in this sector in France tend to diversify their energy sources to mitigate the over reliance on one type of energy, such as Engie with energy production in geothermal energy, wind energy, solar energy, biogas, green hydrogen, biomass and on-site utilities (Engie, 2025).

Finally, it was demonstrated in Dominguez and Tesar's 2001 working paper on exchange rate exposure that France's "Electricity, Gas and Water" sector to be negatively coefficient at the 5% level of US Dollar exposure (Dominguez &Tesar, 2001). In application to this paper, the hypothesis can estimate Utilities' equity returns to be weakly or negatively exposed to the USD/EUR rate due to its domestic focus (H3).

3.4 The Consumer Service sector

Consumer Services has the particularity of being the most diverse sector as the services in question englobe different sub-sectors such as tourism (Air-France-KLM), retail (Fnac Darty), media (Canal +), entertainment (Compagnie des Alpes) and leisure (Pierre et Vacances) among others. Some of these sub-sectors like tourism are intrinsically linked to international events and exchange-rate sensitivity with a distinctive DCP in US Dollars. Ding and Timmer highlighted that "bilateral exchange rate movements and orthogonal [US Dollar] movements are important drivers of international tourism flows" and quantitively demonstrated that "when the origin-country currency depreciates relative to the destination-country currency by 10%, bilateral tourism flows decline by 1.1%" without controlling the US Dollar exchange rate (Ding & Timmer, 2022). However, outside tourism related sub-sectors, many other segments of Consumer

Services are domestically oriented, such as television and French media companies. The national nature of these sub-sectors makes their equity exposure to FX smaller than "firms engaged in international activities" (Dominguez & Tesar, 2005).

Consumer Services differs from Consumer Goods in their pricing mechanics as "services prices are stickier than goods prices" which was demonstrated in a previously mentioned ECB study on European counties where "[direct and indirect import content in consumption] for services [was] small and remained broadly unchanged over the period under review" of 14 years (Ortega & Osbat, 2020). The low level of ERPT demonstrated in the paper goes to show the market and pricing power Consumer Services hold.

Therefore, with such a diverse sector, its aggregate FX sensibility is expected to be episodic and short-lived market shocks, mainly correlated to touristic events and travel demand, indirectly linked to USD FX movements (H4).

3.5 The Financials sector

It is undeniable that the Financials sector, by nature of its activities, has structural exposure to USD/EUR movements in the French market, in addition to having a large international presence with prestigious institutions such as the Société Générale and BNP Paribas. Choi, Elyasiani and Kopecky demonstrated empirically that "exchange-rate innovations were significantly negatively related to bank stock returns", highlighting that exchange rate risk is a material factor of bank equity returns (Choi et al., 1992). This negative FX correlation can be explained by balance-sheet channels, the first being US Dollar funding pressures. As European banks often rely on US Dollar funding and maintain international lending books in several currencies, it makes them sensitive to global US Dollar liquidity cycles. In theory, "a lower [US] federal funds rate causes more lending and more risk taking abroad" which foreign banks leverage and the inverse is true when the US Dollar strengthens (Bruno & Shin, 2014).

Beyond funding channels, exchange rates also impact the Financials sector with interest rate differentials and funding spreads. During the Euro-area sovereign debt crisis of 2011 and 2012, "US Dollar funding became less available to Euro-area banks [and] institutions were required to depend on cross currency swaps to manage their FX exposure and liquidity" (O'Donnell et al., 2019). This reliance on derivatives markets to hedge funding pressures demonstrates how monetary policy divergence link to financial institutions' profitability.

Accordingly, the Financials sector can be hypothesized to experience negative USD/EUR Beta due to inverse hedging dynamics, with sensitivity amplified during global financial events, such as cross-currency basis spreads widening (H5).

3.6 The Technology sector

France stands out as the second-largest high-tech manufacturer in Europe, behind Germany, with €157 million of net turnover (Europea, 2025). Similarly to the Consumer Services sector, the Technology sector regroups different sub-sectors under its umbrella with companies in software (Dassault Systèmes), hardware (STMicroelectronics), information technology (Capgemini) and telecommunication (Avenir Télécom) among others. What these sub-sectors have in common is their reliance on global value chains and high degree of imported inputs, reaching almost 50 billion US Dollars in 2024 as the third-largest largest imported product in France behind vehicles and machinery products (Pangea, 2024). As studied by Timmer and his colleagues in their paper on international fragmentation, as measured by the foreign value-added content of production, France's developed nation has specialized itself in activities carried out by high-skilled workers, such as research and developing innovation, and therefore outsources "imported intermediaries from lower-cost countries", such as raw or processed materials and manufacturing labor (Timmer et al., 2014).

Often time, technology components are priced in the US Dollar currency, demonstrating DCP effects, which can create positive FX exposure even when firms hedge themselves against FX risk. Notably, Eurostat reports the US as the EU's largest importer of high-tech products, accounting for 28% of total EU imports (Europea, 2025). This would imply that several invoices could be priced in US Dollars, which would increase the ERPT to equity returns. However, technology-relevant sectors in Europe demonstrate significant pricing power as "consumer electronics and computers are immune to rising input prices" (Subran, 2021) demonstrating sticky pricing behavior even when input prices rise.

Combining both a high share of component imports priced in US Dollar, raising sensitivity to movements in the USD/EUR rate, with pricing-to-market strength from high-technology goods, lowering sensitivity to FX movements, the sector can hypothetically exhibit mixed or small average FX exposure on its equity returns (H6).

3.7 The Basic Materials sector

This following sector includes several raw materials and commodities such as chemicals, metals, construction materials and paper. World leading French company Air Liquide specializes in gases, technologies, industrial and health care services, and is present in 60 countries with over 4 million clients and patients (Air Liquide, n.d.-a). As Basic Materials firms are highly dependent on commodities commonly priced in US Dollar as previously demonstrated, the sector is not exempted from being exposed to US Dollar movements as they "have amplified commodity price swings, increasing the burden on non-

US economies" (Hofmann et al., 2023). As with other industries reliant on commodities, they are subject to exposure due to large imports from global value chains, often invoiced in US Dollar or other currencies.

Despite this, companies tend to seek out firm-level hedging to ERPT effects in their balance sheets. For example, Air Liquide details its FX hedging practices by executing centralized policy for managing and hedging FX and interest rate risks across its global operations, with the goal of mitigating FX sensibility (Air Liquide, n.d.-b). All in all, it can be hypothesized that the Basic Materials sector will exhibit exposure to USD/EUR movements through US Dollar denominated input costs and exported goods, whilst taming its effect thanks to firm-level hedging and sectoral heterogeneity (H7).

3.8 The Industrials sector

Behind countries like China and the US, France is considered to have the 10th largest industrials sector in the world, manufacturing 1,6% of global production output (Manufacturing Digital, 2025). Its Industrials sector is developed on all fronts, with internationally renowned companies in aerospace with Airbus, in defense with Thales and in transportation with Alstom. Notably, the aircraft and spacecraft industry were crowned as the top exporting sector at €17,1B in 2024 (The Observatory of Economic Complexity, 2023). In aerospace and many capital goods contracts, the pricing is typically done is US Dollar, as seen with Airbus specifically as "Aircrafts are typically invoiced in [US Dollars], of which 50% is naturally hedged by sourcing in [US Dollars and the] remaining 50% is to a large extent EUR and to a lower extent GBP denominated costs" (Pons, 2014). This creates a direct USD/EUR exchange rate transaction channel for listed industrial companies with large foreign order books, especially when commercializing large contracts such as aircrafts and machinery. Nonetheless, this effect can be muted with companies with larger European books such as transportation companies like Alstom with over half of its €200 B three-year pipeline concentrated in Europe (Alstom, 2025).

Similarly to sectors before, the Industrials sector is also dependent on an array of commodities such as metals and fuel, but also several imported-input components such as machinery components and electronics. As previously mentioned, the reliance on these resources increase the sensitivity to the US Dollar exchange rate due to its DCP.

It can be expected for the Industrials sector to exhibit heterogeneous exposure with a concentration for aerospace companies with a large share of US Dollar-invoiced contracts and muted effects for more domestically focused companies (H8).

3.9 The Consumer Goods sector

The final economic sector of Consumer Goods groups the most diverse array of sub-sectors discerning qualities amongst themselves with different types of clienteles, distribution volume, geographical presence, competition, manufacturing and therefore, dissimilar exposure levels to exchange rates. Consumer retail brands, including luxury brands such as Hermes, L'Oreal and LVMH, have large extra-EU sales, as much as 75% of sales generated outside Europe for LVMH (LVMH, 2025). Their strong market power puts them "in a more favorable position to pass on [...] cost increases to consumers, resulting in higher pricing power" (Zilien et al., 2023). PTM for luxury goods allows partial exchange rate pass-through, so margins and returns move with FX whilst quantities remain stable.

In contrast, food-processing firms such as Bonduelle, Danone and Fleury Michon operate in competitive domestic and international markets with thinner margins. These competitive conditions insulate global price volatility due to trade costs and policy barriers and in turn limits their ability to adjust margins when input costs or FX movements shift (Brander et al., 2023).

Automotive manufacturers such as Renault, Peugeot and Faurecia are characterized by heavy reliance on imported components. Import to price ERPT is greater in this market as demonstrated empirically in Turkcan and Ates' study concluding that "auto-parts (intermediate goods) have relatively higher pass-through rates than motor vehicle products (final goods)" (Turkcan & Ates, 2008).

At the aggregate level, Consumer Goods companies can be hypothesized to be positively exposed to USD/EUR movements through high foreign sales as well as US Dollar-priced inputs and sales. The diversity in the sub-sectors and their target markets can however mitigate the aggregate index exchange rate exposure but still produce sharp daily equity reactions tied to shocks in input costs or demand for the sub-sectors with less pricing autonomy (H9).

Overall, it is clear that each sector's structure is unique and varies across distribution, sourcing and hedging activities. Analyzing each sector one at a time is crucial to understanding theoretical and practical sectoral dynamics and their hypothesized attitude in relation to the USD/EUR exchange rate before following suit into the quantitative analysis. The following section will define the collected data and its statistical description.

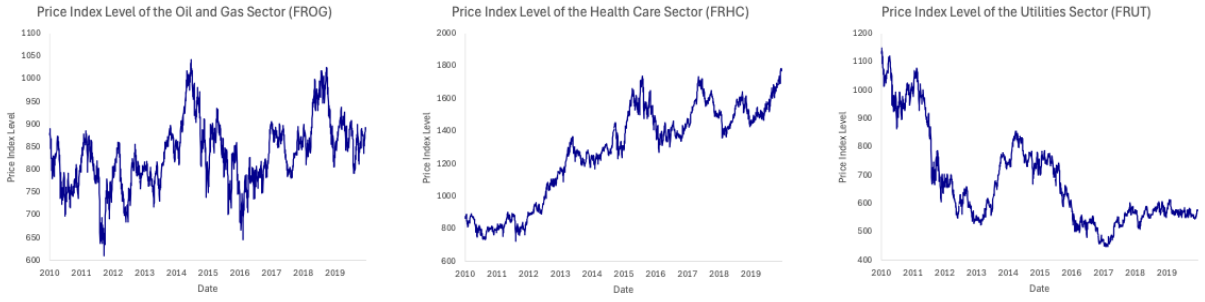
4 Contextualization

4.1 Collected Data

The focus of this paper relies on understanding the price returns dynamics of different sectoral indices under the influence of the USD/EUR exchange rate. France's key blue-chip index is known as the CAC40 index (PX1GR), which represents a market rate for France of its 40 top performing companies, similar to the US S&P500. Similar to the Euronext quoted index, there exists as well sectoral indices with the same 'CAC' designation, which evaluates the most performing companies of France in each sector. The underlying companies in these indices are periodically adjusted, as demonstrated in Appendix B which lists the companies present at the beginning and end of the data collection period. In the context of this study, the CAC40 will be used as the market rate and the CAC sector indices as the observables indices. The data for these indices was collected using the Investing.com financial market platform, for the time period of ten years between the dates of 04/01/2010 and 31/12/2019 using the following names and tickers:

- CAC Oil & Gas (FROG)
- CAC Health Care (FRHC)
- CAC Utilities (FRUT)
- CAC Consumer Service (FRCS)
- CAC Financials (FRFIN)
- CAC Technology (FRTEC)
- CAC Basic Materials (FRBM)
- CAC Industrials (FRIN)
- CAC Consumer Goods (FRCG)

Figure 1 shows the price evolution of these indices and Appendix C illustrates their logarithmic returns. Figure 2 below shows the price evolution and the logarithmic returns for the CAC40 French market index. In the context of the modelling section of this paper, we will only be observing the logarithmic returns as it makes more sense in the model.



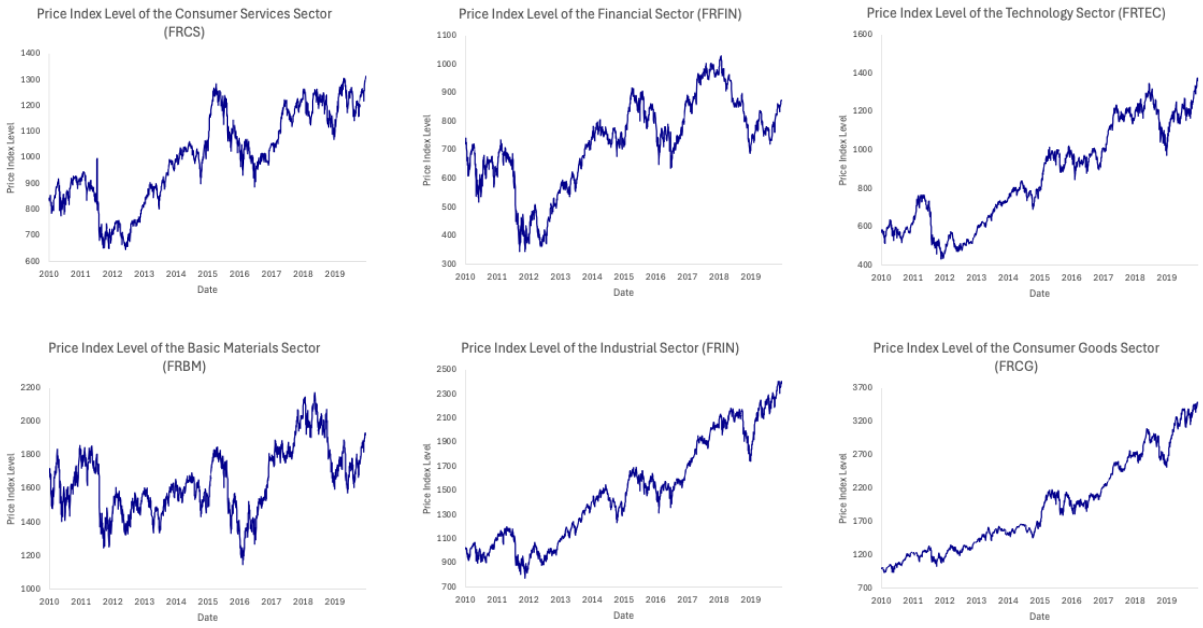


Figure 1: Line Plots of Sectoral Indices Prices

Source: Investing.com

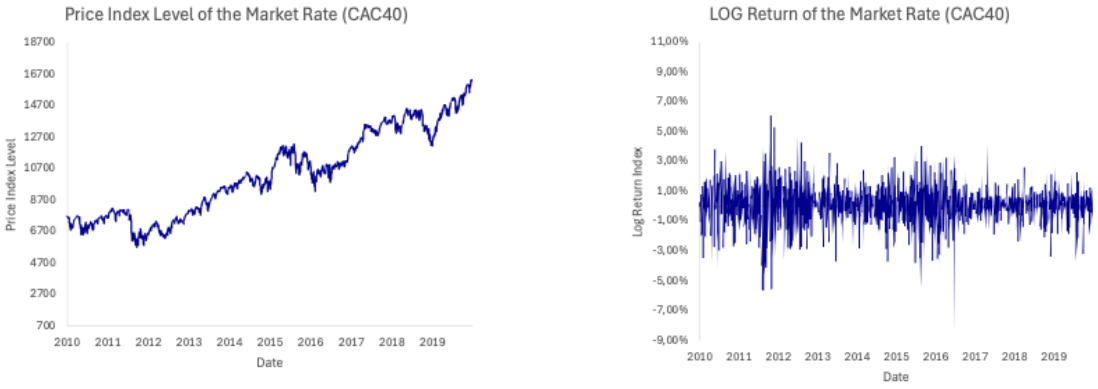


Figure 2: Line Plots of the Market Rate Index Price Level and LOG Returns

Source: Investing.com

Across the different models, the logarithmic returns will be modeled to analyze whether or not exchange rate movements translate into these equity indices. In addition, the volatility of these indices will also be included, especially in the GARCH model. Appendix D represents the 30-Day Rolling Volatility graph for the market rate and the average of the sectors. It can be observed that although the trends mirror each other, the average volatility of the sectors experiences a more muted effect.

In addition to the equity indices to be observed and modeled, the second main component of the analysis is the independent variable of the FX rate of the US Dollar against the EUR. Below the exchange

rate level is displayed in Figure 3 for the dame dates and was collected from the same source, and in Appendix E is represented the 30-Day rolling volatility. Over the period it can be observed that the FX rate varied significantly reaching as low as 0,6744 USD/EUR and 0,9627 USD/EUR at its highest point. This can be explained by major macroeconomic and geopolitical events which shaped these movements such as the Eurozone's sovereign debt crisis (2010-2012), the ECB's launching of its Quantitative Easing (QE) program (2015), the US's Federal Reserve's tightening cycle (2015-2018) and the trade tensions under President Trump's first mandate (2016-2019).

Figure 3: Line Plot of USD/EUR Foreign Exchange Rate Level

Source: Investing.com

Finally, the third data components of the analysis are the two macro-economic control variables. The first represents one of the three rates the European Central Bank (ECB) controls for the Euro Zone named Main Refinancing Rate (MRO). As the ECB decides directly monetary policies at an aggregate level for the Euro Zone, France's overall economy is directly dependent on these rates. In the context of this study, the MRO rate is the most relevant out of the three rates as it is the rate that defines the rate banks may borrow from the Central Bank. The data for the time period was collected directly from the ECB's official data portal website (ECB Data Portal, 2025). The second crucial control variable is the annual inflation rate of the French economy as inflation is another key determinant as it defines the economic cycle of a given country and therefore highly influences financial markets. The annual inflation data was collected from the Insee website (Insee, 2025). As seen below in Figure 4, both rates are plotted for the observed period. What is interesting to observe is how the French inflation and ECB MRO de-escalate in a similar manner for the first half of the period but diverge in the second half as France's inflation rises.

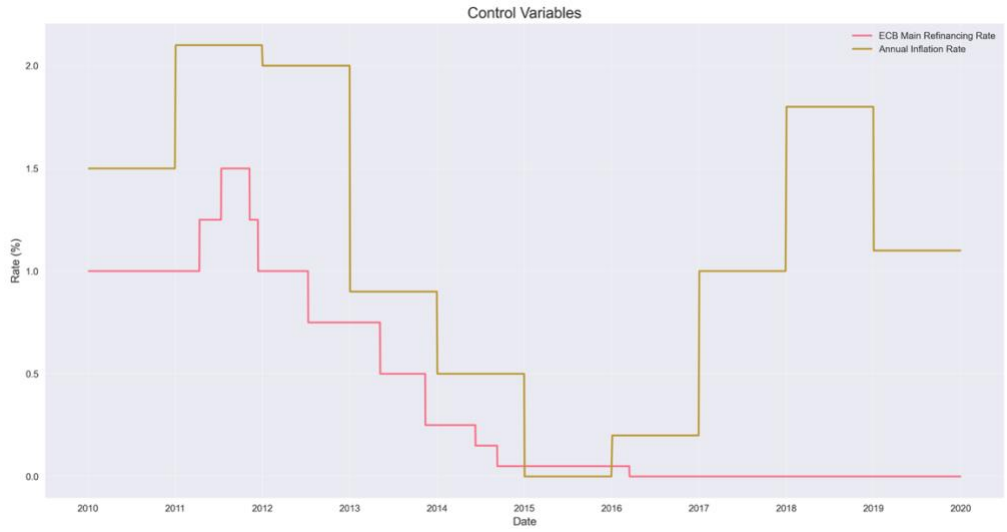


Figure 4: Line Plots of Control Variables

Source: ECB Data Portal and Insee

4.2 Data and Descriptive Statistics

Three different panels are presented in the Appendix F, annotated with Panels from A to C presenting a comprehensive statistical analysis including detailed information on the number of observations, the mean, standard deviation, percentiles, skewness and kurtosis of the data. Each panel presents a different data type: Panel A describes the indices returns, Panel B the foreign exchange rates and Panel C the control variables.

Appendix F shows that Panel A' indices data, there is the same number of daily indices returns during the same time frame totaling to 2 558 observations. It can be observed that the mean is very close to zero, which is expected for high-frequency returns. The standard deviation averages around 1,3% which is typical for daily volatility. The percentiles demonstrate that the index with the largest range is the FRCS index and the lowest is the FRCG index. As for the skewness of these observations, they are almost all slightly negative demonstrating a small left tail bias, with an exception for the FRFIN index, demonstrating a small right tail bias. The Kurtosis for six of the indices is below the critical value indicating that they are platykurtic, while the remainder are leptokurtic. Finally, for the Jarque-Bera test, all p-values are below the critical value of 0,05 demonstrating strong evidence against normality. It's important to note that the FRCS index, observed from the statistics in this table, has a highly elevated Kurtosis Jarque-Bera test level. Overall, this demonstrates the returns as not normally distributed, suggesting volatility clustering and extreme events, which is a standard observation in financial equities markets.

Panel B' FX rates data, there is the same number of daily observations as in Panel A. It can be observed that the mean is very close to zero, which is expected also for this asset class. The standard deviation averages around 0,06% which is much lower than the indices but expected as FX rates are

typically less volatile on a daily basis. The skewness of these observations is slightly positive demonstrating a small right tail bias. The Kurtosis for six of the indices is below the critical value of 3 indicating that they are leptokurtic. Finally, for the Jarque-Bera test, both p-values are below the critical value of 0,05 demonstrating strong evidence against normality. Overall, this verifies that the FX returns are much more stable than the indices returns but still not normally distributed.

Finally, Panel C for the control variables, which represent two macroeconomic indications. The ECB's MRO rate is discrete with some spikes compared to France's yearly inflation level which has limited movement. As for the last two Panels, there is the same number of observations. The variables are not continuous in the same way as the previous returns are. For example, the skewness of the MRO rate is much higher than any of the returns and the Kurtosis levels are negative for both. Still, the JB test rejects normality with a p-value below the critical value.

5 Methodology

This chapter outlines the econometric framework used in the quantitative analysis, whose goal is to examine the impact of USD/EUR exchange rate fluctuations on French sectoral equity returns. The analysis proceeds in four progressive stages, in which each model refines the understanding of exchange rate exposures and volatility dynamics. Firstly, the Ordinary Least Squares (OLS) baseline regression model (Section 5.1) was conducted at the sector level to determine the initial sensitivities to FX considering both without and with control variables. Secondly, the panel regression model (Section 5.2), observed at the aggregate level combining all sectors' observations, exploits both cross-sectional and times-series dimensions of the data. Thirdly, to account for potential time variation in FX rate exposures, the Time-varying parameter (TVP) (Section 5.3) model is based on the sectors' rolling regressions, which allows for sectoral Betas to evolve during the time-period. Finally, the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model focuses on the volatility transmission effects from the FX rate to sectoral equity returns, observing both the intensity and the persistence of volatility (Section 5.4). These four different models complement themselves in explaining how both of the French economy's return and volatility channels are impacted from exchange rate movements. All models in this paper were implemented and run in Python using packages such as 'pandas' for data manipulation, 'statsmodels' and 'linearmodels' for regression estimation and 'arch' for volatility models.

5.1 Baseline OLS Regression Model

The OLS method, first formalized by Carl Friedrigh Gauss in the early 19th century (Magnus, 2022), is the most widely used estimation method in econometrics due to its simplicity. It is a type of linear least square method used for choosing the unknown parameter in a linear regression model, useful for a preliminary analyzing of exchange rate sensibilities. By minimizing the sum of square residuals, it ensures the best linear unbiased estimator (BLUE) when estimating the OLS regression. The baseline regression model was used to estimate at the sector level the relationship between equity returns and exchange rate fluctuations. As previously mentioned in the Contextualization section, the models use daily log returns of the different indices' prices. Sector returns can be defined as:

$$r_{i,t} = \ln(P_{i,t}) - \ln(P_{i,t-1}) \quad (1)$$

where '$P_{i,t}$' is the sector index price level for sector 'i' on day 't' and '$r_{i,t}$' is the return between the previous daily observation price level and the observed one. The independent variable in the model is the daily log return of the USD/EUR exchange rate, which can be denoted as:

$$f_t = \Delta \ln\left(\frac{USD}{EUR}\right) \quad (2)$$

Accounting for the control variables of the model, the market return proxied by the gross log return of the French blue-chip CAC40 index (PX1GR) can be denoted as '$r_{m,t}$'. Let the two macroeconomic variables be considered as π_t for the annual inflation rate in France and Δi_t as the change in the ECB Main Refinancing Operations (MRO) policy rate. The baseline model without controls can be estimated as:

$$r_{i,t} = \alpha_i + \beta_{m,i} r_{m,t} + \beta_{fx,i} f_t + \varepsilon_{i,t} \quad (3)$$

And the augmented model with control variables as:

$$r_{i,t} = \alpha_i + \beta_{m,i} r_{m,t} + \beta_{fx,i} f_t + \delta_i \pi_t + \gamma_i \Delta i_t + \varepsilon_{i,t} \quad (4)$$

In both these equations, $\beta_{m,i}$ measures each for each sector 'i' its exposure to overall market movements, while $\beta_{fx,i}$ captures the sensitivity of the sector returns to FX movements. A $\beta_{m,i}$ above one indicates a strong sensitivity of the observed sector 'i' to the market rate and a positive $\beta_{fx,i}$ implies that sector 'i' tends to benefit from a US Dollar appreciation relative to the Euro. Both macroeconomic control coefficients, denoted as δ_i and γ_i, reflect the impact of inflation and monetary policy respectively. Finally, the error term $\varepsilon_{i,t}$ captures all other impacts on the observed sector returns $r_{i,t}$ which are not explicitly

included in the regression model, such as idiosyncratic shocks, firm-level impacts, additional risk factors or measurement errors.

5.2 Panel Data Model

The panel regressions model extends on the previously demonstrated OLS and was developed some years later, notably by Hausman (1978). The panel regressions model combines cross-section, with the different sectors, and time series variation to improve efficiency and allows the control of unobserved sector-specific heterogeneity. The regressions help answer questions about average exposure across all sectors and whether exchange rate effects persist once sector fixed effects are accounted for. The pooled OLS, with common coefficients across sectors, can be expressed as:

$$r_{i,t} = \alpha + \beta_m r_{m,t} + \beta_{fx} f_t + z_t'\theta + u_{i,t} \quad (5)$$

Where z_t is a vector of both macroeconomic control variables and $u_{i,t}$ is the composite error. Following suit, the second regression of two-way fixed effects incorporates sector fixed effects with α_i and time fixed effects with λ_t, expressed as:

$$r_{i,t} = \alpha_i + \lambda_t + \beta_m r_{m,t} + \beta_{fx} f_t + z_t'\theta + u_{i,t} \quad (6)$$

In both regressions, clustered standard errors are used to mitigate intra-sector autocorrelation and heteroskedasticity.

5.3 Time-Varying Parameter Model

The previous models, the static OLS baseline regression and the panel model, both assume constant sensitivities of sector returns to exchange rate movements. To relax this assumption, the TVP model is used with a rolling regressing approach, which allows Betas to change over time rather than remain constant. This model was first introduced in the financial context by Ferson and Harvey (1991) to study the evolving risk premia, where the purpose was to estimate coefficients over a moving window. This model is highly relevant to financial markets as traded values of assets can evolve drastically over a moving window of time due to both micro and macro-economic factors. For each sector ‘i’, the baseline was estimated with a moving window of fixed length of 252 trading days, expressed as:

$$r_{i,t} = \alpha_{i,t} + \beta_{m,i,t} r_{m,t} + \beta_{fx,i,t}\, f_t + \varepsilon_{i,t}$$

(7)

where the time varying intercept $\alpha_{i,t}$ and Betas $\beta_{m,i,t}$ and $\beta_{fx,i,t}$ are estimated recursively in each window. A higher $\beta_{m,i,t}$ indicates stronger sensitivities of a given sector to FX changes and periods of shifts in $\beta_{fx,i,t}$ suggest the exchange rate exposure to be time dependent. The model was programmed to also compute rolling R^2 values to measure the accuracy of the model's ability to explain returns at each point in time, demonstrated by:

$$R^2_{i,t} = 1 - \frac{\sum_{s \in W_t} \hat{\varepsilon}^2_{i,s}}{\sum_{s \in W_t} (r_{i,s} - \bar{r}_{i,W_t})^2}$$

(8)

where WT is the estimation window ending at 't'.

5.4 Volatility Transmission GARCH Model

After analyzing effects on mean returns with the three previous models, the GARCH model focuses on how exchange rate volatility affects sectoral return volatility. The GARCH model introduced by Engle (1982) and extended in Bollerslev (1986) is highly popular in financial studies as it captures volatility clusters present in financial time series. In application, the conditional mean per sector 'i' without controls can be expressed as:

$$r_{i,t} = \alpha_i + \beta_{m,i} r_{m,t} + \beta_{fx,i} f_t + \varepsilon_{i,t}, \qquad \varepsilon_{i,t} = \sigma_{i,t} u_{i,t}, \qquad u_{i,t} \sim i.i.d.(0,1)$$

(9)

and the conditional mean with control variables as:

$$r_{i,t} = \alpha_i + \beta_{m,i} r_{m,t} + \beta_{fx,i} f_t + z_t' \gamma_i + \varepsilon_{i,t}, \qquad \varepsilon_{i,t} = \sigma_{i,t} u_{i,t}, \qquad u_{i,t} \sim i.i.d.(0,1)$$

(10)

where z_t' represents the macroeconomic variables and $u_{i,t}$ represents the standardized innovation. Next the conditional variance of GARCH(1,1) can be defined as the following:

$$\sigma^2_{i,t} = \omega_i + \alpha_i^{(v)} \varepsilon^2_{i,t-1} + \beta_i^{(v)} \sigma^2_{i,t-1}$$

(11)

where ω_i represents the GARCH Omega, $\alpha_i^{(v)}$ represents the GARCH Alpha and $\beta_i^{(v)}$ represents the GARCH Beta. A larger Alpha result represents a bigger intra-day volatility reaction to new shocks while a larger Beta represents a more persistent volatility. To test the goodness of fit of the model, the log likelihood

was computed assuming Normal innovations as well as the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) model selection criteria. The log likelihood named l_i was defined as:

$$l_i = -\frac{1}{2}\sum_{t=1}^{T}[\ln(2) + \ln(\sigma_{i,t}^2) + \frac{\varepsilon_{i,t}^2}{\sigma_{i,t}^2}]$$

(12)

The goal of the log likelihood model test is to obtain the highest value as it would indicate a better model fit. This is contrary to the AIC and BIC whose goal for a good model fit is to be as low as possible. With k estimated parameters and T usable observations, the AIC and BIC were computed as:

$$AIC = 2k - 2l_i, \qquad BIC = (lnT)k - 2l_i$$

(13)

Taken as a whole, the sequence of four models focusing on different aspects of return and volatility impacts of FX dynamics on French equities progressively build an understanding of exchange rate exposures. The OLS and panel regressions establish baseline and average sensitivities across the sectors, the third model highlights time variation of the return sensitivities and the fourth GARCH model focuses on volatility transmission. This econometric framework is analyzed in the next section with the presentation of the empirical results.

6 Obtained Results, Findings and Discussion

Now that the methodology of this thesis has been defined, the results obtained, and their interpretations can be analyzed. The sequence of the four models used proceeds in a progressive manner in order to build depth of analysis. To begin, the simple OLS regressions are run at the lector level, which establishes the baseline relationship between the sectors' returns, the market index and exchange rate changes. While this starter analysis provides initial evidence in answering the thesis' problematic, it remains a static representation of the data. To build on this, the panel regressions follow in pooling information across time regrouping the sectors. This controls the unobserved heterogeneity and provides insights of FX sensitivities across the market.

The next step introduces a dynamic perspective with a focus on rolling regressions, where time-varying coefficients help identify exchange rate dynamics and volatility in different economic and financial conditions. The GARCH model concludes the analysis providing insights specifically on the relationship between the USD/EUR rate and the equity indices' volatility, both on the intensity and persistence of movements. The four-model approach provides a layered approach grouping static and aggregated estimate, time varying sensitivities and volatility dynamics. For each model, the control variables are added

progressively in order to observe their impact on the database. At the end of this section, a summary of the results is provided as well as a discussion in the limitations of the findings.

6.1 Baseline OLS Regression Model

The Baseline OLS regression model was run with two different databases: the first excluding the macro-economic control variables and a second time including them.

6.1.1 Baseline Regression Model Without Control Variables

To firstly present the baseline OLS regression, Table 1 presents the results of the regression without the control variables.

Table 1: Baseline OLS Model Results Without Control Variables

Sector	R^2	Adj R^2	Market Beta	Market P-value	FX Beta	FX P-value	F-statistic	F P-value	Observations
FROG	0,6698	0,6696	0,9279	0,0000***	0,0236	0,4001	2591,6650	0,0000***	2558
FRHC	0,6267	0,6265	0,7609	0,0000***	0,1658	0,0000***	2145,0913	0,0000***	2558
FRUT	0,5995	0,5992	0,8643	0,0000***	-0,0833	0,0067***	1912,6496	0,0000***	2558
FRCS	0,6434	0,6431	0,8018	0,0000***	0,0250	0,3310	2304,5452	0,0000***	2558
FRFIN	0,8007	0,8006	1,1955	0,0000***	-0,2956	0,0000***	5132,9022	0,0000***	2558
FRTEC	0,6379	0,6377	0,8271	0,0000***	0,0131	0,6271	2250,9784	0,0000***	2558
FRBM	0,7670	0,7668	1,0072	0,0000***	-0,0514	0,03240*	4205,3520	0,0000***	2558
FRIN	0,8751	0,8750	0,9615	0,0000***	-0,0283	0,0721*	8950,9299	0,0000***	2558
FRCG	0,8032	0,8030	0,8390	0,0000***	0,0930	0,0000***	5213,2119	0,0000***	2558

Source: Own elaboration

There are several factors to explore in the table above, the first being the goodness of fit per index with the coefficient of determination (R^2) and adjusted R^2 indicators. These two coefficients range from 60% to 88% across the indices indicating varying explanatory power. It can be observed that the adjusted R^2 values are more conservative as they are smaller than the R^2 values. This reduction in value is due to the adjusted R^2 considering predictors which are not present in the normal R^2, which in this case do not improve the model. Following suit, the Market Beta of each index can be analyzed as being highly correlated with values ranging from 0,76 to almost 1,20 as well as the p-values demonstrating strong statistical significance to the market index. This intuitively makes sense as the market index, the CAC 40, regroups a wide range of sectors and several companies in the market index are included in each respective sectoral index.

As for the FX effects variables, the OLS analysis demonstrates that several sectoral indices exhibit statistically significant sensitivities to exchange rate fluctuations of the USD/EUR rate. We can first observe both negative and positive values of the FX Beta, with the Financials index having the largest decorrelation and the Health Care sector the largest correlation. The most significant FX Beta are the Utilities, Health Care, Financial and Consumer Goods indices as indicated by their p value. This result can be interpreted as

the firms in these sectors being more globally exposed, due to its large foreign earnings share, exporting activity or US Dollar input costs. On the contrary, the Technology, Consumer Services and Oil and Gas sector suggest from its highly elevated p value that there is no evidence to suggest significance of USD/EUR movements on the returns of this sector. This is coherent as many of the companies in the sector tend to dominate their domestic market, such as Consumer Services, or have strong PTM power and hedging practices, such as the Technology sector. However, the Oil and Gas sector experiencing no significant explanatory correlation from the exchange rate is contradicting to the previously established hypothesis. Finally, the F-statistic and its corresponding p-value demonstrate levels reject the null hypothesis for all sectors, confirming that the explanatory variables in the sectoral regressions of the model are highly significant.

6.1.2 Baseline Regression Model With Control Variables

The same analysis was conducted as seen in Table 2 below, using both macroeconomic control variables described earlier.

Table 2: Baseline OLS Model Results With Control Variables

Sector	R^2	Adj R^2	Market Beta	Market P-value	FX Beta	FX P-value	F-statistic	F P-value	Observations
FROG	0,6699	0,6694	0,9281	0,0000***	0,0237	0,3998	1295,2956	0,0000***	2558
FRHC	0,6271	0,6266	0,7612	0,0000***	0,1662	0,0000***	1073,5377	0,0000***	2558
FRUT	0,5997	0,5991	0,8642	0,0000***	-0,0826	0,0071***	956,3627	0,0000***	2558
FRCS	0,6434	0,6428	0,8017	0,0000***	0,0253	0,3266	1151,5162	0,0000***	2558
FRFIN	0,8008	0,8005	1,1953	0,0000***	-0,2960	0,0000***	2566,3647	0,0000***	2558
FRTEC	0,6381	0,6375	0,8269	0,0000***	0,0129	0,6326	1125,3997	0,0000***	2558
FRBM	0,7670	0,7666	1,0071	0,0000***	-0,0514	0,0325**	2101,0522	0,0000***	2558
FRIN	0,8751	0,8749	0,9614	0,0000***	-0,0284	0,0709*	4472,3926	0,0000***	2558
FRCG	0,8033	0,8029	0,8391	0,0000***	0,0928	0,0000***	2605,7370	0,0000***	2558

Source: Own elaboration

The table show confirms that results remain constant despite the addition of the control variables. The R^2 level consistently outperform the levels of the previous R values on a small scale, indicating a better model fit, and the adjusted R^2 indicators remain in the same range. The Market Beta and its p-value also demonstrate levels close to the previous database rejecting each null hypothesis. The FX Betas as well as the p-values show the same level of significance for each index as the previous table. Lastly, the F-stat indicators demonstrate the same level of high significance. These similar results demonstrate the statistical significance of the USD/EUR FX rate movements on the returns of these individual sectoral returns.

6.2 Panel Data Model

For the second model of this study, the panel data model observes the pooled OLS as well as entity fixed effects of the nine sectoral indices as the dependent variables and both the market index and FX USD/EUR rate as independent variables. When introducing time fixed effects on the data, the model fit deteriorated leading to a loss of explanatory power. The results from the time fixed and two-way fixed effects suggested that daily sector returns exhibit co-movement overtime and that sector-specific FX sensitivities are weak once time effect considered. The results could be explained from sector-level sensitivities to FX movements which are often masked by the dominant influence of market-wide factors on daily returns. For these reasons, these tests have been set aside in Appendix G.

6.2.1 Panel Data Model Without Control Variables

Below in Table 3 are the results of the Panel effects for the indices clear of the control effects. There are 23 022 observations as for each of the nine sectors observed there are 2 558 daily data observations.

Table 3: Panel Model Results Without Control Variables

Model	R^2	R^2 Within	R^2 Between	Market Beta	Market P-value	FX Beta	FX P-value	F-statistic	F P-value	Observations
Pooled	0,7011	0,7013	0,2176	0,9092	0,0000***	-0,0157	0,6996	27001,6492	0,0000***	23022
Entity Fixed	0,7013	0,7013	0,2173	0,9095	0,0000***	-0,0153	0,7054	27016,8680	0,0000***	23022

Source: Own elaboration

When observing the results of both types of effects, we can observe that they yield similar results, with their R^2 values being almost identical at 70%. This level suggests that a large portion of the variation in the observed returns are explained by these models. The panel regressions confirm that the sector returns are strongly driven by the general market factor as the Market Beta is highly significant for both effects (p-value<0,05). As for exchange rate effects, the effects demonstrate that the FX Beta is negative and that they are statistically insignificant (p-values of 0,699 and 0,705). A possible explanation for these results could be that at the aggregate daily frequency and combined sector point of view, the direct effect of FX movements on the observed returns is relatively weak once market movements are considered. In addition, fixed effect time dummies absorb global macro-level shocks, such US Dollar movements or central bank decisions, which can explain why the FX variations are muted.

6.2.2 Panel Data Model With Control Variables

The Table 4 below represents the panel regressions for the observed variables considering control variables.

Table 4: Panel Model Results With Control Variables

Model	R^2	R^2 Within	R^2 Between	Market Beta	Market P-value	FX Beta	FX P-value	F-statistic	F P-value	Observations
Pooled	0,7011	0,7013	0,2176	0,9092	0,0000***	-0,0157	0,7005	13499,6948	0,0000***	23022
Entity Fixed	0,7013	0,7013	0,2173	0,9095	0,0000***	-0,0153	0,7063	13507,3032	0,0000***	23022

Source: Own elaboration

The same conclusions can be drawn from the previous analysis as the introduction of these macro-economic variables prove only to slightly influence the FX Beta as being slightly less statistically significant (p-values of 0,700 and 0,706). Circling back to the initial hypothesis of each sector, it can be concluded from the conclusion of the panel data model only resonate with the Utilities and Consumer Services sectors, which were both expected to demonstrate weak exchange rate exposure. The remainder of the sector hypothesis are proven to be rejected with the aggregate results for the pooled and fixed entity effects.

6.3 Time-Varying Parameter (TVP) Model

As explained in the methodology section, to ensure that each regression is based on a full year of daily observations, the number of observations is reduced in this model. In financial markets, the assumption of the number of trading days is 250 days. Due to this 250-day rolling window in the Time-Varying Parameter estimation, the first observation point therefore begins in late December 2010. The model was run estimating Betas for the constant variables (which are the regression intercept terms $\alpha_{i,t}$ estimated at each rolling window), the market variable, the FX rate observable variable and each of the macro-economic variables in the second section of this model. Due to the results demonstrating that the constant variables presented null values across all sectors, the data was omitted from the result tables.

6.3.1 TVP Model Without Control Variables

Presented below in Table 5 is the TVP Model run without any control variables.

Table 5: TVP Model Results Without Control Variables

Indexes	Avg. Const Beta	Min Const Beta	Max Const Beta	Avg. Market Beta	Min Market Beta	Max Market Beta	Avg. FX Beta	Min FX Beta	Max FX Beta	Avg. R^2	Min R^2	Max R^2
FROG	-0,0002	-0,0013	0,0007	0,9547	0,7859	1,2620	-0,0474	-0,3107	0,3440	0,6536	0,4027	0,8477
FRHC	0,0000	-0,0010	0,0011	0,7855	0,5841	1,0089	0,1033	-0,1496	0,3478	0,6112	0,4118	0,8390
FRUT	-0,0005	-0,0016	0,0013	0,8406	0,6084	1,0221	-0,0552	-0,3619	0,2138	0,5413	0,2312	0,8165
FRCS	-0,0001	-0,0010	0,0004	0,8099	0,6664	1,0206	0,0159	-0,2115	0,1706	0,7150	0,1899	0,9056
FRFIN	-0,0002	-0,0013	0,0007	1,0908	0,6968	1,5510	-0,1405	-0,5634	0,1602	0,7814	0,5475	0,8887
FRTEC	0,0001	-0,0010	0,0009	0,8255	0,5998	1,2426	0,0464	-0,2516	0,2979	0,6112	0,4185	0,7884
FRBM	-0,0002	-0,0011	0,0010	1,0145	0,8008	1,2771	-0,0611	-0,2882	0,2793	0,7408	0,5087	0,8945
FRIN	0,0001	-0,0005	0,0005	0,9412	0,7816	1,1280	0,0398	-0,0907	0,1671	0,8646	0,7821	0,9259
FRCG	0,0002	-0,0005	0,0009	0,8530	0,6764	1,0873	0,0557	-0,1565	0,3232	0,7812	0,6189	0,9009
Index Average	-0,0001	-0,0010	0,0008	0,9017	0,6889	1,1777	-0,0048	-0,2649	0,2560	0,7001	0,4568	0,8675

Source: Own elaboration

The results presented above show the averages as well as the maximum and minimum range values of the Betas for the Constant variable, Market rate and the FX rate, as well as the R^2 values across all nine sectoral sectors. The Constant variable corresponds to the rolling intercept parameter $\alpha_{i,t}$ estimated in each window. The Betas of the parameter for all sectors are effectively zero expressing a near-zero mean of daily log returns. In the Market Beta columns, it can be observed that on average, the Financials and Basic Materials sectors have the strongest sensitivities to the market rate movements with average Market Beta values above one, whereas the Health Care and Consumer Services sectors have the weakest with values closer to 0,8.

As for the FX impact on the variables, it can be observed that the average FX Betas are much weaker than the Betas of the market index as they circulate around the value of zero, with some indices presenting positive values and some negative. The sector most positively correlated on average with the FX rate is the Health Care sector with a Beta of 0,10, and on the contrary, the least correlated is the Financial sector with –0,14 Beta. The largest variation of Beta values is the Financials sector with a range of 0,70 in absolute values and the sector with the least variation is Industrials sector with a range of 0,13 in absolute values. These results align in theory with H5 as the Financial sector tends to benefit from the most financial knowledge when it comes to hedging itself against foreign exchange variation, explained by the inverse correlation, while also having a large range of values due to the sensitivity of the activities run by financial institutions. The Industrials sector having the smallest range in values is coherent as the activity tends to be more focused on the domestic economy and less dependent on FX movements. Finally, the Health Care sector having the highest degree of correlation perfectly matches the theoretical H2 hypothesis, which highlighted France's Health Care sector as being a global pioneer in pharmaceuticals and other patented products, thus increasing its foreign sales volume.

When observing the R^2 values in the table that on average for all the indices, the average R^2 is 0,7. This means that, on average, the model explains about 70% of the variance of the sectors, suggesting that market and FX dynamics are strong drivers of the sectors' results. It's interesting to observe that the index with the highest degree of explanatory power is the Industrials index with the highest level of average, maximum and minimum R^2 (0,86, 0,93 and 0,78 respectively) but also by having the smallest range between maximum and minimum values. This reveals that over nine years, Market and FX factors have had strong explanatory power in the highest daily peaks of the index's returns. On the flip side, the Utilities sector has the weakest average R^2 value of only 0,54, suggesting that the factors do not strongly explain the volatile movements. Interestingly, it can be observed that although the Financials sector has a strong average R^2 at 0,72, it has the largest range of R^2 values with a variating at its lowest at 0,19 and its highest at 0,91. This resonates with the conclusion that the Financials sector is exposed to a larger range of factors.

Appendix H represents the graphical representations of the line plots of Market and FX Betas as well as the R^2 values for each index, reflecting the conclusions previously stated. It is most interesting to focus on the relevant indices such as the Health Care, Industrials, Utilities and Financials sectors.

In addition to the statistical variables results discussed above, the model helps to highlight the dates of FX Beta spikes, which is highly relevant for the purpose of answering the hypothesis question: "Does FX rate impact French Financial Markets Sectors?". Below Table 6 summarizes the periods where the 20 major daily FX Betas spikes occur across all the sectors as well as the range of these daily variations peaks. Some of these key dates occur during the same months.

Table 6: TVP Model Results Significant Dates Without Control Variables

Indexes	Oil & Gas	Health Care	Utilities	Consumer Service	Financials
Periods of FX Beta Spike	2013 : 01, 02 2014: 11 2015: 02 2017: 02, 05, 06 2019: 03, 04, 05	2013: 08, 09 2014: 05, 06, 08 2015: 03, 04, 06, 11 2016: 01, 02 2018: 03, 04	2011: 09, 10, 11 2013: 12 2014: 02, 03, 04, 05, 11, 12 2015: 02, 03 2018: 02	2012: 02, 04, 07, 08, 09, 11 2014: 09, 11 2015: 04 2016: 04, 05, 12 2017: 04, 05 2018: 01, 10 2019: 05	2013: 11, 12 2014: 01, 12 2015: 01, 03 2016: 06 2019: 09, 10, 11, 12
Intra Day FX Beta Spike Variations	240% - 9200%	300% - 2860%	290% - 2830%	810% - 46090%	250% - 2960%

Indexes	Technology	Basic Materials	Industrials	Consumer Goods
Periods of FX Beta Spike	2012: 02 2014: 09, 10, 11 2015: 02 2016: 09 2017: 01, 02, 12 2018: 01 2019: 04, 10, 11	2011: 01, 06, 07, 08, 12 2012: 01, 02 2014: 06, 12 2015: 01 2017: 04 2018: 05	2011: 07, 08, 09, 11 2012: 07 2013: 08 2014: 10 2016: 08 2017: 01, 04, 05, 06 2019: 10	2015: 01, 02 2016: 11 2017: 02, 03, 04 2018: 05, 06, 07, 08, 09 2019: 04, 06
Intra Day FX Beta Spike Variations	450% - 33870%	370% - 5220%	330% - 2760%	450% - 5550%

Source: Own elaboration

It can be observed in Table 6 that the index with the highest intraday variation observation is the FRCS sector reaching over 46000%. This same sector also has the highest value for its 20th observation (810%) as well as the largest range in daily variation compared to other sectors. This observation can be justified as the Consumer Services sector was previously hypothesized to be volatile depending on its underlying sub-sectors such as tourism-intensive activities (H4), which react sensitively to international news and US Dollar DCP dynamics.

When collecting the 20 dates with the largest daily variation, several of these instances occurred during the same month. Notably, some key events can be highlighted which could explain the concentration of observations swaying the different sectors.

In November and December of 2014, six sectors including Oil and Gas, Utilities, Consumer Services, Technologies, Financials and Basic Materials experienced significant equity variations. During this time, France's economy experienced faint growth with only an increase of 0,2% of GDP volume, compared to triple that amount in 2013 with a 0,7% growth rate, and a drastic decrease in investments tumbling at -6.9% (Insee, 2015). The economic landscape was so gleam that over a period of three months, S&P's October AA rating outlook change to negative (S&P Global, 2014), on the 7th of November Morningstar's DBRS changed their AAA rating outlook from stable to negative on the AAA nation (MorningStar DBRS, 2014), as well as Fitch downgrading France's sovereign rating from AA+ to AA in December (Fitch Ratings, 2014). Specifically affecting the Financials sector in 2014 was the €9 billion penalty awarded to BNP Paribas from US authorities, after the bank violated economic embargos in Iran, Cuba and Sudan (Chocron, 2015). In the Technology sector, major telecommunications leaders announced important strategies, such as SFR and Numericable announcing their collaboration in a new router and Wi-Fi network product increasing significantly their market share (Gueugneau & Schmitt, 2014), as well as Numericable's previous acquisition of Virgin Mobile for €325 million earlier that year in May (Godeluck, 2014). These competitive tactics presented threats to other telecommunication corporations and explain the notable market reactions.

In January of 2015, the ECB announced the launch in March for its QE program which then President François Hollande welcomed. As previously presented in the literature review, the announcement created important reactions in French financial markets as concern persisted over competitiveness and low profitability. Indeed, ECB economists had predicted that France would be one of the countries the most affected by the shortage of bonds (Delivorias, 2015). Over the course of the first quarter of 2015, seven out of the nine sectors experienced high daily FX volatility spikes, excluding the Consumer Services and Industrials sector, as seen in this paper's analysis but also in a working paper form the Banque de France. Cezar and Silvestrini (2018) analyzed further testing econometrically the relationship between the QE program and France's International Investment Position (IIP) and found a greater effect through the January announcements rather than the effective purchases beginning in March.

Two years later, Holland's term was reaching its end, and the presidential campaigns were ableist throughout the nation. The rise of political uncertainty in February, especially with far-right Marine Le Pen's political campaign led to the widening of French German bond spreads, increasing market sensibilities across several sectors (Hempell et al., 2017). The first round of the election was on the 23rd of April and around this time markets became increasingly volatile. Notable movements were observed the following day in European indices (with France's CAC40 3.4% jump and German DAX increase of 2.44%) as well as overseas with major Asian indices (such as Japan's Nikkei increase of 225 bps and China's Shanghai Composite 43bps drop) (Sands, 2017). The second round on the eighth of May marking Macron's

victory provoked muted reactions in the markets with Macron's victory as investors shifted their attention from poll results to expectations on monetary policy (Euronews, 2017). These different events highlight the transmission impact geopolitical, and macro economical events have on financial markets.

6.3.2 TVP Model With Control Variables

Presented below in Table 7 is the TVP Model run with the control variables considered. The table includes as in the previous one the constant Beta, the market Beta, FX Beta and R^2 values. In addition, it includes the ECB and Inflation Beta values. As more variables a considered, Appendix I presents the complete table including the maximum and minimum levels for all variables.

Table 7: TVP Model Results With Control Variables

Indexes	Avg. Const Beta	Avg. Market Beta	Avg. FX Beta	Min FX Beta	Max FX Beta	Avg. ECB Rate	Avg. Inflation Beta	Avg. R^2
FROG	7,56E+06	0,95	-0,05	-0,30	0,35	1,58E+07	8,31E+07	0,66
FRHC	4,49E+07	0,79	0,10	-0,17	0,35	-4,83E+07	1,48E+08	0,61
FRUT	-5,82E+07	0,84	-0,06	-0,38	0,22	1,05E+08	-8,93E+07	0,55
FRCS	-1,20E+06	0,81	0,02	-0,21	0,17	-2,02E+07	-5,63E+07	0,72
FRFIN	-4,69E+07	1,09	-0,14	-0,54	0,16	1,28E+08	3,30E+07	0,78
FRTEC	-2,95E+07	0,83	0,05	-0,26	0,29	8,65E+07	3,51E+07	0,61
FRBM	-1,49E+07	1,01	-0,06	-0,29	0,28	4,40E+07	1,88E+07	0,74
FRIN	1,94E+07	0,94	0,04	-0,09	0,17	-1,95E+07	6,75E+07	0,87
FRCG	1,01E+07	0,85	0,06	-0,16	0,34	-6,92E+07	-1,08E+08	0,78
Index Average	-7,65E+06	0,90	0,00	-0,27	0,26	2,47E+07	1,47E+07	0,70

Source: Own elaboration

It is apparent in the table that the values for the constant Beta, ECB rate Beta and inflation Beta values are substantial. The large magnitude of these values is expected as the ECB MRO rate varies little at a daily frequency, since it depends on lengthy decision making from the ECB, so any movement creates intense reactions. The same can be concluded for the inflation variable due to the difference in periodicity: the inflation variable is measured annually whilst the observations are daily. When the control rates experience change, their changes are scaled into disproportionately large coefficients compared to the observable equity indices. Their impact translates directly into the Constant parameter, $\alpha_{i,t}$, as the inclusion of these slowly varying macro variables changes the regression geometry and shifts estimated intercepts. As a result, these three estimates are to be interpreted with caution as they do indicate the model captures macro-economic variations but the economic meaning of the daily Betas for these indicators are less relevant to the goal of the study.

Despite these significantly large values, when observing the values of the market, FX Betas as well as the R^2 values, the values for each index are almost identical with at most an absolute difference of 0,03

between the results without the control variables and with them. Therefore, we can deduct the same conclusions as in the previous analysis concerning the indices having a strong sensibility to the market rate (with an average of 0,69 for indices), especially the Financials and Basic Materials sectors. It can further be confirmed that although the FX Beta is not as strong on the stock price returns as the market rate, with average values circling around zero. The most sensitive sector remains the Health Care sector whilst the least sensitive also remains the Financials sector. Finally, when observing the R^2 values, once again the same conclusions can be drawn on the sectorial stock returns with an overall average of 70% explanatory power.

For the purpose of comparison, Appendix J shows the graph analysis without control variables. It is worth highlighting to also observe the Health Care, Industrials, Utilities and Financials sectors.

To conclude this model, below in Table 8 are the periods of the 20 most significant dates FX Beta spikes across all sectors over the nine years of observable data. Most of the significant periods are the same as the previous analysis as well as the range of variations which remain elevated. For most of the sectors, the maximum variation is greater with the inclusion of control variables than in the previous analysis, with the highest rate of daily variation observed in the Oil and Gas sector at 38010%. More precisely, the 20 most significant observations are on average all superior to the database without control variables, especially for the Oil and Gas sector outranking all observations. Only the Financial sector and Industrial sectors have muted observations with only two and three respective higher values.

Table 8: TVP Model Results Significant Dates With Control Variables

Indexes	Oil & Gas	Health Care	Utilities	Consumer Service	Financials
Periods of FX Beta Spike	2011: 05, 06 2013: 02 2015: 02 2017: 06 2019: 03, 04, 05	2013: 08, 09 2014: 05, 06, 08 2015: 03, 04, 06, 11 2016: 01, 02 2018: 03, 04	2011: 09, 10 2012: 03 2013: 12 2014: 02, 03, 05, 11 2015: 02, 03 2018: 01	2012: 05, 06, 07, 08, 11 2014: 11 2015: 03, 12 2016: 01, 03, 05 2017: 01, 05 2019: 08, 09	2013: 11, 12 2014: 01, 11, 12 2015: 01 2016: 06 2019: 09, 10, 11, 12
Intra Day FX Beta Spike Variations	270% - 38010%	260% - 2750%	270% - 15840%	590% - 33190%	200% - 7630%

Indexes	Technology	Basic Materials	Industrials	Consumer Goods
Periods of FX Beta Spike	2012: 02, 04 2014: 09, 10, 11 2015: 02 2017: 01, 02, 04, 12 2018: 01 2019: 04, 10, 11	2011: 01, 06, 07, 08, 09 2012: 01 2014: 05, 06, 12 2015: 01 2017: 03, 04 2018: 05	2011: 07, 08, 09, 10, 11 2012: 07 2013: 08 2014: 02, 10 2016: 08 2017: 04, 05, 06 2019: 10	2016: 03, 04, 11 2017: 02, 03, 04 2018: 05, 07, 08, 09 2019: 01, 04, 05, 06
Intra Day FX Beta Spike Variations	450% - 22270%	340% - 5670%	270% - 21820%	520% - 14950%

Source: Own elaboration

Many of the most significant observable dates are the same or at least occur during the same month, especially for the Health Care sector where for all the observable dates, all of them occur in the same monthly periods and the dates line up exactly for sixteen of them. What is most interesting to observe in comparison to the previous analysis without controls, is different dates the largest daily variation observations occur. There are at least one different period and up to eleven different periods for the remaining eight sectors. The sector with the least amount of overlap in the observable dates in comparison to the previous table is the Consumer Services index. This exposes that when considering the control variables, the FX rate affected the index at different periods more significantly.

The observations considering control variables highlighted several observations in 2011 for the Oil and Gas, Basic Materials and Financials sectors. Both shale gas exploration and hydraulic fracking were banned following public pressure and political party lobbying (Agasse, 2011) (Legifrance, 2011). These measures increased "wholesale gas prices in France on the spot market [increasing by 30% in comparison to 2010, reaching up to €22.9/MWh]" which continued to increase in the first half of 2012 as well (CRE, 2012). The summer of 2012, nicknamed the summer of "stock storms", marked the peak of the debt crisis in Europe and plummeted global financial markets, particularly France's CAC40 experienced a 34% drop between the end April to mid-September (Guinot, 2011). In addition to the Financials sector being impacted from these events, the Basic Materials sector experienced on average a –3.1% drop in prices in September, with intense commodities price declines in metals (-5.6%), in food-related primary goods like cacao an tea (-2.7%) as well as agro-industrial raw materials like cotton (-6.7%) and natural textile fibers (-7.2%) (Insee, 2011). The accumulation of this traumatizing year for markets was reflected in Fitch's December outlook rating change from AAA Stable to Negative (Fitch Ratings, 2011).

Two years later, the Utilities sector was heavily impacted from the European windstorm "Cyclone Dirk" which hit France and neighboring countries in December of 2013 left 240 000 households without electricity the night of the storm (Martin & Agence, 2013) and total assessed damages were estimated at € 100 million (AFP, 2014-a). Shortly after in February, several strikes across the energy and utilities sector occurred. A couple of months later, political debates and talks about the Montebourg decree and foreign takeover restrictions in the energy sector surfaced. In April 2014, US company General Electric proposed an initial offer of €12.35 billion to buy business units of Alstom with counter bids from Mitsubishi and Siemens followed (AFP, 2014-b). The French government disapproved of this deal and the minister of economy at the time Arnaud Montebourg passed the decree n° 2014-479 limiting international overtake in sectors of defense, security, energy, transportation, water supply, electronic communications and public health protection (LegiFrance, 2014). After several negotiations, an agreement between the French state and Bouygues allowed the French state to acquire a 20% stake in Alstom (De Saint Leger & Fourneret, 2017).

To summarize the analysis of the time-varying model, the regressions highlight sectoral exposures to the USD/EUR exchange rate to be dynamically impacted in response to macroeconomic shocks, policy announcement and sector specific events. This perspective demonstrates the periods of heightened sensitivity as well as substantial heterogeneity across the sectors. Despite the interesting observations of how the Betas shift over time, the TVP model focusses solely on the conditional mean of returns. To capture the equally important volatile impacts, it is necessary to analyze the data with the GARCH model, which explicitly models the dynamics of conditional variance.

6.4 Volatility Transmission GARCH Model

Finally, the final model used in the empirical framework is the GARCH model with the goal to analyze the impact of FX in shaping sectoral volatility dynamics. This model relaxes the assumption that volatility is constant, instead allowing volatility to cluster over time. This feature makes it particularly appropriate in the context of this study as it can help detect volatility patterns and transmission, from FX rates to equity index sectors.

6.4.1 Volatility Transmission GARCH Model Without Control Variables

The analysis was first run on the database without the control variables. Table 9 below presents different metrics for each of the 9 observable variables, the first being the R^2 of the model explaining how much the model accounts for the return variation. Following suit, there are three parameters directly related to model with its Alpha measuring how reactive volatility responds to new information shocks or news, the Beta measuring the volatility's persistence and the omega measuring the baseline long-run variance. Finally, the last three metrics help discern the goodness of fit of the model with the log likelihood, the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC).

Table 9: GARCH Model Results Without Control Variables

Sector	Factor Model R^2	GARCH Alpha	GARCH Beta	GARCH Omega	Log Likelihood	AIC	BIC
FROG	0,67	0,0500	0,9300	1,25E-06	8901,91	-17795,82	-17772,43
FRHC	0,63	0,0500	0,8500	5,02E-06	9057,61	-18107,23	-18083,84
FRUT	0,60	0,0650	0,5963	2,53E-05	8541,70	-17075,40	-17052,01
FRCS	0,64	0,2000	0,5000	1,57E-05	9357,71	-18707,42	-18684,03
FRFIN	0,80	0,0500	0,9300	1,08E-06	**-4533,29**	**9074,59**	**9097,97**
FRTEC	0,64	0,0100	0,9700	1,14E-06	8914,35	-17820,70	-17797,31
FRBM	0,77	0,0100	0,9700	9,12E-07	9181,48	-18354,97	-18331,58
FRIN	0,88	0,0500	0,9300	3,90E-07	**-2508,56**	**5025,12**	**5048,51**
FRCG	0,80	0,0500	0,8500	2,52E-06	9956,60	-19905,20	-19881,81

Source: Own Elaboration

The most striking feature of Table 9's results at first glance is the goodness of fit metrics for the Financials and Industrials sectors compared to the other sectors. The very low log likelihood combined with the elevated AIC and BIC results clearly indicate the poor model fit for these sectors in the database. We will later examine whether this is the case in the database with the control variables. Therefore, this demonstrates that the FX rate does not substantially explain the variance observed during the time period of observations, suggesting that other factors could have better explained the daily movements. Apart from these two sectors, the remainder of the sectors have similarly high goodness of fit. The sector with the best fit is the Consumer Goods sector with the highest values of near 10.000 in the log likelihood metric, and the AIC and BIC metrics approaching the –20.000 levels.

The most informative parameters in the model are Alpha, Beta and Omega, as they focus on variance. Firstly, it can be observed that the Omega for all sectors is low and approaches zero. This informs the reader that the long-term average level of volatility for the sectors is fairly modest. The sectors with the highest Beta, or persistence of past volatility are the Technology and Industrials sectors at 0,97, which is logical as these sectors tend to be highly cyclical and sensitive to macroeconomic conditions, with innovations and investment cycles generating long-lasting volatility effect on the markets, previously highlighted in H6 and H8. Conversely, the Consumer Services and Utilities sectors have the least amount of persistent volatility across the rest of the sectors. This implies that significant news impacting these sectors translate weakly into persistent reactions in the markets, indicating a robust and stable sectoral structure.

In addition to the Beta, it can be noticed that the Consumer Services index has by far the highest Alpha level, at 0,2 compared to an average of 0,05 for all index, as well as the lowest Beta level at 0,5. The high Alpha level suggests that volatility spikes quickly after large return shocks for this sector and in combination with the lower Beta level which indicates the volatility spikes do not persist long after. This reflects the initial hypothesis concerning the Consumer Services sector, H9, as it is highly exposed to tourism and leisure activities, both defined by the economic propensity to consume and spend of households. This economic measure is directly correlated with inflation and is impacted by several factors, such as geopolitical events, travel demand shifts and FX-driven pricing power conditions. These transfer into financial markets with sharp intense reactions in the short term that stabilize soon after. The majority of sectors have an Alpha of around 0,05 with a Beta level between 0,85 and 0,93 suggesting that in reaction to return changes, volatility spikes with less intensity but does however persist for a longer duration. Contrariwise, the Technology and Basic Materials sectors have the weakest Alpha at 0,01 detailing subtle volatility movements in reaction to new information, but these movements persist the longest with a Beta of 0,97. These sectors both behave in similar ways due to their dependence on global demand cycles,

commodity price fluctuations and the domestic economy, which cause shocks to have a more gradual but enduring effect.

Overall, the Alpha and Beta metrics show a slightly inverse relationship between interactions and remain proportionally affected by each other. One exception is the Utilities sector with an Alpha of 0,065 and a Beta of 0,5963 which shows a proportionally low Beta for its level of Alpha compared to the previous observations. The conclusions suggested from these results paint a picture that although the volatility spikes are slightly above the average level, they persist in time longer than proportionally seen in the other indices. This conclusion could resonate with the idea that the Utilities sector is largely domestically driven and regulated by the government, muting its effects to long-lived volatility shocks but still subject to occasional reactions to energy price shocks or policy changes.

Lastly, the R^2 results in this model are less relevant than previous ones where the focus was set onto mean returns more than the variance. The AIC and BIC values express more accurately the goodness of fit of the model than the R^2. Still, it can be observed that the model captures around 71% of the return structure on average. Interestingly, it can be observed that although the Financial and Industrials previously demonstrated a poor goodness of fit with the AIC and BIC metrics, they are the two sectors that have the highest R^2 values above 80%. The sector with the lowest R^2 value is the Utilities sector just below 60%.

6.4.2 Volatility Transmission GARCH Model With Control Variables

The same model was run taking into consideration the control variables of Inflation and the ECB rate and produced results in the same format, as shown in Table 10 below.

Table 10: GARCH Model Results With Control Variables

Sector	Factor Model R²	GARCH Alpha	GARCH Beta	GARCH Omega	Log Likelihood	AIC	BIC
FROG	0,67	0,0500	0,9300	1,25E-06	8901,76	-17795,53	-17772,14
FRHC	0,63	0,0500	0,8500	5,02E-06	9058,85	-18109,69	-18086,30
FRUT	0,60	0,0597	0,6434	2,21E-05	8542,18	-17076,36	-17052,98
FRCS	0,64	0,2000	0,5000	1,57E-05	9355,83	-18703,67	-18680,28
FRFIN	0,80	0,0500	0,9300	1,10E-06	3671,07	-7334,14	-7310,76
FRTEC	0,64	0,0100	0,9700	1,14E-06	8914,55	-17821,10	-17797,71
FRBM	0,77	0,0100	0,9700	9,12E-07	6816,74	-13625,49	-13602,10
FRIN	0,88	0,0500	0,9300	3,89E-07	9627,35	-19246,70	-19223,32
FRCG	0,80	0,0500	0,8500	2,52E-06	9957,08	-19906,16	-19882,77

Source: Own Elaboration

When comparing both tables, it can be observed that the results stay around the same suggesting regularity in the databases. However, two main differences can be detected, the first being the difference of fit of the Financials and Industrials sector. In the previous analysis, the model fit was an obvious poor fit without accounting for control variables. The improvement in fit metrics (Log likelihood, AIC and BIC)

for these sectors considering macroeconomic variables highlight the relevance of systemic monetary factors in explaining sector-level equity volatility.

This resonates with the earlier conclusion that these sectors are exceptionally influenced by several factors. By controlling for macro-economic variables, the model can reduce statistical noise from these factors and provide a better explanation for exchange rate dynamics. Although the Industrials sector has similar results in these metrics as the other sectors, the Financials sector remains the sector with the least log likelihood with a difference of over 5000 from the other sectors, in combination with the most important AIC and BIC values around –7300. It can also be highlighted that in improving the fit of some sectors, one sector suffered a slightly worse fit being the Basic Materials sector.

The second notable difference between the databases run in the model is the improved fit for the Utilities sector through the results of the Alpha and Beta metrics. The inclusion of the ECB rate and inflation controls resulted in a slight decrease in the Alpha, dampening the impact of daily return changes on variation. It also brought upon a proportionally larger increase in Beta, demonstrating greater volatility persistence, indicating that macroeconomic variables when considered help stabilize short-term fluctuations. In addition, it is noteworthy that the R^2 values also slightly increased by 0,0002 adding to the conclusion that the inclusion of control variables improves the model's robustness and interpretation.

Apart from these two previous remarks, the differences between both databases are quite faint with slight improvements in R^2 values for the Health Care sector (increasing by 0,0004), the Technology sector (increasing by 0,0002) as well as the Oil and Gas, Financials and Consumer Goods sector (increasing by 0,0001). These marginal improvements are not statistically significant but do indicate a slightly enhanced model fit. In summary, the GARCH model underscores the importance of distinguishing between short-term and long-term reactions in markets, as well as the intensity of volatility in equity returns. Unlike the previous models, the inclusion of control variables here was observed to materially improve explanatory power for two sectors, highlighting the relevance of macro-economic conditions in volatility dynamics. Taken together, the GARCH results complete the econometric framework of the analysis providing a nuanced view of how exchange rate movements transmit into sectoral returns.

7 Summary of Obtained Results

The use of four models to analyze the data helped to answer the question whether the American US Dollar FX rate dynamics with the Euro impacted domestic French Financial Markets. Firstly, it is important to reemphasize that each model focuses on different aspects of the problem, whether it be observing returns or volatility, having a static or dynamic analysis, or even the use of default OLS and GARCH assumptions compared to the use of clustered errors in the panel regressions. These distinctions in turns creates

limitations when comparing the models between themselves as the results should be interpreted as complementary perspectives. However, one truth common to all models is the considerable model fit for each analysis, with an average of 0,7 R^2 value. This helps to solidify and validate that the conclusions drawn from the results of the models suggest an appropriate fit. Secondly, it was noticed that the differences between the use of the database without the control variables compared to the one that included them were minor between each model. In the end, the models demonstrated whether the FX rate had influence on the returns and the volatility of each index substantially well without the control variables. When they were included, they either reinforced the conclusions already drawn previously or reinforced the model, the fourth model for example where the fit improved drastically for two indices. But above all, what is most interesting to observe is how each index behaves differently compared to each other across the different models.

7.1 Summary for Each Sector

7.1.1 CAC Oil and Gas (FROG)

This first sector blends into the averages of the behaviors of all other indices. It is neither the most nor least sensitive to FX movements. Already in the first model, it was observed that it had one of the least significant FX Beta p-values, accepting the null hypothesis. This suggested that USD/EUR FX rate did not impact or not nearly enough the returns on the Oil and Gas sector in France. However, in the third model, although the FX Beta was slightly negative and close to null, the range between its maximum and minimum FX Beta values were amongst the largest ranges, suggesting important spikes. This was also reflected in the daily Beta spike variations which correlated with relevant events which significantly impacted the sector and its regulatory scope. In this same model, once the control variables were considered, the daily FX Beta spike variation maximum was much higher than without the control variables. Meaning that accounting for macro-economic effects demonstrated that the variation from the FX rate was much more significant than previously demonstrated. As for the fourth model, the Oil and Gas sector's results ended up in the averages of the indices, with no particularly important takeaways. Overall, the French Oil and Gas sector demonstrated that it behaved on average similarly to the average of all sectors concerning the FX exposure and effects it has cascading down in the markets. In the end, the H1 hypothesis which predicted the Oil and Gas sector to experience high exposure to the exchange rate proved to not be true in the first two models, experiencing average exposure levels or statistically insignificant results, but true in the third and fourth model with levels significant to the other sectors.

7.1.2 CAC Health Care (FRHC)

This following sector is the most strongly influenced by movements in the USD/EUR FX rate across several models, completely validating the H2 hypothesis. Firstly, it was observed right from the first model that it had the highest significance level of FX Beta implying the strongest correlation. At the same time, it indicated having the weakest Market Beta, signifying that the index didn't sway to the market rate's every movement. Following suit, it was observed in the third model that as the market Beta was weaker compared to the average, it had the highest FX Beta correlation. Even with the inclusion of the control variables, it maintained its sensitivity to the FX rate. This high sensitivity resonates with the previous assumptions of positive exposure due to the high international exposure. Despite having high sensitivities, it can be observed that the daily variation levels for the 20 most significant spikes average in the lower tranches. This resonates when observing the volatility effects in the fourth model, as the Health Care sector blends into the averages with its Alpha and Beta levels. This implies that the volatility of these returns although correlated with the FX rate, the spikes remain moderate, and the volatility spikes persist over time. The only exception to the sector's hypothesis proof is the results in the second model which demonstrated statistically insignificant low exposure for all sectors.

7.1.3 CAC Utilities (FRUT)

When observing the results for the Utilities sector, the first significant observation concerns the poor average R^2 value across all models. This value is of 0,5996 without controls and 0,5998 with controls for the first model, 0,54 for the no controls and 0,55 with controls for the third model and 0,5995 without controls for the fourth model. These values on the lower end of the range suggests that the models explain barely 60% of the observable results. The fit metrics of the fourth model do however show that the model is of significant fit with the high log likelihood and low AIC and BIC values. Nonetheless, the results demonstrate that the Utilities sector is lightly impacted from the FX rate. In the first model, it can be observed that the FX Beta has a high significance and therefore confirming the negative H3 hypothesis, confirming the impact on the returns. In the second model, as the aggregate result for all sectors presented weak exposure to the FX rate, the Utilities validates its hypothesis in this analysis. In the third model, it was observed that the FX Beta was slightly negative at –0,06 on average, demonstrating a slightly inverse correlation between movements in the Utilities sector prices returns against the FX rate movements. These movements were observed to be slightly more intense on average than other sectors but persisted for shorter periods of time as seen in the fourth model.

7.1.4 CAC Consumer Service (FRCS)

The Consumer Services sector behaves differently across the different models. In the first, it was observed that it was one of three sectors to have completely failed to reject the null hypothesis with the level of p-value for the FX Beta, signifying there wasn't enough statistic explanatory power from the FX rate which affected the index's returns. The second model demonstrated for the Consumer Services sector just as for the Utilities sector to present a weak and statistically insignificant aggregate impact from FX, therefore reinforming the H4. Despite having an average positive FX Beta level, the Consumer Services presented impressive results in terms of the level of daily FX Beta spike variation for the 20 highest observations. These intense reactions in return change levels correlates with the volatility observations run in the fourth model presenting the highest FX Alpha level of all sectors while having the smallest Beta. Overall, the Consumer Services although at first not significantly impacted by the market and FX rate presents the largest daily volatility shocks with low persistence in reaction to FX rate movements.

7.1.5 CAC Financials (FRFIN)

The Financials sector stands out as one of the most relevant sectors in this analysis due to its strong decorrelation to the FX rate in each model. It is intrinsically correlated to the market rate with Beta values of over one in the different models whilst simultaneously having negative Beta FX values. However, this decorrelation has strong significance due to the high p-value in the first model and the R^2 values across all models. It was also observed that the FX Beta had the largest range in values in the third model implying significant volatility. This volatility was confirmed in the fourth model with an average level of Alpha but an above average level of Beta implying that shocks persisted in time. This high sensitivity and inverse correlation reinforce the H5 assumption that this sector tends to hedge itself against currency movements. This sector also is impacted by several economic factors, as it revealed to have an important difference in terms of model fit before and after including the control variables in the fourth analysis. To sum up, the Financials sector is indeed one of the most interesting to focus on when observing the way it interacts with FX movements.

7.1.6 CAC Technology (FRTEC)

The Technology sector establishes from the start that it is not particularly swayed by the USD/EUR FX movements, contrary to the initial H6 assumptions. In the first model, the FX Beta was only slightly positive but with an insignificant p-value, contrary to the Market Beta which was of 82,7%. The positive FX Beta is maintained in the third model at 0,05, implying a positive correlation with the FX rate, as well as a similar Market Beta. The sector has the highest Beta at 0,97 meaning that these spikes tend to persist in the markets

the longest. The Technology sector also has the weakest Alpha at 0,01 further confirming that returns are slightly affected by FX movements. Interestingly, despite the semi strong correlation, the daily FX Beta variation reaches quite high levels in the 20 most significant observations, reaching over 33.87% for the most significant observation in the analysis without control variables and 22.27% with the controls. This signifies that although the index is barely swayed by FX movements across all observations, the sector still experiences large changes in daily variations. For all models, their R^2 values average around 60%, signifying that the variation is less explained by the regression models than other sectors.

7.1.7 CAC Basic Materials (FRBM)

The Basic Materials index demonstrates signs of not being impacted by the FX rate, which resonates with the initial H7 assumption of a mixed exposure due to strong hedging practices. Firstly, the FX Beta's p-value shows a semi strong significance with a FX Beta of –0,05 and a market Beta slightly over the value of one. This FX Beta shifts more into the negative at –0,06 in the third model, whilst maintaining a sensible level of R^2 at 74%. The Basic Materials reveals to have the same parameters in the fourth model as the previous Technology sector, with an Alpha of 0,01 and a Beta of 0,97 however with a stronger R^2 value and a better model fit. This solidifies the conclusion in a superior manner compared to the Technology sector that the volatility in market returns do not outperform other sectors in terms of magnitude but does in terms of its longer-term impact on markets. However, the level of return sways are almost six times weaker than the Technology sector maxing out at 5.22% without controls and 5.67% with control variables.

7.1.8 CAC Industrials (FRIN)

The Industrials sector demonstrates different attitudes towards the FX rate across the model starting with a weak level of p-value right off the bat in the first model when exposing the slightly negative FX Beta of -0,028 for a high level of R^2 explanatory power of 87,5%. However, in the third model it demonstrates now a positive level at 0,04 whilst having the smallest range in values and the highest levels of average, maximum and minimum R^2 values. Furthermore, the levels of variation of daily return movements are the weakest for the 20 most significant observations in the analysis without control variables with a maximum of 2.76%. One relevant observation in this sector is the differences in results observed when including the macro economical control variables. Firstly, the FX Beta daily variation increases almost ten times once the control variables were accounted for, reaching a maximum change of 21.82% while maintaining the same level of FX Beta at 0,04 and the same R^2 values. Secondly, the fourth model proved to be a terrible fit for the model without controls as indicated by the model fit variables. Perhaps by including these controls, they were able to highlight these important changes which were offset from the simpler database.

In the case of the fourth model, once the controls were included, the sector confirmed to be one of the most stable sectors due to its smaller Alpha of 0,05 and its higher Beta of 0,93. Overall, the conclusions of the behaviors of this sector demonstrate a weaker reaction than anticipated in the theoretical assumption H8, determining the Industrials sectors to be very rarely exposed to USD/EUR FX dynamics due to its more domestically oriented companies and solid firm-level hedging practices .

7.1.9 CAC Consumer Goods (FRCG)

This final model demonstrated very significant behaviors towards the USD/EUR FX rate across the models. It first displayed a high level of p-value significance towards its FX Beta level of 0,09, crowning itself as the second most correlated sector behind the Health Care sector in the first model, all while having a higher R^2 level at 80% and Market Beta at 83,9%. With a slightly smaller average FX level, it also followed right behind the Health Care sector with a positive correlation of 0,06 in the third model. It did however surpass the Health Care sector's levels of daily return variations peaking at 5.55% in the no controls analysis and 14.95% in the controls analysis. Finally, in the GARCH model, it had the same level of Alpha of 0,05 and Beta 0,85 as its fellow positively correlated Health Care sector, while having a higher R^2 value of almost 20% higher at 80%. Overall, it can be concluded that much like the Health Care sector, the Consumer Goods sector is positively correlated to the FX rate of USD/EUR with return variations that reach moderate levels but persist the repercussions for significant periods of time. This ties back to the H9 assumption that Consumer Goods are influenced by exchange rates in a nonlinear manner, deeply dictated by economic consumption conditions.

7.2 Summary Table

The Table 11 below encapsulates the above conclusions made for each sector distinguished by model as well as pre and post inclusion of the control variables, with a 'Y' notation validating the assumptions and a 'N' rejecting the hypothesis.

Table 11: Summary of Results

Sector	Hypothesis	Model 1		Model 2		Model 3		Model 4	
		W/O Contro	W/ Control	W/O Control	W/ Control	W/O Control	W/ Control	W/O Control	W/ Control
FROG	H1: High Exposure	N	N	N	N	Y	Y	Y	Y
FRHC	H2: High Positive Exposure	Y	Y	N	N	Y	Y	Y	Y
FRUT	H3: Weak or Negative Exposure	Y	Y	Y	Y	Y	Y	Y	Y
FRCS	H4: Weak Exposure	Y	Y	Y	Y	N	N	N	N
FRFIN	H5: High Negative Exposure	Y	Y	N	N	Y	Y	N	Y
FRTEC	H6: Mixed/Weak Exposure	Y	Y	N	N	Y	Y	Y	Y
FRBM	H7: Mixed Exposure	Y	Y	N	N	Y	Y	Y	Y
FRIN	H8: Mixed Exposure	Y	Y	N	N	Y	Y	N	Y
FRCG	H9 : High/Mixed Exposure	Y	Y	N	N	Y	Y	Y	Y

Source: Own Elaboration

Markedly, the second model demonstrates clearly how its aggregated results impacted the conclusions taken by each sector. Besides this, it can be observed that most of the results presented resonated with the researched sectoral assumptions.

8 Conclusion and Recommendations

8.1 Conclusion

This thesis set out to investigate whether exchange rate fluctuations of the USD/EUR influenced French equity returns. By compartmentalizing the domestic financial market into nine different economic sectors, it allowed the analysis to draw different hypothesis of each sector depending on its scope of activity and to observe their different sensitivities to the FX rate. To mitigate statistical complexity when interpreting the indices' results, three control variables were considered: the French market rate (represented by the CAC40 index) to assess the market correlation of the indices; the MRO rate from the ECB, to control for changes in monetary policies; and the annual inflation rate, to explain the varying economic landscape during the observed period.

Four different models were computed to create a comprehensive econometric framework with the goal of addressing the thesis' objective with different complementary angles. Focusing on both mean return exposure and volatility transmission of the indices, the four following models were used: a baseline OLS regressions model, an aggregate panel regressions model, a TVP model and finally a GARCH model.

The results from the primary OLS regressions analysis demonstrated each index to have a strong correlation with the market rate and a statistically significant relationship for some sectors to the underlying exchange rate, notably the Health Care, Financials and Consumer Goods indices. These findings aligned with the sectoral hypothesis formed prior to the analysis, which highlighted the international exposure of each industry.

The secondary analysis, focusing on the aggregate fixed and pooled effects of the indices, revealed market wide factors to have an impact on equity markets but demonstrated limitations as much of the variance was absorbed.

The third model provided further depth in understanding the relationship between the USD/EUR rate and the industries' returns. It offered evidence that FX Betas were not stable over time but instead fluctuated in response to macro economical, geopolitical and sector-specific events. By highlighting these different Betas as well as the specific dates the sectors experienced important changes in return levels, the spikes could be traced back to key episodes such as the European debt crisis in 2012, the ECB's QE program in 2015 and the 2017 elections.

Lastly, the GARCH model highlighted the volatility channels of these equity indices, demonstrating that FX volatility does spillover into sectoral return volatilities. Different volatility profiles were identified, on one side with sectors experiencing intense volatility spikes that were short lived, such as the Consumer Services sector, and on the other end indices with more muted volatility spikes but with a more persistent volatility, such as the Technology and Basic Materials sectors.

Taken together, these models demonstrated that exchange rate fluctuations do matter in French sectoral returns with heterogenous effects across industries, time periods and market conditions. The findings of this thesis can present some implications both for investors when considering sectoral hedging implications, as well as for policymakers when deliberating on monetary and FX exposure management.

Professionals such as portfolio managers or individual investors may find practical relevance in these findings, confirming intuitive belief on exchange rate dynamics impacting financial markets. Identifying sectors which display positive and persistent FX exposures, such as the Health Care and Consumer Goods sectors, may benefit portfolios from a strengthening US Dollar and serve as a natural hedge. Conversely, sectors which exhibited negative correlations and high varying FX Betas, such as the Financials sector, would require more active hedging strategies. The strong volatility persistence for sectors such as the Technology and Basic Materials suggests to investors to exercise caution when holding these sectors during periods of economic uncertainty, as shocks may linger and amplify risk. A sector-specific hedging approach compared to a broad market hedge would act as an effective strategy when holding globally diversified portfolios.

Other economic agents such as policymakers may also find this paper to offer insights on the sensitivity of French industries to exchange rate fluctuations, especially in internationally exposed sectors. As observed in the study, decisions from the ECB, such as the QE program, translates near-systematically in financial markets providing different types of reactions. In addition, the improved fit of the GARCH model once control variables were considered demonstrated that monetary policy interacts meaningfully with sectoral volatility. Policymakers should therefore consider the spillover effects of exchange rate movements on sectoral stability when drafting monetary policy, especially when the heterogenous impact was highlighted across sectors.

8.2 Limitations and Recommendations

Despite the valuable insights this thesis provides for professionals, it still holds some limitations related to the different components of the models. Firstly, the main limitation in this approach is the multi-correlation effect when arguing whether FX movements impact equity returns as it raises the issue of causality. While the analysis frames this argument, it could equally be argued that equity market movements

influence exchange rate dynamics. Disentangling the multi-correlation effect of financial variables which are influenced by a multitude of factors remains challenging and beyond the scope of the econometric models employed in this study.

Another limitation in this study, which contributes to the multi-correlation effect, is the limited number of control variables. While both the ECB's MRO and the annual inflation rates improved explanatory power in some models, many potential drivers were considered but set aside. In addition to macroeconomic effects, global risk factors such as commodity prices, interest rate spreads or global risk aversion indicators like the VIX index could yield richer insights. In addition, specifically controlling for important historical events such as presidential elections, sovereign rating downgrades and regulatory reforms may provide clearer insights on the true impact of the USD/EUR exchange rate on financial markets.

The choice of underlying assets in representing the French economy as well as the attributes of the chosen data both present some limits. The reliance on the CAC40 to represent the market index may be limited when compared to the S&P500 as a market index for the US due to the limited number of companies in the index. Indeed, France's size in comparison to the US is relative however an index which covers a broader range of companies, such as the CAC All-Tradable of around 250 companies, may act as a better market rate. In addition, the market rate and the CAC based sector indices may limit the representativeness of the French economy due to the important amount of international activity of some underlying companies have as well as important sub-sectors grouped in broader categories. The large international profit contribution of the corporations may limit the true representation of the French market as a domestic economy. As for the sub-sectors, key industries of France such as luxury goods (e.g., LVMH, Kering, Hermès) and aerospace and defense (e.g., Airbus, Dassault Aviation, Thales) deserve their own standalone indices and are instead aggregated under larger indices.

In regard to the attributes of the data, the frequency of the data utilized represents some constraints. The use of daily returns provides a high-frequency perspective but introduces statistical noise and microstructure effects. In comparison, the mismatch in periodicity with the annual inflation rate or the occasional changes in the ECB MRO rate creates disproportionally large coefficients and interpretational challenges. A harmonization of data frequency would be preferable.

The final limitations can be identified within the models. While the first two models with the OLS and panel regressions provide intuitive starting points in building a comprehensive econometric framework, the reliance on static assumptions are counterintuitive considering the dynamic nature of the financial data utilized. In addition, the absence of the HAC/Newey-West and Hausman statistical tests limit the robustness of the models and should be considered when revisiting this subject. Concerning the TVP model, the window size of 252 trading days presents some questions as a shorter or longer window might yield

different results. Indeed, when constructing the window for the rolling regressions, the entire data points of the year 2010 could not be used for estimation therefore reducing the sample size. In addition, the results from the rolling betas should be interpreted with caution as the short-term spikes may only reflect statistical noise.

Lastly, the insightful results on the volatility of the equity returns impacted from the observed exchange rate from the GARCH model also holds some limitations. Although the model significantly improved its robustness for two of the sectors when control variables were considered, the restrictive assumptions associated with the model limited its applicability. The conditional normality of errors that the GARCH model assumes presents a limitation with the type of data considered as financial returns often have fat tails, which may bias the estimates of the persistence of volatility. In addition, the cross-sector volatility spillover effects were not captured due to the separate modelling of volatility for each sector. Overall, the framework did still provide valuable insights in tackling the impacts of FX in equity returns. Still, the methodological caveats underline the need to interpret the results with caution and leave room for improvement for future research.

Considering the different limitations of the models, they offer several opportunities to expand the literature with reinforced quantitative models as well as different perspectives with regard to the underlying focus for future research. Firstly, the scope of the research could be changed to observe different countries or the aggregate Euro Area countries and study the cross- spillovers in different sectors. Secondly, custom indices could be constructed to be able to capture specific sectors impacts from FX, especially for the luxury goods or aerospace and defense sectors of France which were overlooked in the aggregate indices.

Thirdly, in addition to the underlying equities, the observed currency rates could be broadened to include several sets of currencies for a more realistic mapping of France's international interactions and FX exposures. Notably, the exchange rates with the Great British Pound (GBP), the Chinese Yuan (CNY) or even the Japanese Yen (JPY) could make great contenders for future research. Fourth, the sampling period could be modified to include crisis episodes, such as the 2020 COVID-19 pandemic, and observe how FX exposures evolve pre and post global crisis.

Finally, future studies could apply richer econometric models to push the analysis further. Notably, more volatility frameworks such as the EGARCH, the GJR-GARCH or a multivariate GARCH model would improve the fit when dealing with financial and intercorrelated data. In addition, machine learning approaches could be used to improve the accuracy in the dataset or to reveal nonlinear relationships.

On a concluding note, this thesis has sought to illuminate the role of exchange rate fluctuations in shaping French sectoral capital returns and volatility. By combining four econometric models, the framework was able to uncover different facades of the problem, demonstrating that FX exposures are heterogenous across sectors, evolve over time and vary depending on the given macro-economic and

geopolitical context. While the insights presented some limitations, they offer valuable guidance for investors and policymakers when assessing their hedging strategies, highlighting the importance of holding a top-level sectoral view in equity portfolios. The summative message of the paper is that exchange rate dynamics are deeply intertwined alongside a multitude of factors with the functioning of French equity markets, and understanding this relationship remains a crucial task in an increasing globalized financial environment.

9 Bibliographical References

2024 full year results - LVMH. (2025, January 28). https://www.lvmh.com/en/financial-calendar/2024-full-year-results

AFP, L. M. A. (2014a, January 23). Tempête Dirk : les dégâts évalués à 100 millions d'euros en Bretagne. *Le Monde.fr*. https://www.lemonde.fr/societe/article/2014/01/23/tempete-dirk-en-bretagne-les-degats-evalues-a-100-millions-d-euros_4352824_3224.html

AFP, L. M. A. (2014b, May 6). L'offre de GE pour Alstom ne satisfait pas l'Etat. *Le Monde.fr*. https://www.lemonde.fr/economie/article/2014/05/05/alstom-pour-montebourg-l-offre-de-ge-n-est-pas-acceptable-en-l-etat_4411959_3234.html

Agasse, A. (2011, February 3). *Le gouvernement suspend les forages de prospection de gaz de schiste | Public Sénat*. https://web.archive.org/web/20110207042141/http://www.publicsenat.fr/lcp/politique/gouvernement-suspend-forages-prospection-gaz-schiste-72713

Air Liquide. (n.d.-a). *Air Liquide in brief*. https://www.airliquide.com/group/air-liquide-brief

Air Liquide. (n.d.-b). *Managing financial and tax risks*. https://www.airliquide.com/managing-financial-and-tax-risks

Alstom. (2025). Full year results Fiscal year 2024/25. In *Alstom*. https://www.alstom.com/sites/alstom.com/files/2025/05/13/20250514_Alstom_FY_%202024_25_Annual_Results_Presentation_EN.pdf

Altavilla, C., Carboni, G., & Motto, R. (2015). Asset purchase programmes and financial Markets: lessons from the Euro area. *ECB*, No 1864. https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1864.en.pdf

Bartram, M., & Bodnar, M. (2005). The exchange rate exposure puzzle. *Research Gate*. https://doi.org/10.1108/03074350710776226

Becuwe, S., & Blancheton, B. (2011). Le commerce international de la France dans la première mondialisation (1850-1913). *Histoire & Mesure*, *XXVI*(2), 105–130. https://doi.org/10.4000/histoiremesure.4310

Berman, N., Martin, P., & Mayer, T. (2012). How do different exporters react to exchange rate changes? *The Quarterly Journal of Economics*, 127. 437-492. https://doi.org/10.2307/41337214

Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics*, *31*(3), 307–327. https://doi.org/10.1016/0304-4076(86)90063-1

Boz, E., Casas, C., Georgiadis, G., Gopinath, G., Mezo, H. L., Mehl, A., & Nguyen, T. (2020). Patterns in invoicing currency in global trade. *IMF Working Paper*, *20*(126). https://doi.org/10.5089/9781513550435.001

Brander, M., Bernauer, T., & Huss, M. (2023). Trade policy announcements can increase price volatility in global food commodity markets. *Nature Food*, *4*(4), 331–340. https://doi.org/10.1038/s43016-023-00729-6

Bruno, V., & Shin, H. S. (2014). Cross-Border banking and global liquidity. *The Review of Economic Studies*, *82*(2), 535–564. https://doi.org/10.1093/restud/rdu042

CAC 40 Gross TR | Cours Indice CAC 40 Gross Total Return en direct - Investing.com. (n.d.). Investing.com France. https://fr.investing.com/indices/cac-40-gr

CAC Basic Materials Historical Data (FRBM) - Investing.com. (n.d.). Investing.com. https://www.investing.com/indices/cac-basic-materials-historical-data

CAC Consumer Goods Index Today (FRCG) - Investing.com. (n.d.). Investing.com. https://www.investing.com/indices/cac-consumer-goods

CAC Consumer Service Index Today (FRCS) - Investing.com. (n.d.). Investing.com. https://www.investing.com/indices/cac-consumer-service

CAC Financials Index Today (FRFIN) - Investing.com. (n.d.). Investing.com. https://www.investing.com/indices/cac-financials

CAC Health Care Index Today (FRHC) - Investing.com. (n.d.). Investing.com. https://www.investing.com/indices/cac-health-care

CAC Industrials Index Today (FRIN) - Investing.com. (n.d.). Investing.com. https://www.investing.com/indices/cac-industrials

CAC Oil & Gas Index Today (FROG) - Investing.com. (n.d.). Investing.com. https://www.investing.com/indices/cac-oil---gas

CAC Technology Index Today (FRTEC) - Investing.com. (n.d.). Investing.com. https://www.investing.com/indices/cac-technology

CAC Utilities Index Today (FRUT) - Investing.com. (n.d.). Investing.com. https://www.investing.com/indices/cac-utilities

Caldara, D., & Iacoviello, M. (2022). Measuring geopolitical risk. *American Economic Review*, *112*(4), 1194–1225. https://doi.org/10.1257/aer.20191823

Campa, J. M., & Goldberg, L. S. (2005). Exchange Rate Pass-Through into Import Prices. *SSRN Electronic Journal*. https://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID556762_code347008.pdf?abstractid=556762&mirid=3

Campa, M., & Goldberg, L. (2002). Exchange Rate Pass-Through into import prices: a macro or micro phenomenon? *NBER*, *Working Paper No. 8934*. https://www.nber.org/system/files/working_papers/w8934/w8934.pdf

Cezar, R., & Silvestrini, M. (2018). Impact of the ECB quantitative easing on the French international investment position. *Banque De France*, *Working Paper 701*. https://publications.banque-france.fr/sites/default/files/medias/documents/wp701.pdf

Chagnaud, I., Gossé, J. B., Le Gallo, F., & Lecat, R. (2023, January). *The stages in France's European financial integration | Banque de France*. Banque De France. https://www.banque-france.fr/en/publications-and-statistics/publications/stages-frances-european-financial-integration

Chocron, V. (2019, August 6). BNP Paribas, un an après l'amende. *Les Echos*. https://www.lesechos.fr/2015/09/bnp-paribas-un-an-apres-lamende-1108300

Choi, J. J., Elyasiani, E., & Kopecky, K. J. (1992). The sensitivity of bank stock returns to market, interest and exchange rate risks. *Journal of Banking & Finance*, *16*(5), 983–1004. https://doi.org/10.1016/0378-4266(92)90036-y

DBRS confirms France at AAA, trend changed to negative. (2014, November 7). Morning Star DBRS. https://dbrs.morningstar.com/research/273733/dbrs-confirms-france-at-aaa-trend-changed-to-negative

De Saint Leger, O., & Fourneret, A. (2017). Case study Alstom-GE. *HEC MIF Program*. https://www.vernimmen.net/ftp/Case_Study_Alstom_GE.pdf

Décret n° 2014-479 du 14 mai 2014 relatif aux investissements étrangers soumis à autorisation préalable. (2014, May 16). Legi France. https://www.legifrance.gouv.fr/loda/id/JORFTEXT000028933611/

Delivorias, A. (2015). The ECB's quantitative easing early results and possible risks. In *European Parliament*. https://www.europarl.europa.eu/RegData/etudes/BRIE/2015/572824/EPRS_BRI(2015)572824_EN.pdf

Ding, D., & Timmer, Y. (2022). Exchange rate elasticities of international tourism and the role of dominant currency pricing. *IMF Working Paper*, *2022*(024), 1. https://doi.org/10.5089/9781616358563.001

Dominguez, K. M., & Tesar, L. L. (2005). Exchange rate exposure. *Journal of International Economics*, *68*(1), 188–218. https://doi.org/10.1016/j.jinteco.2005.01.002

Dominguez, K., & Tesar, L. (2001). Exchange rate exposure. *NBER*, *Working Paper 8453*. https://www.nber.org/system/files/working_papers/w8453/w8453.pdf?utm_source=PANTHEON_STRIPPED

Doukas, J. A., Hall, P. H., & Lang, L. H. P. (2003). Exchange rate exposure at the firm and industry level. *Financial Markets Institutions and Instruments*, *12*(5), 291–346. https://doi.org/10.1046/j.0963-8008.2003.00001.x

En septembre 2011, les prix des matières premières importées reculent de nouveau - Informations rapides | Insee. (2011, October 7). Insee. https://www.insee.fr/fr/statistiques/1564402

Energy generation | ENGIE. (2025). Engie.com. https://www.engie.com/en/activities/energy-generation

EssilorLuxottica. (2024). In *Moody's Ratings*. https://www.essilorluxottica.com/cap/content/241852/

Euronext publishes Q4 and full year 2024 results. (2025). In *Euronext*. https://www.euronext.com/en/about/media/euronext-press-releases/euronext-publishes-q4-and-full-year-2024-results

Ferson, W., & Harvey, C. (1989). The variation of economic risk premiums. *Journal of Political Economy*, *99*(2). https://people.duke.edu/~charvey/Research/Published_Papers/P5_The_variation_of.pdf

Fitch affirms France at "AAA"; outlook revised to negative. (2011). In *Fitch Ratings*. https://www.fitchratings.com/research/sovereigns/fitch-affirms-france-at-aaa-outlook-revised-to-negative-16-12-2011

Foreign Exchange Committee releases FX Volume Survey results. (2025). *Foreign Exchange Commitee*. https://www.newyorkfed.org/medialibrary/Microsites/fxc/files/2025/Volume-Survey-Press-Release-07222025

France. (2023). *IEA*. https://www.iea.org/countries/france/energy-mix

France Electricity imports & exports review | RTE. (2025). https://analysesetdonnees.rte-france.com/en/exchanges/imports-exports

France (FRA) Exports, Imports, and Trade Partners | The Observatory of Economic Complexity. (2023). The Observatory of Economic Complexity. https://oec.world/en/profile/country/fra

Gallant, N. (2023, October 16). Bourse : guerres en Israël et en Ukraine, taux. . . les plus grands dangers depuis des décennies selon JPMorgan. *Capital*. https://www.capital.fr/entreprises-marches/bourse-guerres-en-israel-et-en-ukraine-taux-les-plus-grands-dangers-depuis-des-decennies-selon-jpmorgan-1482353

Georgiadis, G., & Schumann, B. (2021). Dominant-currency pricing and the global output spillovers from US dollar appreciation. *Journal of International Economics*, *133*, 103537. https://doi.org/10.1016/j.jinteco.2021.103537

Godeluck, S. (2014, May 19). Numericable va avaler Virgin Mobile pour 325 millions d'euros. *Les Echos*. https://www.lesechos.fr/2014/05/numericable-va-avaler-virgin-mobile-pour-325-millions-deuros-282978

Gopinath, G., Boz, E., Casas, C., Díez, F. J., Gourinchas, P., & Plagborg-Møller, M. (2020). Dominant Currency paradigm. *American Economic Review*, *110*(3), 677–719. https://doi.org/10.1257/aer.20171201

Gueugneau, R., & Schmitt, F. (2014, November 19). Le nouveau SFR-Numericable lance sa première offensive. *Les Echos*. https://www.lesechos.fr/2014/11/le-nouveau-sfr-numericable-lance-sa-premiere-offensive-297475

Guinot, D. (2011, December 30). Le CAC 40 a perdu 17 % en 2011, miné par la crise. *Le Figaro*. https://www.lefigaro.fr/marches/2011/12/30/04003-20111230ARTFIG00413-le-cac-40-a-perdu-17-en-2011-mine-par-la-crise.php

Gygli, S., Haelg, F., Potrafke, N., & Sturm, J. (2019). The KOF Globalisation Index – revisited. *The Review of International Organizations*, *14*(3), 543–574. https://doi.org/10.1007/s11558-019-09344-2

Hahn, E. (2007). The impact of exchange rate shocks on sectoral activity in the euro area. *ECB*, *Working Paper Seriers No 796*. https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp796.pdf

Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica*, *46*(6), 1251. https://doi.org/10.2307/1913827

He, J., & Ng, L. K. (1998). The Foreign Exchange Exposure of Japanese Multinational Corporations. *The Journal of Finance*, *53*(2), 733–53. https://www.jstor.org/stable/117368?seq=1

Hempell, T., Zanghieri, P., & Wolburg, M. (2017). Market perspectives. In *Generali Investments*. https://www.generali.com/doc/jcr:59049bce-ba9d-45e1-b943-fd2b9cca2b1b/lang:en/MP_0317.pdf

Historique. (n.d.). Ministère De L'économie Des Finances Et De La Souverainte Industrielle Et Numérique. https://www.economie.gouv.fr/facileco/historique#

Hofmann, B., Igan, D., & Rees, D. (2023). The changing nexus between commodity prices and the dollar: causes and implications. *Bank for International Settlements*, *No 74*. https://www.bis.org/publ/bisbull74.pdf

International trade and production of high-tech products. (2025). In *Europea*. https://ec.europa.eu/eurostat/statistics-explained/SEPDF/cache/39716.pdf

Jorion, P. (1990). The Exchange-Rate exposure of U.S. multinationals. *The Journal of Business*, 63(3), 331–345. http://www.jstor.org/stable/2353153

Kang, W., Ratti, R., & Vespignani, J. (2015). The impact of oil price shocks on the U.S. stock market: A note on the roles of U.S. and Non-U.S. oil production. *Federal Reserve Bank of Dallas*, Working Paper No. 249. https://www.dallasfed.org/~/media/documents/institute/wpapers/2015/0249.pdf?utm_

Krugman, P. (1986). *Pricing to Market when the Exchange Rate Changes*. https://doi.org/10.3386/w1926

Le Bris, D., & Hautcœur, P. (2010). A challenge to triumphant optimists? A blue chips index for the Paris stock exchange, 1854–2007. *Financial History Review*, *17*(2), 141–183. https://doi.org/10.1017/s096856501000003x

Lepeltier, S. (2004, March 3). *Mondialisation : une chance pour l'environnement ? - Sénat*. Sénat. https://www.senat.fr/rap/r03-233/r03-23311.html

L'essentiel sur. . . l'inflation | Insee. (2025, February 18). https://www.insee.fr/fr/statistiques/4268033#tableau-figure1

LOI n° 2011-835 du 13 juillet 2011 visant à interdire l'exploration et l'exploitation des mines d'hydrocarbures liquides ou gazeux par fracturation hydraulique et à abroger les permis exclusifs de recherches comportant des projets ayant recours à cette technique (1). (2011, July 14). Legi France. https://www.legifrance.gouv.fr/loda/id/JORFTEXT000024361355

Macron's victory gets muted reaction from financial markets. (2017, May 8). *Euronews*. https://www.euronews.com/business/2017/05/08/macron-s-victory-gets-muted-reaction-from-financial-markets

Magnus, J. R. (2022). Gauss on least-squares and maximum-likelihood estimation. *Archive for History of Exact Sciences*, *76*(4), 425–430. https://doi.org/10.1007/s00407-022-00291-w

Martin, A., & Agence, A. (2013, December 24). Tempête Dirk : 240.000 foyers sans électricité. *Le Figaro*. https://www.lefigaro.fr/actualite-france/2013/12/23/01016-20131223ARTFIG00646-tempete-la-plus-grande-vigilence-est-de-mise.php

Nguyen, H., Faff, R., & Marshall, A. (2007). Exchange rate exposure, foreign currency derivatives and the introduction of the euro: French evidence. *International Review of Economics & Finance*, *16*(4), 563–577. https://doi.org/10.1016/j.iref.2006.01.002

O'Donnell, S., Lizarazo, C., Brophy, T., Le Quéau, L., Katsalirou, I., Jurado, R., & Herrala, N. (2019). Role of cross currency swap markets in funding and investment decisions. *ECB*. https://www.ecb.europa.eu/pub/pdf/scpops/ecb.op228~bb3e50120a.en.pdf

Official interest rates. (2025). ECB Data Portal. https://data.ecb.europa.eu/data/data-categories/ecbeurosystem-policy-and-exchange-rates/official-interest-rates

Ortega, E., & Obsat, C. (2020). Exchange rate pass-through in the Euro area and EU countries. *ECB*, *Occasional Paper Series*. https://doi.org/10.2866/544865

Outlook revised to negative on several French entities following similar action on France. (2014). In *S&P Global*. https://www.spglobal.com/ratings/es/regulatory/article/-/view/type/HTML/id/1364167

Özyurt, S. (2016). Has the exchange rate pass through recently declined in the euro area? *ECB*, *No 1955*. https://doi.org/10.2866/986987

Pangea. (2024, July 1). *Top 10 imports to France in 2024: key products and insights*. Pangea Network | Freight Forwarder Network. https://pangea-network.com/top-10-imports-to-france-in-2024-key-products-and-insights/

Pons, J. B. (2014). Corporate approach to hedging Airbus Group as an example. In *ECB And Airbus Group*. https://www.ecb.europa.eu/paym/groups/pdf/fxcg/1710/airbus.pdf?b401147

Prasad, E. S., Rogoff, K., Wei, S.-J., & Kose, M. A. (2003). Effects of financial globalization on developing countries: Some empirical evidence -- IMF Occasional Paper No. 220. *IMF*. https://www.imf.org/external/pubs/nft/op/220/#overview

Rating Action commentary Fitch downgrades France to "AA"; Outlook stable. (2014). In *Fitch Ratings*. https://www.fitchratings.com/research/sovereigns/fitch-downgrades-france-to-aa-outlook-stable-12-12-2014#:~:text=Fitch%20Ratings%2DLondon%2D12%20December,term%20ratings%20are%20now%20Stable.

Rees, D. (2023). Commodity prices and the dollar. *Bank for International Settlements*, *No 1083*. https://www.bis.org/publ/work1083.pdf?utm

Rey, H. (2015). *Dilemma not Trilemma: The Global Financial Cycle and Monetary Policy Independence*. https://doi.org/10.3386/w21162

Rogoff, B. S. B. K. (2001, January 1). *NBER Macroeconomics Annual 2000, Volume 15*. NBER. http://www.nber.org/books/bern01-1

Sadgui, S. (2022, April 17). CAC 40 : Avec la guerre en Ukraine, quel est l'impact du conflit sur les valeurs du CAC 40? *BFM Bourse*. https://www.tradingsat.com/cac-40-FR0003500008/actualites/cac-40-avec-la-guerre-en-ukraine-quel-est-l-impact-du-conflit-sur-les-valeurs-du-cac-40-1014723.html

Sands, S. (2017, April 25). *Gauging the immediate impact of the French election exit polls*. Market Realist. https://marketrealist.com/2017/04/immediate-impact-france-election-exit-polls-markets-volatility/

Sanofi. (2025). Full-Year 2024 Results. In *Sanofi*. https://www.sanofi.com/assets/dotcom/content-app/events/quaterly-results/2025/2024-q4-and-full-year-2024-results/Full_Year_2024_Sanofi_Results_EN_ACCESSIBLE_VERSION.pdf

Slow growth for the French economy in 2014 − French economy - Accounts and files | Insee. (2015, December 6). https://www.insee.fr/en/statistiques/1301597?sommaire=1301606

Subran, L. (2021). Pricing superpowers: Which sectors have them in the eurozone? In *Allianz Research*. https://www.allianz.com/content/dam/onemarketing/azcom/Allianz_com/economic-research/publications/specials/en/2021/may/2021_05_07_PricingPower.pdf

Team, C. (2024, November 27). *Economic integration*. Corporate Finance Institute. https://corporatefinanceinstitute.com/resources/economics/economic-integration/

The functioning of the electricity, CO2 and natural gas wholesale markets in 2011-2012. (2012). In *Commission for Energy Regulation (CRE)*. https://www.cre.fr/fileadmin/Documents/Rapports_et_etudes/import/RS_marche_gros_2011-2012_en.pdf

Timmer, M. P., Erumban, A. A., Los, B., Stehrer, R., & De Vries, G. J. (2014). Slicing up global value chains. *The Journal of Economic Perspectives*, *28*(2), 99–118. https://doi.org/10.1257/jep.28.2.99

Top 10: manufacturing countries. (2025, August 13). Manufacturing Digital. https://manufacturingdigital.com/top10/top-10-manufacturing-countries

Turkcan, K., & Ates, A. (2008). An Examination of Exchange Rate Pass-Through to U.S. Motor Vehicle Products and Auto-Parts Import Prices. *International Trade and Finance Association*, Working Papers 2008.

https://services.bepress.com/cgi/viewcontent.cgi?referer=&httpsredir=1&article=1132&context=itfa

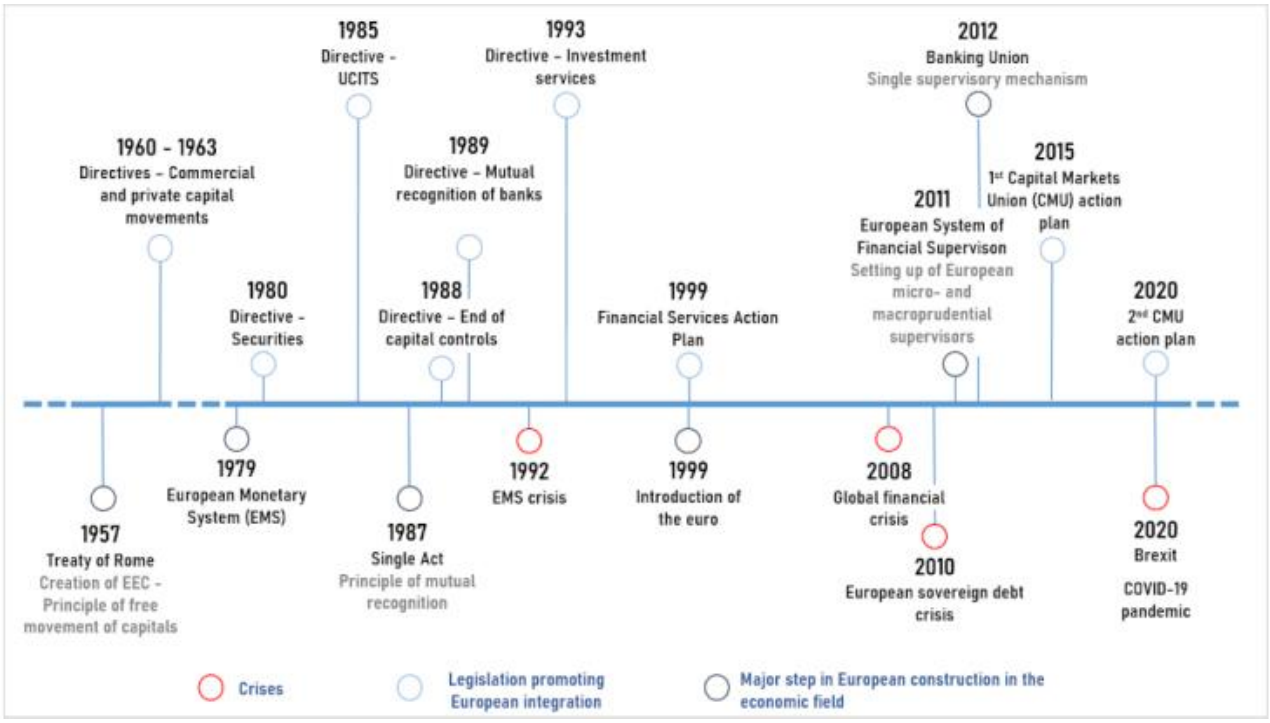
Viktorija, Adler, M., & Dumas, B. (1984). *Exposure to currency Risk: Definition and Measurement*. Scribd. https://www.scribd.com/document/859066631/Adler-and-Dumas-Exposure-1984-ovaa

Vujakovic, P. (2010). *How to measure globalisation? A New Globalisation Index (NGI)*. http://hdl.handle.net/10419/121046s

Zilien, C., Fruschki, A., & Pidlubnyy, O. (2023). The pillars of premium brands' price-setting power. In *Allianz Global Investors*. https://www.allianzgi.com/-/media/allianzgi/globalagi/editorial/premium-brands-price-setting-power/allianzgi-premiumbrandspricesettingpower-global-en-2023.pdf

10 Appendixes

Appendix A - Timeline of France's History



Source: Adapted from The stages in France's European financial integration, by Banque de France. (n.d.).

Appendix B - Index Company Breakdown

FRCG - Consumer Goods
04/01/2010

Ticker	Company Name	Stock Price
Companies in common between 2010 and 2019		
ALATA FP Equity	Atari SA	4,840 €
ALFLE FP Equity	Fleury Michon SA	34,200 €
ALHEX FP Equity	Maisons France Confort	25,220 €
BB FP Equity	Société BIC SA	49,190 €
BEN FP Equity	Bénéteau SA	10,965 €
BIG FP Equity	Bigben Interactive	8,470 €
BN FP Equity	Danone	43,220 €
BON FP Equity	Bonduelle S.C.A.	80,500 €
CRI FP Equity	Chargeurs SA	5,210 €
DPT FP Equity	S.T. Dupont SA	0,190 €
FR FP Equity	Valeo SE	25,305 €
FRVIA FP Equity	Faurecia	16,080 €
ITP FP Equity	Interparfums SA	18,100 €
KOF FP Equity	Kaufman & Broad SA	16,855 €
LOUP FP Equity	LDC	81,240 €
LPE FP Equity	Laurent-Perrier	54,310 €
MBWS FP Equity	Marie Brizard Wine & Spirits SA	31,000 €
MC FP Equity	Moet Hennessy Louis Vuitton SA	78,700 €
ML FP Equity	Compagnie Générale des Etablissemer	55,010 €
OPM FP Equity	Plastic Omnium SA	19,740 €
OR FP Equity	L'Oréal SA	79,830 €
RCO FP Equity	Rémy Cointreau SA	36,025 €
RI FP Equity	Pernod-Ricard SA	60,830 €
RIN FP Equity	Vilmorin & Cie	87,750 €
RMS FP Equity	Hermès International	93,610 €
RNO FP Equity	Renault SA	38,200 €
SAVE FP Equity	Bongrain SA	52,040 €
SK FP Equity	SEB SA	39,635 €
TRI FP Equity	Trigano SA	13,580 €
UBI FP Equity	UBISOFT Entertainment	10,135 €
UG FP Equity	Peugeot SA	24,525 €
VRAP FP Equity	Vranken-Pommery Monopole SA	29,360 €
Companies not in common between 2010 and 2019		
ALLAN FP Equity	Lanson-BCC	41,200 €
ALPHY FP Equity	Alès Groupe	11,450 €
FII FP Equity	LISI	34,700 €
GFT FP Equity	GameLoft SE	3,600 €
NRX FP Equity	Naturex	28,300 €
SIPH FP Equity	Société Internationale de Plantations	46,800 €
SPR FP Equity	Sperian Protection	49,785 €
SPV FP Equity	Sucrière Pithiviers-Le-Vieil	728,000 €
31/12/2019		
Ticker	**Company Name**	**Stock Price**
Companies in common between 2010 and 2019		
ALATA FP Equity	Atari SA	0,330 €
ALFLE FP Equity	Fleury Michon SA	31,600 €
ALHEX FP Equity	Maisons France Confort	36,800 €
BB FP Equity	Société BIC SA	62,000 €
BEN FP Equity	Bénéteau SA	10,830 €
BIG FP Equity	Bigben Interactive	16,040 €
BN FP Equity	Danone	73,900 €
BON FP Equity	Bonduelle S.C.A.	23,300 €
CRI FP Equity	Chargeurs SA	17,280 €
DPT FP Equity	S.T. Dupont SA	0,112 €
FR FP Equity	Valeo SE	31,410 €
FRVIA FP Equity	Faurecia	48,030 €
ITP FP Equity	Interparfums SA	37,000 €
KOF FP Equity	Kaufman & Broad SA	37,000 €
LOUP FP Equity	LDC	104,500 €
LPE FP Equity	Laurent-Perrier	87,400 €
MBWS FP Equity	Marie Brizard Wine & Spirits SA	1,602 €
MC FP Equity	Moet Hennessy Louis Vuitton SA	414,200 €
ML FP Equity	Compagnie Générale des Etablissemer	109,100 €
OPM FP Equity	Plastic Omnium SA	24,900 €
OR FP Equity	L'Oréal SA	264,000 €
RCO FP Equity	Rémy Cointreau SA	109,500 €
RI FP Equity	Pernod-Ricard SA	159,400 €
RIN FP Equity	Vilmorin & Cie	48,250 €
RMS FP Equity	Hermès International	666,200 €
RNO FP Equity	Renault SA	42,180 €
SAVE FP Equity	Bongrain SA	61,400 €
SK FP Equity	SEB SA	132,400 €
TRI FP Equity	Trigano SA	94,100 €
UBI FP Equity	UBISOFT Entertainment	61,580 €
UG FP Equity	Peugeot SA	21,300 €
VRAP FP Equity	Vranken-Pommery Monopole SA	19,900 €
Companies not in common between 2010 and 2019		
ABEO FP Equity	Abeo SA	16,900 €
AKW FP Equity	MGI Coutier	20,200 €
ALAST FP Equity	AST Groupe	3,590 €
ALAVI FP Equity	Advini	26,200 €
ALCAT FP Equity	Poncin Yachts SA	4,330 €
ALDLT FP Equity	Delta Plus Group	48,900 €
ALJXR FP Equity	Archos	0,107 €
ALVG FP Equity	VEOM Group	0,880 €
BASS FP Equity	Les Nouveaux Constructeurs S.A.	47,000 €
BCAMF FP Equity	Société Brasseries du Cameroun	86,000 €
BCRA FP Equity	Baccarat	208,000 €
BELI FP Equity	Le Bélier	36,400 €
BUI FP Equity	Barbara Bui SA	6,700 €
BUR FP Equity	Burelle SA	818,000 €
CDI FP Equity	Christian Dior SA	456,800 €
CHSR FP Equity	Chausseria	4,100 €
FAYE FP Equity	Fayenceries de Sarreguemines, Digoin	34,800 €
FBEL FP Equity	Fromageries Bel SA	312,000 €
GJAJ FP Equity	Groupe JAJ	1,240 €
ITXT FP Equity	Intexa SA	2,500 €
JBOG FP Equity	Jacques Bogart	11,100 €
KAZI FP Equity	Orchestra-Premaman SA	0,169 €
LAF FP Equity	Lafuma SA	17,800 €
LEBL FP Equity	Foncière 7 Investissement S.A.	0,860 €
MALT FP Equity	Malteries Franco-Belges	630,000 €
MDM FP Equity	Maisons du Monde SA	12,970 €
RBO FP Equity	Roche Bobois SA	17,500 €
SMCP FP Equity	SMCP SA	9,450 €
TIPI FP Equity	Tipiak SA	66,500 €
UNBL FP Equity	Unibel	580,000 €

FRBM - Basic Materials
04/01/2010

Ticker	Company Name	Stock Price
Companies in common between 2010 and 2019		
AI FP Equity	Air Liquide SA	84,500 €
NK FP Equity	Imerys SA	42,440 €
ERA FP Equity	ERAMET	236,800 €
MT NA Equity	ArcelorMittal SA	33,375 €
JCQ FP Equity	Jacquet Metal Service	9,812 €
AKE FP Equity	Arkema SA	26,790 €
RX FP Equity	Recylex SA	9,280 €
METEX FP Equity	METabolic EXplorer SA	6,790 €
EUR FP Equity	Euro Ressources SA	3,950 €
RBT FP Equity	Robertet SA	85,000 €
Companies not in common between 2010 and 2019		
RHA FP Equity	Rhodia SA	13,220 €
SEQNR FP Equity	Sequana	7,949 €
9426142 FP Equity	Jacquet Metals Service	44,000 €
31/12/2019		
Ticker	**Company Name**	**Stock Price**
Companies in common between 2010 and 2019		
AI FP Equity	Air Liquide SA	126,200 €
NK FP Equity	Imerys SA	37,680 €
ERA FP Equity	ERAMET	45,840 €
MT NA Equity	ArcelorMittal SA	15,642 €
JCQ FP Equity	Jacquet Metal Service	15,420 €
AKE FP Equity	Arkema SA	94,700 €
RX FP Equity	Recylex SA	3,395 €
METEX FP Equity	METabolic EXplorer SA	1,540 €
EUR FP Equity	Euro Ressources SA	3,030 €
RBT FP Equity	Robertet SA	923,000 €
Companies not in common between 2010 and 2019		
PVL FP Equity	Plastivaloire	6,920 €
ALGAE FP Equity	Fermentalg	1,544 €
ALMIB FP Equity	Amoeba SAS	0,525 €
APAM NA Equity	APERAM SA	28,510 €
EXPL FP Equity	Société Anonyme d'Explosifs et de Pro	765,000 €
ALEXA FP Equity	Exacompta Clairefontaine	115,000 €
ORAP FP Equity	ORAPI	3,550 €
ANTA FP Equity	Antalis SA/Boulogne-Billancourt	0,794 €
SOLB BB Equity	Solvay SA	103,300 €
PCA FP Equity	Produits Chimiques Auxiliaires et de S	13,000 €

FBIN - Industrials
04/01/2010

Ticker	Company Name	Stock Price
Companies in common between 2010 and 2019		
ADP FP Equity	Aéroports de Paris	57,120 €
AIR FP Equity	Airbus SE	13,990 €
AKA FP Equity	Akka Technologies SA	11,950 €
ALCIS FP Equity	Catering International & Services (Cl	55,800 €
ALO FP Equity	Alstom SA	51,520 €
ALTPC FP Equity	Société Marseillaise du Tunnel Prado	27,560 €
ASY FP Equity	Assystem	8,150 €
AURE FP Equity	AUREA SA	7,350 €
BOL FP Equity	Bolloré	116,600 €
BVI FP Equity	Bureau Veritas SA	37,115 €
CEN FP Equity	Groupe Crit	17,810 €
COM FP Equity	Construction Industrielle de la Médi	71,200 €
DBG FP Equity	Derichebourg SA	3,186 €
DG FP Equity	Vinci SA	39,975 €
ECASA FP Equity	ECA	13,510 €
EN FP Equity	Bouygues SA	37,020 €
EXE FP Equity	Exel Industries	25,000 €
FGR FP Equity	Eiffage SA	39,550 €
GET FP Equity	Getlink SE	6,725 €
HO FP Equity	Thales SA	35,520 €
LR FP Equity	Legrand SA	20,425 €
MAN FP Equity	Manutan International	40,000 €
MRN FP Equity	Mersen	25,840 €
MTU FP Equity	Manitou BF SA	10,615 €
NEX FP Equity	Nexans SA	57,910 €
PIG FP Equity	Haulotte Group SA	6,450 €
RXL FP Equity	Rexel SA	10,180 €
SAF FP Equity	Safran SA	13,865 €
SAMS FP Equity	Samse SA	57,200 €
SCHP FP Equity	Séché Environnement SA	59,950 €
SDG FP Equity	Synergie SA	17,800 €
SGO FP Equity	Compagnie de Saint-Gobain	39,100 €
STF FP Equity	STEF-TFE	42,990 €
SU FP Equity	Schneider Electric SE	82,450 €
TES FP Equity	Tessi SA	49,990 €
TFF FP Equity	Tonnellerie François Frères	30,990 €
THEP FP Equity	Thermador Groupe	94,990 €
TOUP FP Equity	Touax SA	22,400 €
VCT FP Equity	SA des Ciments VICAT	59,790 €
VK FP Equity	Vallourec SA	133,150 €
VU FP Equity	Store Electronic	11,220 €
XPO FP Equity	Norbert Dentressangle SA	38,940 €
Companies not in common between 2010 and 2019		
ALHRG FP Equity	VM Matériaux SA	42,500 €
CMA FP Equity	Cimants Français SA	74,000 €
DCH FP Equity	Delachaux SA	42,200 €
GLO FP Equity	GL Events	17,250 €
GTO FP Equity	Gemalto NV	30,655 €
ING FP Equity	Ingenico	17,090 €
LEY FP Equity	Faiveley Transport	56,120 €
LG FP Equity	Lafarge SA	58,420 €
SAFT FP Equity	Saft Groupe SA	34,170 €
SEV FP Equity	Suez Environnement Co	16,380 €
ZC FP Equity	Zodiac Aérospace	29,395 €
31/12/2019		
Ticker	**Company Name**	**Stock Price**
Companies in common between 2010 and 2019		
ADP FP Equity	Aéroports de Paris	176,100 €
AIR FP Equity	Airbus SE	130,480 €
AKA FP Equity	Akka Technologies SA	65,500 €
ALCIS FP Equity	Catering International & Services (Cl	13,300 €
ALO FP Equity	Alstom SA	42,230 €
ALTPC FP Equity	Société Marseillaise du Tunnel Prado	20,300 €
ASY FP Equity	Assystem	32,300 €
AURE FP Equity	AUREA SA	6,920 €
BOL FP Equity	Bolloré	3,890 €
BVI FP Equity	Bureau Veritas SA	23,260 €
CEN FP Equity	Groupe Crit	73,600 €
COM FP Equity	Construction Industrielle de la Médi	20,000 €
DBG FP Equity	Derichebourg SA	3,620 €
DG FP Equity	Vinci SA	99,000 €
ECASA FP Equity	ECA	32,600 €
EN FP Equity	Bouygues SA	37,880 €
EXE FP Equity	Exel Industries	46,600 €
FGR FP Equity	Eiffage SA	102,000 €
GET FP Equity	Getlink SE	15,510 €
HO FP Equity	Thales SA	92,520 €
LR FP Equity	Legrand SA	72,640 €
MAN FP Equity	Manutan International	61,400 €
MRN FP Equity	Mersen	34,150 €
MTU FP Equity	Manitou BF SA	21,450 €
NEX FP Equity	Nexans SA	43,490 €
PIG FP Equity	Haulotte Group SA	5,300 €
RXL FP Equity	Rexel SA	11,845 €
SAF FP Equity	Safran SA	137,650 €
SAMS FP Equity	Samse SA	169,000 €
SCHP FP Equity	Séché Environnement SA	37,600 €
SDG FP Equity	Synergie SA	29,200 €
SGO FP Equity	Compagnie de Saint-Gobain	36,500 €
STF FP Equity	STEF-TFE	80,400 €
SU FP Equity	Schneider Electric SE	91,500 €
TES FP Equity	Tessi SA	130,000 €
TFF FP Equity	Tonnellerie François Frères	36,700 €
THEP FP Equity	Thermador Groupe	53,000 €
TOUP FP Equity	Touax SA	5,300 €
VCT FP Equity	SA des Ciments VICAT	40,350 €
VK FP Equity	Vallourec SA	2,812 €
VU FP Equity	Store Electronic	31,700 €
XPO FP Equity	Norbert Dentressangle SA	260,000 €
Companies not in common between 2010 and 2019		
AGTA FP Equity	Agta Record Ltd	68,000 €
ALATI FP Equity	Actia Group	4,310 €
ALGID FP Equity	Egide	0,842 €
ALGIR FP Equity	Signaux Girod	11,700 €
ALHYP FP Equity	HiPay Group SA	4,700 €
ALLEC FP Equity	Cogelec SACA	6,360 €
ALLIX FP Equity	Installux SA	350,000 €
ALNEO FP Equity	Alpha MOS - Multi Organoleptic Syst	0,800 €
ALPM FP Equity	Precia SA	191,000 €
ALSOG FP Equity	Sogeclair	29,300 €
ALTIV FP Equity	Tivoly	23,000 €
AM FP Equity	Dassault Aviation SA	1 170,000 €
AUGR FP Equity	Augros Cosmetic Packaging	6,700 €
AYV FP Equity	Ayvens SA	13,840 €
BALYO FP Equity	Balyo SA	1,758 €
DPAM FP Equity	Docks des Pétroles d'Ambes	460,000 €
EDEN FP Equity	Edenred	46,100 €
EKI FP Equity	Ekinops SAS	6,610 €
ELIS FP Equity	Elis SA	18,500 €
EXA FP Equity	Groupe Gorge	17,040 €
FGA FP Equity	FIGEAC-AERO	9,300 €
FII FP Equity	LISI	30,050 €
GEA FP Equity	GEA	112,000 €
GPE FP Equity	GPE Groupe Pizzorno	13,450 €
HOLN FP Equity	Holcim AG	48,950 €
IDL FP Equity	ID Logistics Group SACA	180,400 €
INFE FP Equity	Compagnie Industrielle et Financière	50,000 €
LACR FP Equity	Lacroix SA	27,500 €
LAT FP Equity	Sté Industrielle d'Aviation Latécoère	3,855 €
NAVYA FP Equity	NAVYA SAS	1,000 €
ODET FP Equity	Financière de l'Odet	782,000 €
OREGE FP Equity	Orège	1,320 €
PERR FP Equity	Gérard Perrier Electric	63,400 €
PID FP Equity	PARAGON ID SA	31,600 €
PSB FP Equity	PSB Industries	20,600 €
PWG FP Equity	Prodways Group SA	2,690 €
RE FP Equity	Colas SA	140,800 €
SBT FP Equity	OENEO	13,780 €
SEC FP Equity	Soditech Ingenierie SA	0,625 €
SEFER FP Equity	Serge Ferrari SAS	6,100 €
SLCO FP Equity	Selcodis	–
SO FP Equity	Somfy SA	87,500 €
SPIE FP Equity	SPIE SA	18,160 €
SX FP Equity	CS Communication & Systèmes	4,320 €
TEP FP Equity	Teleperformance	217,400 €
TITC BB Equity	Titan SA	19,100 €
TKTT FP Equity	Tarkett SADIR	14,400 €
VRLA FP Equity	Verallia SA	30,260 €
WLN FP Equity	Worldline SA/France	63,150 €

CAC40
04/01/2010

Ticker	Company Name	Stock Price
Companies in common between 2010 and 2019		
AC FP Equity	Accor SA	38,890 €
ACA FP Equity	Crédit Agricole S.A.	12,820 €
AI FP Equity	Air Liquide SA	84,500 €
AIR FP Equity	Airbus SE	13,990 €
BN FP Equity	Danone	43,220 €
BNP FP Equity	BNP Paribas	57,240 €
CA FP Equity	Carrefour SA	34,000 €
CAP FP Equity	Capgemini SE	33,350 €
CS FP Equity	AXA SA	16,800 €
DG FP Equity	Vinci SA	39,975 €
EL FP Equity	EssilorLuxottica SA	41,615 €
EN FP Equity	Bouygues SA	37,020 €
ENGI FP Equity	Engie SA	30,220 €
GLE FP Equity	Société Générale	50,240 €
KER FP Equity	Kering	87,020 €
MC FP Equity	Moet Hennessy Louis Vuitton SA	78,700 €
ML FP Equity	Compagnie Générale des Etablissemer	55,010 €
MT NA Equity	ArcelorMittal SA	33,375 €
OR FP Equity	L'Oréal SA	79,830 €
ORA FP Equity	Orange SA	17,760 €
RI FP Equity	Pernod-Ricard SA	60,830 €
RNO FP Equity	Renault SA	38,200 €
SAN FP Equity	Sanofi	96,750 €
SGO FP Equity	Compagnie de Saint-Gobain	39,100 €
STMPA FP Equity	STMicroelectronics NV	6,476 €
SU FP Equity	Schneider Electric SE	82,450 €
TTE FP Equity	TotalEnergies SE	45,795 €
UG FP Equity	Peugeot SA	24,525 €
VIE FP Equity	Veolia Environnement SA	23,350 €
VIV FP Equity	Vivendi SA	21,410 €
Companies not in common between 2010 and 2019		
ALO FP Equity	Alstom SA	51,520 €
ALU FP Equity	Alcatel-Lucent SA	2,455 €
DEXB BB Equity	Dexia Holding NV	4,564 €
EDF FP Equity	EDF SA	41,375 €
LG FP Equity	Lafarge SA	58,420 €
MMB FP Equity	Lagardère SA	29,130 €
SEV FP Equity	Suez Environnement Co	16,380 €
TEC FP Equity	Technip SA	50,380 €
UL FP Equity	Unibail-Rodamco-Westfield SE	155,300 €
VK FP Equity	Vallourec SA	133,150 €
31/12/2019		
Ticker	**Company Name**	**Stock Price**
Companies in common between 2010 and 2019		
AC FP Equity	Accor SA	41,750 €
ACA FP Equity	Crédit Agricole S.A.	12,925 €
AI FP Equity	Air Liquide SA	126,200 €
AIR FP Equity	Airbus SE	130,480 €
BN FP Equity	Danone	73,900 €
BNP FP Equity	BNP Paribas	52,830 €
CA FP Equity	Carrefour SA	14,950 €
CAP FP Equity	Capgemini SE	108,900 €
CS FP Equity	AXA SA	25,110 €
DG FP Equity	Vinci SA	99,000 €
EL FP Equity	EssilorLuxottica SA	135,800 €
EN FP Equity	Bouygues SA	37,880 €
ENGI FP Equity	Engie SA	4,400 €
GLE FP Equity	Société Générale	31,015 €
KER FP Equity	Kering	585,200 €
MC FP Equity	Moet Hennessy Louis Vuitton SA	414,200 €
ML FP Equity	Compagnie Générale des Etablissemer	109,100 €
MT NA Equity	ArcelorMittal SA	15,642 €
OR FP Equity	L'Oréal SA	264,000 €
ORA FP Equity	Orange SA	13,120 €
RI FP Equity	Pernod-Ricard SA	159,400 €
RNO FP Equity	Renault SA	42,180 €
SAN FP Equity	Sanofi	89,620 €
SGO FP Equity	Compagnie de Saint-Gobain	36,500 €
STMPA FP Equity	STMicroelectronics NV	23,970 €
SU FP Equity	Schneider Electric SE	91,500 €
TTE FP Equity	TotalEnergies SE	49,200 €
UG FP Equity	Peugeot SA	21,300 €
VIE FP Equity	Veolia Environnement SA	23,710 €
VIV FP Equity	Vivendi SA	25,820 €
Companies not in common between 2010 and 2019		
ATO FP Equity	Atos5	74,320 €
DSY FP Equity	Dassault Systemes SA	146,550 €
FTI FP Equity	TechnipFMC PLC	18,910 €
HO FP Equity	Thales SA	92,520 €
LR FP Equity	Legrand SA	72,640 €
PUB FP Equity	Publicis Groupe SA	40,360 €
RMS FP Equity	Hermès International	666,200 €
SAF FP Equity	Safran SA	137,650 €
SW FP Equity	Sodexo	105,650 €
URW NA Equity	Unibail-Rodamco-WestField	140,650 €

FRHC - Health Care
04/01/2010

Ticker	Company Name	Stock Price
Companies in common between 2010 and 2019		
BIM FP Equity	bioMérieux	83,500 €
DIM FP Equity	Sartorius Stedim Biotech	28,000 €
LNA FP Equity	Le Noble Age	16,000 €
CLARI FP Equity	Clarisne SE	20,000 €
VIRP FP Equity	Virbac SA	72,920 €
VETO FP Equity	Vétoquinol SA	22,250 €
ERF FP Equity	Eurofins Scientific	40,190 €
EL FP Equity	EssilorLuxottica SA	41,615 €
GDS FP Equity	Ramsay Generale de Sante SA	13,285 €
GBT FP Equity	Guerbet	97,250 €
TNG FP Equity	Trangene SA	20,910 €
BOI FP Equity	Boiron SA	29,600 €
VLA FP Equity	Vivalis SA	9,820 €
SAN FP Equity	Sanofi	96,750 €
IPN FP Equity	Ipsen SA	38,940 €
EMDS FP Equity	ORPEA	31,780 €
ALCOX FP Equity	NicOx SA	6,003 €
Companies not in common between 2010 and 2019		
ADI FP Equity	Audika SA	22,030 €
LVL FP Equity	LVL Médical Groupe SA	16,000 €
GENP FP Equity	Stallergenes SA	59,000 €
31/12/2019		
Ticker	**Company Name**	**Stock Price**
Companies in common between 2010 and 2019		
BIM FP Equity	bioMérieux	79,350 €
DIM FP Equity	Sartorius Stedim Biotech	147,700 €
LNA FP Equity	Le Noble Age	49,550 €
CLARI FP Equity	Clarisne SE	41,920 €
VIRP FP Equity	Virbac SA	236,500 €
VETO FP Equity	Vétoquinol SA	64,460 €
ERF FP Equity	Eurofins Scientific	494,200 €
EL FP Equity	EssilorLuxottica SA	135,800 €
GDS FP Equity	Ramsay Generale de Sante SA	16,800 €
GBT FP Equity	Guerbet	41,300 €
TNG FP Equity	Trangene SA	1,930 €
BOI FP Equity	Boiron SA	36,400 €
VLA FP Equity	Vivalis SA	2,570 €
SAN FP Equity	Sanofi	89,620 €
IPN FP Equity	Ipsen SA	79,000 €
EMDS FP Equity	ORPEA	114,300 €
ALCOX FP Equity	NicOx SA	4,355 €
Companies not in common between 2010 and 2019		
AB FP Equity	AB Science SA	5,380 €
ABNX FP Equity	Abionyx Pharma SA	0,337 €
ABVX FP Equity	Abivax SA	22,550 €
ADOC FP Equity	Adocia	9,960 €
ALDMS FP Equity	Diagnostic Medical Systems /PARIS	1,230 €
ALDVI FP Equity	Advicenne SACA	8,800 €
ALEMG FP Equity	Euromedis Groupe	4,540 €
ALIMS BB Equity	European Medical Solutions SA	0,312 €
ALMKT FP Equity	Mauna Kea Technologies	1,366 €
ALPIX FP Equity	Pixium Vision SA	0,777 €
ALSEI FP Equity	SuperSonic Imagine SA	1,454 €
ALVIO FP Equity	BioAlliance Pharma SA	0,555 €
AMPLI FP Equity	Amplitude Surgical SAS	1,890 €
BIOS BB Equity	Biosensic SA	3,640 €
BLC FP Equity	Bastide le Confort Médical	37,700 €
BUP FP Equity	Biom'Up SACA	0,288 €
CLNV FP Equity	Cellnovo Group SA	–
CYAD BB Equity	Celyad Oncology SA	9,700 €
DBV FP Equity	DBV Technologies SA	19,630 €
EOSI FP Equity	EOS Imaging SA	2,215 €
ESP NA Equity	Esperitz NV	0,046 €
GKTX FP Equity	Calliditas Therapeutics France SAS	2,180 €
GNFT FP Equity	Genfit	17,850 €
GNRO FP Equity	GeNeuro SA	3,700 €
GTBP FP Equity	GT Biopharma Inc	–
GV FP Equity	Genomic Vision	0,339 €
IPH FP Equity	Innate Pharma SA	5,960 €
IVA FP Equity	Inventiva SACA	3,670 €
LBIRD FP Equity	Quantel SA	15,200 €
LYS FP Equity	Lysogene SA	1,815 €
MEDCL FP Equity	Medincell SA	6,880 €
MSTY FP Equity	Mainstay Medical International Ltd	3,400 €
NANO FP Equity	Nanobiotix SA	8,280 €
OSE FP Equity	OSE Immuno	3,700 €
PHXM FP Equity	PHAXIAM Therapeutics SA	9,700 €
POMS. FP Equity	Poxel SA	12,200 €
SIGHT FP Equity	GenSight Biologics SA	2,485 €
STNT FP Equity	Stentys	–

FRTEC - Technology
04/01/2010

Ticker	Company Name	Stock Price
Companies in common between 2010 and 2019		
LIN FP Equity	Linedata Services	9,300 €
EQS FP Equity	Pharmagest Interactive	40,410 €
STMPA FP Equity	STMicroelectronics NV	6,476 €
CGM FP Equity	Cegedim SA	57,300 €
SII FP Equity	Société Pour l'Informatique Indust	4,580 €
SWP FP Equity	Sword Group	25,000 €
DSY FP Equity	Dassault Systemes SA	40,405 €
DVT FP Equity	Devoteam SA	18,050 €
QDT FP Equity	Quadient SAS	57,800 €
NRO FP Equity	Neurones	6,100 €
CAP FP Equity	Capgemini SE	33,350 €
PARRO FP Equity	Parrot SA	10,450 €
ALNTG FP Equity	Netgem SA	4,800 €
AVT FP Equity	Avenir Telecom	1,130 €
SOP FP Equity	Sopra Group SA	50,310 €
ALT FP Equity	Altran Technologies SA	3,726 €
SOI FP Equity	SOITEC	10,765 €
ATO FP Equity	Atos5	33,565 €
ATE FP Equity	Alten	19,685 €
Companies not in common between 2010 and 2019		
BULL FP Equity	Bull	3,130 €
MTG FP Equity	Metrologic Group SA	26,900 €
ILD FP Equity	Iliad SA	83,640 €
LAC FP Equity	LaCie SA	3,050 €
GFI FP Equity	GFI Informatique	3,000 €
CGID FP Equity	Groupe Cegid	15,750 €
ALU FP Equity	Alcatel-Lucent SA	2,455 €
RIA FP Equity	Groupe Steria SCA	22,695 €
RALL FP Equity	Radiall	42,700 €
31/12/2019		
Ticker	**Company Name**	**Stock Price**
Companies in common between 2010 and 2019		
LIN FP Equity	Linedata Services	26,700 €
EQS FP Equity	Pharmagest Interactive	60,600 €
STMPA FP Equity	STMicroelectronics NV	23,970 €
CGM FP Equity	Cegedim SA	29,000 €
SII FP Equity	Société Pour l'Informatique Indust	28,700 €
SWP FP Equity	Sword Group	34,100 €
DSY FP Equity	Dassault Systemes SA	146,550 €
DVT FP Equity	Devoteam SA	94,500 €
QDT FP Equity	Quadient SAS	21,580 €
NRO FP Equity	Neurones	20,600 €
CAP FP Equity	Capgemini SE	108,900 €
PARRO FP Equity	Parrot SA	2,670 €
ALNTG FP Equity	Netgem SA	0,362 €
AVT FP Equity	Avenir Telecom	0,012 €
SOP FP Equity	Sopra Group SA	143,500 €
ALT FP Equity	Altran Technologies SA	14,160 €
SOI FP Equity	SOITEC	93,700 €
ATO FP Equity	Atos5	74,320 €
ATE FP Equity	Alten	112,500 €
Companies not in common between 2010 and 2019		
XFAB FP Equity	X-Fab Silicon Foundries SE	4,170 €
SQI FP Equity	Sqli SA	24,300 €
ALHF FP Equity	HF Company	4,990 €
LSS FP Equity	Lectra	22,350 €
EOS FP Equity	Acteos	1,280 €
ALGEC FP Equity	GECI International	0,033 €
ATEME FP Equity	ATEME SA	11,200 €
IGE FP Equity	IGE + XAO	170,000 €
OPN FP Equity	Groupe Open	10,920 €
ALAUR FP Equity	AuriaTechnologies	24,920 €
VMR FP Equity	Verimatrix SA	1,980 €
ING FP Equity	Ingenico	96,800 €
ITS FP Equity	ITS Group	6,640 €
ALKEY FP Equity	Keyrus	2,840 €
ITE FP Equity	ITESOFT	2,920 €
DLT FP Equity	Dalet	12,450 €
GUI FP Equity	Guillemot Corp	2,420 €
GENX FP Equity	Generix	6,700 €
INF FP Equity	Infotel SA	39,950 €
SOA FP Equity	Sodifrance	16,500 €
ESI FP Equity	ESI Group	32,500 €
CAS FP Equity	Cast SA	3,130 €
ALCBX FP Equity	CIBOX INTER@CTIVE	0,141 €
WAVE FP Equity	Wavestone	26,000 €
MEMS FP Equity	Memscap SA	1,720 €
ALVTX FP Equity	Volumis SA	2,310 €
ALRIB FP Equity	Riber SA	2,670 €
ALMIC FP Equity	Micropole	1,280 €
PROAC FP Equity	Hubwoo	0,126 €
EGR FP Equity	Digigram SA	0,610 €
ALINN FP Equity	Innelec Multimédia SA	5,160 €
FPG FP Equity	Union Techno Informatique	0,479 €
745W FP Equity	745oftware SA	12,400 €
ALZSI FP Equity	2CRSI SACA	5,000 €
AUB FP Equity	Aubay	33,450 €
ALTIL FP Equity	IT Link SA	15,750 €
SDT FP Equity	Visiodent SA	2,420 €
BND FP Equity	Business & Decision	7,850 €
COH FP Equity	Coheris SA	2,060 €
DEDAL FP Equity	Medasys	0,391 €
CLA FP Equity	Claranova SE	7,980 €
ALPRG FP Equity	Prologue	0,342 €

FROG - Oil & Gas
04/01/2010

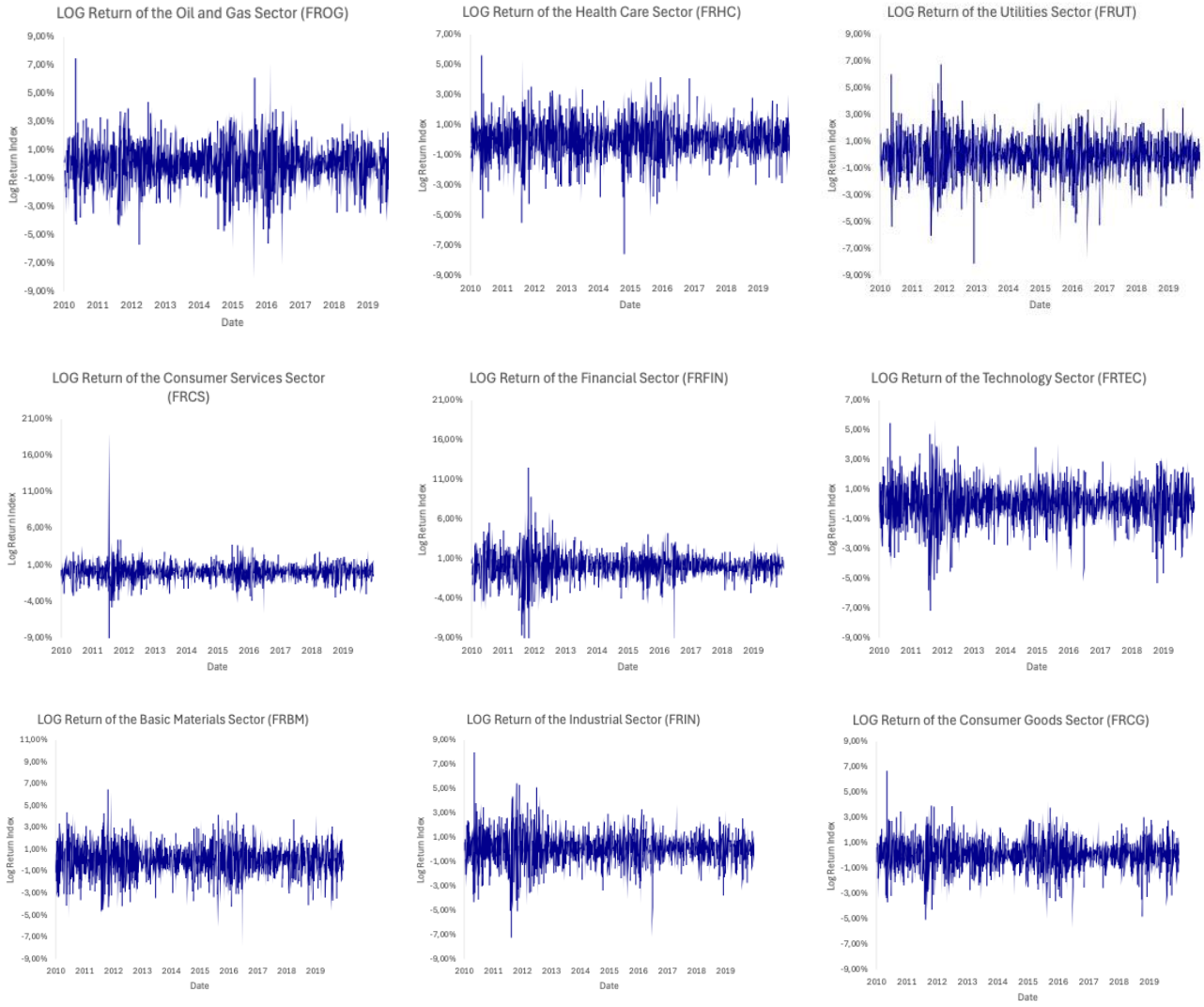
Ticker	Company Name	Stock Price
Companies in common between 2010 and 2019		
TTE FP Equity	TotalEnergies SE	45,795 €
CGG FP Equity	CGG	15,720 €
MAU FP Equity	Etablissements Maurel & Prom	12,845 €
ES FP Equity	Esso S.A. Française	90,500 €
GBB FP Equity	Bourbon SA	27,205 €
Companies not in common between 2010 and 2019		
ENTC FP Equity	Entrepose Contracting	63,000 €
TEC FP Equity	Technip SA	50,380 €
31/12/2019		
Ticker	**Company Name**	**Stock Price**
Companies in common between 2010 and 2019		
TTE FP Equity	TotalEnergies SE	49,200 €
VRK FP Equity	CGG	2,895 €
MAU FP Equity	Etablissements Maurel & Prom	2,820 €
ES FP Equity	Esso S.A. Française	22,800 €
GBB FP Equity	Bourbon SA	- €
Companies not in common between 2010 and 2019		
ALBOO FP Equity	Boostheat SACA	18,050 €
ALMCP FP Equity	McPhy Energy SA	3,715 €
NHOA FP Equity	NHOA	9,000 €
EC FP Equity	Totalenergies EP Gabon	134,000 €
FTI FP Equity	TechnipFMC PLC	18,910 €
GTT FP Equity	Gaztransport & Technigaz SA	85,400 €
FDE FP Equity	La Francaise De L'energie SACA	18,650 €

FRFCS - Consumer Services		
04/01/2010		
Ticker	Company Name	Stock Price
Companies in common between 2010 and 2019		
SW FP Equity	Sodexo	40,355 €
SPI FP Equity	Spir Communication	17,740 €
ALECP FP Equity	EuropaCorp	6,640 €
NRG FP Equity	NRJ Group	5,776 €
MMB FP Equity	Lagardere SA	29,130 €
HCO FP Equity	High Co	7,140 €
TOU FP Equity	Toupargel Groupe SA	15,180 €
MMT FP Equity	Métropole Télévision SA	18,470 €
FLO FP Equity	Groupe FLO	3,650 €
CA FP Equity	Carrefour SA	34,000 €
VAC FP Equity	Pierre Et Vacances SA	54,000 €
ETL FP Equity	Eutelsat Communications	22,915 €
SESG FP Equity	SES SA	15,620 €
TFI FP Equity	Télévision française 1	13,160 €
BAIN FP Equity	Societe des Bains de Mer et du Ce	47,400 €
LOCAL FP Equity	Solocal Group SA	7,950 €
AF FP Equity	Air France-KLM	11,225 €
RAL FP Equity	Rallye SA	25,070 €
CDA FP Equity	Compagnie des Alpes	26,530 €
PUB FP Equity	Publicis Groupe SA	29,085 €
IPS FP Equity	IPSOS SA	21,805 €
AC FP Equity	Accor SA	38,890 €
VIV FP Equity	Vivendi SA	21,410 €
CO FP Equity	Casino Guichard Perrachon SA	64,000 €
KER FP Equity	Kering	87,020 €
DEC FP Equity	JCDecaux SE	17,535 €
ALMRB FP Equity	Mr Bricolage	12,870 €
ADUX FP Equity	Hi-Media SA	5,020 €
PARNR FP Equity	Groupe Partouche SA	2,830 €
TCHNR FP Equity	Technicolor SA	0,916 €
Companies not in common between 2010 and 2019		
EDL FP Equity	Euro Disney SCA	5,100 €
AN FP Equity	Canal +	5,700 €
ALDNX FP Equity	DreamNex	37,650 €
NXTV FP Equity	NextRadioTV	14,230 €
SLG FP Equity	SeLoger.com	23,030 €
HAV FP Equity	Havas SA	2,824 €
GG FP Equity	Guyenne et Gascogne SA	64,640 €
TAM FP Equity	Etam Développement SA	17,700 €
MEET FP Equity	Meetic	19,300 €
CU FP Equity	Club Méditerranée	13,000 €
TEP FP Equity	Teleperformance	23,150 €
31/12/2019		
Ticker	Company Name	Stock Price
Companies in common between 2010 and 2019		
SW FP Equity	Sodexo	105,650 €
SPI FP Equity	Spir Communication	4,320 €
ALECP FP Equity	EuropaCorp	0,693 €
NRG FP Equity	NRJ Group	6,700 €
MMB FP Equity	Lagardere SA	19,430 €
HCO FP Equity	High Co	6,080 €
TOU FP Equity	Toupargel Groupe SA	0,640 €
MMT FP Equity	Métropole Télévision SA	16,780 €
FLO FP Equity	Groupe FLO	0,210 €
CA FP Equity	Carrefour SA	14,950 €
VAC FP Equity	Pierre Et Vacances SA	20,200 €
ETL FP Equity	Eutelsat Communications	14,490 €
SESG FP Equity	SES SA	12,500 €
TFI FP Equity	Télévision française 1	7,400 €
BAIN FP Equity	Societe des Bains de Mer et du Ce	57,400 €
LOCAL FP Equity	Solocal Group SA	0,552 €
AF FP Equity	Air France-KLM	9,924 €
RAL FP Equity	Rallye SA	10,120 €
CDA FP Equity	Compagnie des Alpes	29,850 €
PUB FP Equity	Publicis Groupe SA	40,360 €
IPS FP Equity	IPSOS SA	28,950 €
AC FP Equity	Accor SA	41,750 €
VIV FP Equity	Vivendi SA	25,820 €
CO FP Equity	Casino Guichard Perrachon SA	41,700 €
KER FP Equity	Kering	585,200 €
DEC FP Equity	JCDecaux SE	27,480 €
ALMRB FP Equity	Mr Bricolage	2,900 €
ADUX FP Equity	Hi-Media SA	1,290 €
PARP FP Equity	Groupe Partouche SA	27,800 €
VANTI FP Equity	Technicolor SA	0,685 €
Companies not in common between 2010 and 2019		
SFCA FP Equity	Société française de Casinos	1,590 €
DKUPL FP Equity	ADLPartner	14,300 €
FDJU FP Equity	FDJ UNITED	23,825 €
VDLO FP Equity	IEC Professionnel Média	1,900 €
EDI FP Equity	Media 6	10,800 €
NR21 FP Equity	NR21 SA	1,020 €
EUCAR FP Equity	Europcar Mobility Group SA	4,334 €
SRP FP Equity	SRP Groupe SA	1,298 €
XIL FP Equity	Xilam Animation	44,400 €
SFPI FP Equity	Groupe SFPI	1,715 €
EFG FP Equity	OL Groupe	3,060 €
FNAC FP Equity	Fnac Darty SA	52,800 €
HDP FP Equity	Les Hôtels de Paris	4,280 €
GAM FP Equity	Gaumont SA	136,500 €
TVRB FP Equity	Televerbier	45,200 €
FNTS FP Equity	Finatis SA	26,800 €
FCMC FP Equity	Casino Municipal de Cannes	1 660,000 €
GLO FP Equity	GL Events	24,050 €
PSAT FP Equity	Passat	4,800 €
FINM FP Equity	Clayeux	0,360 €
CAFO FP Equity	Cafom SA	5,250 €
SACI FP Equity	Fiducial Office Solutions	28,200 €
ELIOR FP Equity	Elior Group SA	13,100 €
ALHOP FP Equity	Hopscotch Groupe	8,700 €
GRVO FP Equity	Graines Voltz SA	67,000 €
GREV FP Equity	Musée Grévin SA	68,500 €
MDW FP Equity	Mediawan SA	10,440 €
PRC FP Equity	Artprice.com	9,510 €
MAGIS FP Equity	Ymagis SA	1,800 €
EURS FP Equity	Foncière Euris	16,100 €
FRUT - Utilities		
04/01/2010		
Ticker	Company Name	Stock Price
Companies in common between 2010 and 2019		
RUI FP Equity	Rubis	63,000 €
ENGI FP Equity	Engie SA	30,220 €
EDF FP Equity	EDF SA	41,575 €
VIE FP Equity	Veolia Environnement SA	23,350 €
ABIO FP Equity	Albioma SAS	28,870 €
Companies not in common between 2010 and 2019		
EEN FP Equity	EDF Energies Nouvelles SA	37,000 €
AREVA FP Equity	Areva SA	352,000 €
TEONR FP Equity	THEOLIA SA	2,980 €
31/12/2019		
Ticker	Company Name	Stock Price
Companies in common between 2010 and 2019		
RUI FP Equity	Rubis	54,750 €
ENGI FP Equity	Engie SA	14,400 €
EDF FP Equity	EDF SA	9,928 €
VIE FP Equity	Veolia Environnement SA	23,710 €
ABIO FP Equity	Albioma SAS	26,000 €
Companies not in common between 2010 and 2019		
NEOEN FP Equity	Neoen SA	30,900 €
ELEC FP Equity	Electricité de Strasbourg	118,000 €
SEV FP Equity	Suez Environnement Co	13,485 €
VLTSA FP Equity	Voltalia	13,050 €

FRFIN - Financials		
04/01/2010		
Ticker	Company Name	Stock Price
Companies in common between 2010 and 2019		
KN FP Equity	Natixis	3,631 €
LTA FP Equity	Altamir Amboise	5,450 €
UFF FP Equity	Union Financière de France SA	26,100 €
EIFF FP Equity	Societe de la Tour Eiffel	55,000 €
MF FP Equity	Wendel	44,900 €
ACAN FP Equity	Acanthe Developpement SA	1,420 €
VTR FP Equity	Vitura SA	26,300 €
APR FP Equity	April SAS/France	24,510 €
GLE FP Equity	Société Générale	50,240 €
ACA FP Equity	Crédit Agricole S.A.	12,825 €
MERY FP Equity	Mercialys SA	25,080 €
COVH FP Equity	Covivio Hotels SACA	15,540 €
CNP FP Equity	CNP Assurances	69,890 €
ARG FP Equity	ARGAN SA	11,200 €
LI FP Equity	Klepierre SA	29,295 €
SCR FP Equity	SCOR SE	17,700 €
COV FP Equity	Covivio SA/France	74,100 €
VIL FP Equity	Viel et Compagnie	2,910 €
CS FP Equity	AXA SA	16,800 €
BNP FP Equity	BNP Paribas	57,240 €
GFC FP Equity	Gecina SA	77,990 €
RF FP Equity	Eurazeo	50,970 €
ICAD FP Equity	ICADE	69,350 €
ABCA FP Equity	ABC Arbitrage	6,680 €
NXI FP Equity	Nexity SA	26,535 €
Companies not in common between 2010 and 2019		
FIM FP Equity	Fimalac	39,345 €
ELE FP Equity	Euler Hermes SA	54,820 €
FPF FP Equity	Fonciere Paris-France SA	101,990 €
UL FP Equity	Unibail-Rodamco-Westfield SE	155,300 €
SIL FP Equity	Societe Immobiliere de Location p	85,460 €
BRS FP Equity	Boursorama	10,600 €
ANF FP Equity	ANF Immobilier SA	30,630 €
DEXB BB Equity	Dexia Holding NV	4,564 €
ERSC FP Equity	Eurosic SAS	23,000 €
LD FP Equity	Locindus (Financière pour la Locati	18,000 €
GECM FP Equity	IMMOCARE SAS	1,240 €
IML FP Equity	Affine RE SA	16,550 €
ODET FP Equity	Financière de l'Odet	219,890 €
31/12/2019		
Ticker	Company Name	Stock Price
Companies in common between 2010 and 2019		
KN FP Equity	Natixis	3,958 €
LTA FP Equity	Altamir Amboise	16,650 €
UFF FP Equity	Union Financière de France SA	19,800 €
EIFF FP Equity	Societe de la Tour Eiffel	39,400 €
MF FP Equity	Wendel	118,500 €
ACAN FP Equity	Acanthe Developpement SA	0,470 €
VTR FP Equity	Vitura SA	42,800 €
APR FP Equity	April SAS/France	22,500 €
GLE FP Equity	Société Générale	31,015 €
ACA FP Equity	Crédit Agricole S.A.	12,925 €
MERY FP Equity	Mercialys SA	12,330 €
COVH FP Equity	Covivio Hotels SACA	28,500 €
CNP FP Equity	CNP Assurances	17,730 €
ARG FP Equity	ARGAN SA	77,600 €
LI FP Equity	Klepierre SA	33,850 €
SCR FP Equity	SCOR SE	37,420 €
COV FP Equity	Covivio SA/France	101,200 €
VIL FP Equity	Viel et Compagnie	4,700 €
CS FP Equity	AXA SA	25,110 €
BNP FP Equity	BNP Paribas	52,830 €
GFC FP Equity	Gecina SA	159,600 €
RF FP Equity	Eurazeo	61,000 €
ICAD FP Equity	ICADE	97,050 €
ABCA FP Equity	ABC Arbitrage	6,700 €
NXI FP Equity	Nexity SA	44,780 €
Companies not in common between 2010 and 2019		
FREY FP Equity	Frey	33,300 €
EFI FP Equity	Eurasia Fonciere Investissements	0,220 €
MHM FP Equity	Myhotelmatch SACA	0,030 €
ARTO FP Equity	Société Industrielle et Financière d	4 440,000 €
FLY FP Equity	Societe Fonciere Lyonnaise SA	73,800 €
ALTA FP Equity	Altarea SCA	202,500 €
ALBON FP Equity	Compagnie Lebon SA	121,500 €
ALADV FP Equity	Avenir Finance	1,360 €
CRTO FP Equity	Crédit Agricole Touraine Poitou	128,000 €
FMONC FP Equity	Moncey Financière	5 000,000 €
URW NA Equity	Unibail-Rodamco-Westfield	140,650 €
ALTUR FP Equity	Turenne Investissement SCA	6,000 €
FOAF FP Equity	Cie Financiere de L'Ouest Africain	9,050 €
IDIP FP Equity	IDI	44,400 €
EEM FP Equity	Electricité et Eaux de Madagascar	3,420 €
GALIM FP Equity	Galimmo SCA	18,200 €
INEA FP Equity	Fonciere INEA	41,000 €
CRLO FP Equity	Crédit Agricole Loire Haute-Loire	103,000 €
CRBP2 FP Equity	Caisse Regionale de Credit Agricole	30,600 €
FORE FP Equity	Forestière Equatoriale	680,000 €
ENX FP Equity	Euronext NV	72,650 €
CBSM FP Equity	Societe Centrale des Bois et Scieries	9,950 €
ALDV FP Equity	AD Capital SIIC	0,140 €
SABE FP Equity	Sabeton SA	23,400 €
LFVE FP Equity	La Fonciere Verte	84,000 €
ABLD FP Equity	Fauvet-Girel	--
SELER FP Equity	Selectirente	90,500 €
ATLD FP Equity	Atland SA	164,000 €
CMO FP Equity	Crédit Agricole du Morbihan	102,160 €
SPEL FP Equity	Foncière Volta	7,100 €
ROTH FP Equity	Rothschild & Co	25,600 €
SOFR FP Equity	Société Française de Gestion et d'In	1 650,000 €
PEUG FP Equity	Société Foncière Financière et de P	104,000 €
BLEE FP Equity	Bleecker	149,000 €
MRM FP Equity	MRM	1,470 €
ALCAP FP Equity	Capelli	30,800 €
TAYN FP Equity	Societe de Tayninh SA	1,080 €
CARM FP Equity	Carrefour Property Development	20,000 €
PAT FP Equity	Patrimoine et Commerce	18,400 €
AMUN FP Equity	Amundi SA	69,900 €
CAF FP Equity	Crédit Agricole Ile de France	99,500 €
CARP FP Equity	Carpinienne de Participations SA	33,400 €
CRSU FP Equity	Crédit Agricole Sud Rhône Alpes	227,000 €
FIPP FP Equity	FIPP	0,296 €
CAT31 FP Equity	Crédit Agricole Toulouse 31	134,480 €
CRAV FP Equity	Crédit Agricole Atlantique Vendée	160,000 €
CFI FP Equity	Compagnie Fonciere Internationale	0,500 €
CIV FP Equity	Crédit Agricole Ille et Vilaine	118,980 €
AAA FP Equity	Verneuil Participations	1,620 €
CCN FP Equity	Crédit Agricole Normandie Seine	158,500 €
BERR FP Equity	Financière Immobilière de l'Etang d	5,300 €
CBOT FP Equity	CBo Territoria	3,830 €
CRAP FP Equity	Crédit Agricole Alpes Provence	126,000 €
IMDA FP Equity	Immobiliere Dassault SA	68,500 €
NEXTS FP Equity	Nextstage SCA	97,000 €
COUR FP Equity	Courtois SA	125,000 €
BSD FP Equity	Bourse Direct	1,150 €
CNDF FP Equity	Caisse Régionale de Crédit Agricole	28,450 €
ARTE FP Equity	Artea	11,900 €
PAR FP Equity	Paris Realty Fund SA	84,500 €
CBDG FP Equity	Compagnie du Cambodge	6 200,000 €
IRD FP Equity	Institut Régional de Développemen	26,755 €
ORIA FP Equity	Fiducial real estate	195,000 €
CRLA FP Equity	Crédit Agricole du Languedoc	82,160 €

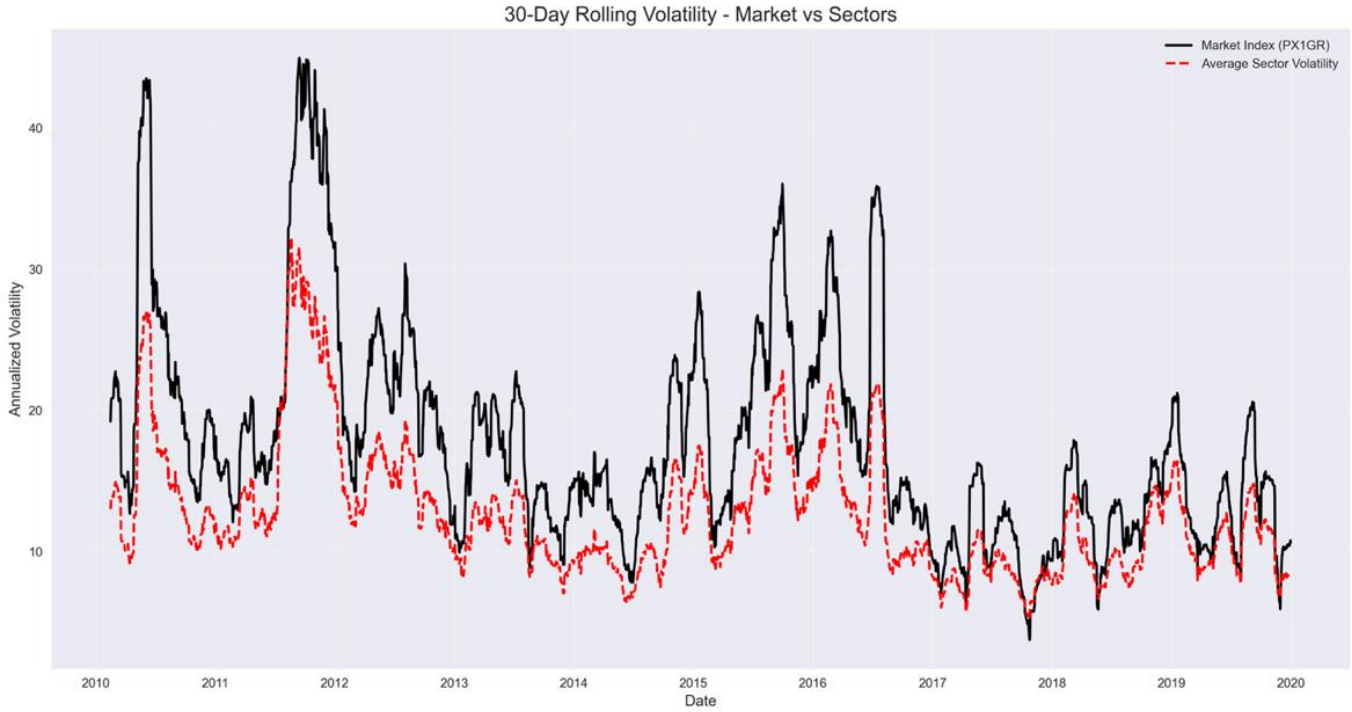
Source: Bloomberg

Appendix C - Line Plots of Sectoral Indices LOG Returns



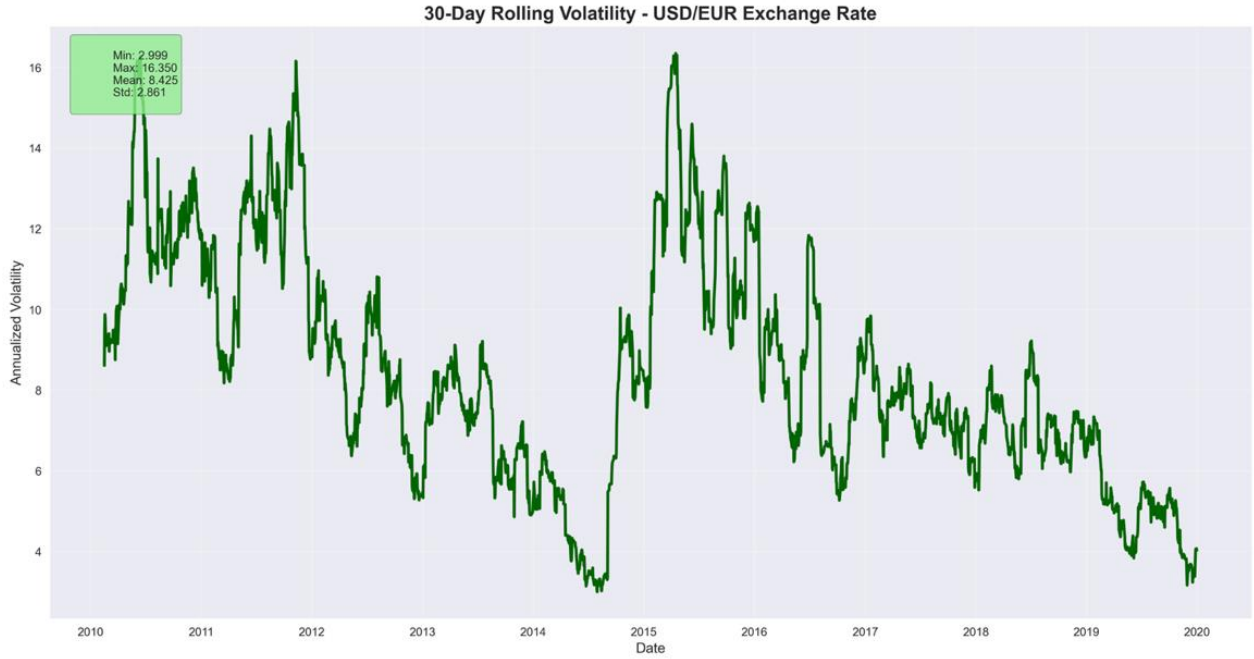
Source: Investing.com

Appendix D - Line Plot of the Market Index and Average Sector Volatility



Source: Investing.com

Appendix E - Line Plot of USD/EUR Foreign Exchange Rate Volatility



Source: Investing.com

Appendix F - Statistic Data Descriptions

Panel A: Sector and Market Indices Log Returns

Index	Observations	Mean	StdDev	Min	25%	50%	75%	Max	Skewness	Kurtosis	JB Stat	JB p-val
FROG	2558	0,0000	0,0137	-0,0808	-0,0075	0,0006	0,0078	0,0751	-0,2219	2,3579	610,0638	0
FRHC	2558	0,0003	0,0116	-0,0756	-0,0063	0,0006	0,0070	0,0562	-0,2593	2,2829	580,7918	0
FRUT	2558	-0,0003	0,0136	-0,0810	-0,0072	0,0003	0,0075	0,0681	-0,2978	2,7090	815,5592	0
FRCS	2558	0,0002	0,0121	-0,1970	-0,0054	0,0005	0,0060	0,1882	-0,3239	50,8185	274198,1099	0
FRFIN	2558	0,0001	0,0165	-0,1251	-0,0073	0,0004	0,0079	0,1661	0,1455	10,3376	11349,6225	0
FRTEC	2558	0,0003	0,0126	-0,0718	-0,0059	0,0006	0,0075	0,0567	-0,3870	2,5489	752,2877	0
FRBM	2558	0,0000	0,0140	-0,0776	-0,0074	0,0005	0,0082	0,0857	-0,0809	2,1873	509,6356	0
FRIN	2558	0,0003	0,0125	-0,0723	-0,0059	0,0006	0,0069	0,0801	-0,2063	3,6906	1462,3319	0
FRCG	2558	0,0005	0,0113	-0,0569	-0,0055	0,0007	0,0068	0,0672	-0,2395	2,2968	583,3480	0
PX1GR	2558	0,0003	0,0121	-0,0838	-0,0055	0,0006	0,0065	0,0922	-0,1768	4,3532	2023,0826	0

Panel B: USD/EUR FX Rate

Rate	Observations	Mean	StdDev	Min	25%	50%	75%	Max	Skewness	Kurtosis	JB Stat	JB p-val
FX USD/EUR	2558	0,0001	0,0056	-0,0300	-0,0030	0,0000	0,0033	0,0264	0,0381	1,7901	339,9428	0

Panel C: Macroeconomic Control Variables

Varibale	Observations	Mean	StdDev	Min	25%	50%	75%	Max	Skewness	Kurtosis	JB Stat	JB p-val
ECB MRO	2558	0,3917	0,4738	0,0000	0,0000	0,0500	1,0000	1,5000	0,7839	-0,8812	344,5329	0
Inflation Annual	2558	1,1103	0,6999	0,0000	0,5000	1,1000	1,8000	2,1000	-0,0874	-1,2524	170,4154	0

Source: Own elaboration

Appendix G - Panel Model Time Fixed and Two Way Fixed

Panel Model Without Control Variables

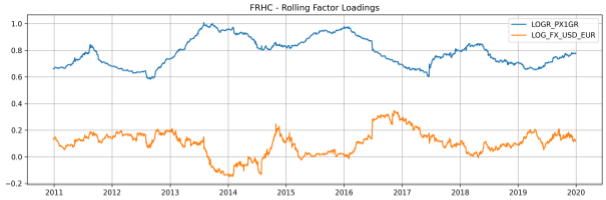
Model	R-squared	R-squared Within	R-squared Between	Market Beta	Market P-value	FX Beta	FX P-value	F-statistic	F P-value	Observations
Pooled	0,7011	0,7013	0,2176	0,9092	0,0000***	-0,0157	0,6996	27001,6492	0,0000***	23022
Entity Fixed	0,7013	0,7013	0,2173	0,9095	0,0000***	-0,0153	0,7054	27016,8680	0,0000***	23022
Time Fixed	0,0000	-0,0434	-0,1803	-0,0328	1,0000	-0,2682	1,0000	0,0000	1,0000	23022
Two Way Fixed	0,0000	0,0411	-0,0627	0,0219	1,0000	-0,2029	1,0000	0,0000	1,0000	23022

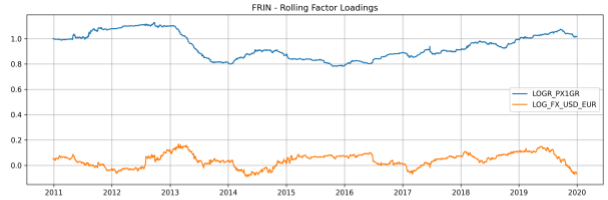
Panel Model With Control Variables

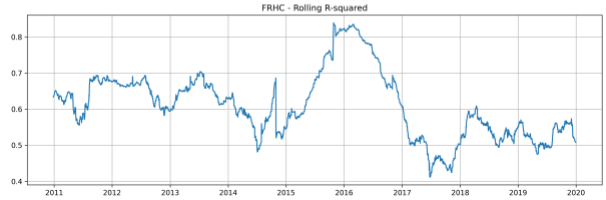
Model	R-squared	R-squared Within	R-squared Between	Market Beta	Market P-value	FX Beta	FX P-value	F-statistic	F P-value	Observations
Pooled	0,7011	0,7013	0,2176	0,9092	0,0000***	-0,0157	0,7005	13499,6948	0,0000***	23022
Entity Fixed	0,7013	0,7013	0,2173	0,9095	0,0000***	-0,0153	0,7063	13507,3032	0,0000***	23022
Time Fixed	0,0000	-10,1471	-0,0463	0,0689	1,0000	-0,3106	1,0000	0,0000	1,0000	23022
Two Way Fixed	0,0000	-0,3208	0,0651	0,0930	1,0000	-0,1271	1,0000	0,0000	1,0000	23022

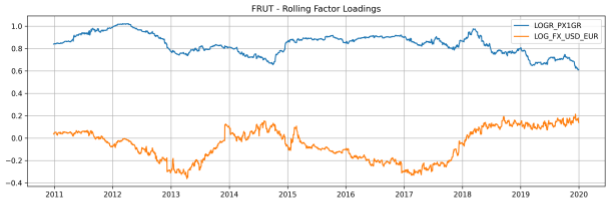
Source: Own elaboration

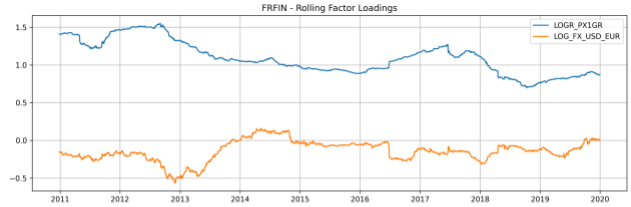
Appendix H - TVP Model Results Graphs Without Control Variables

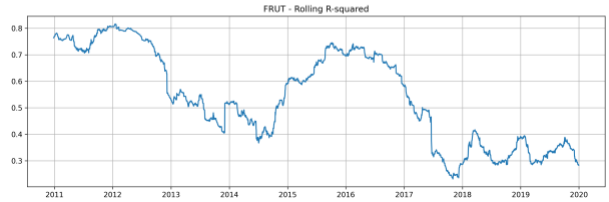


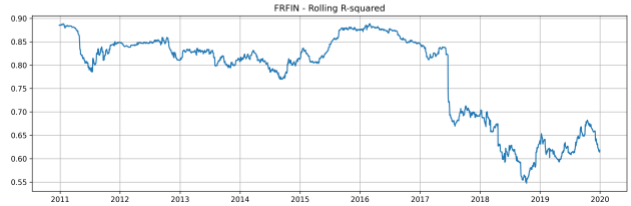


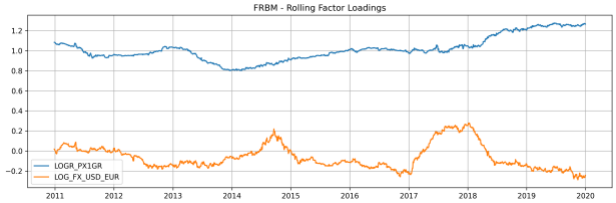


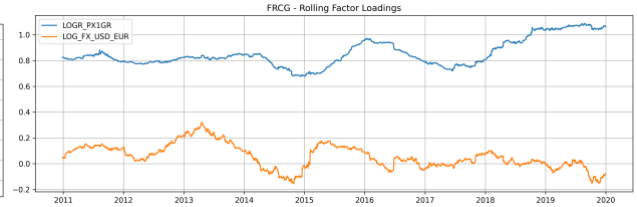


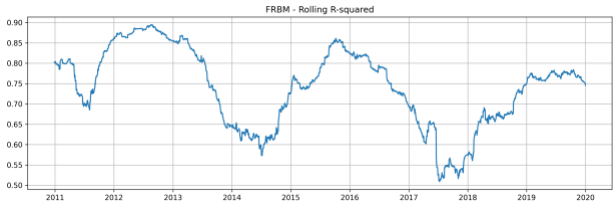


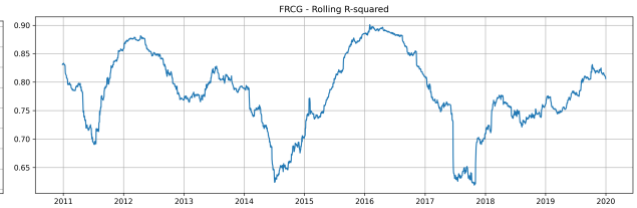


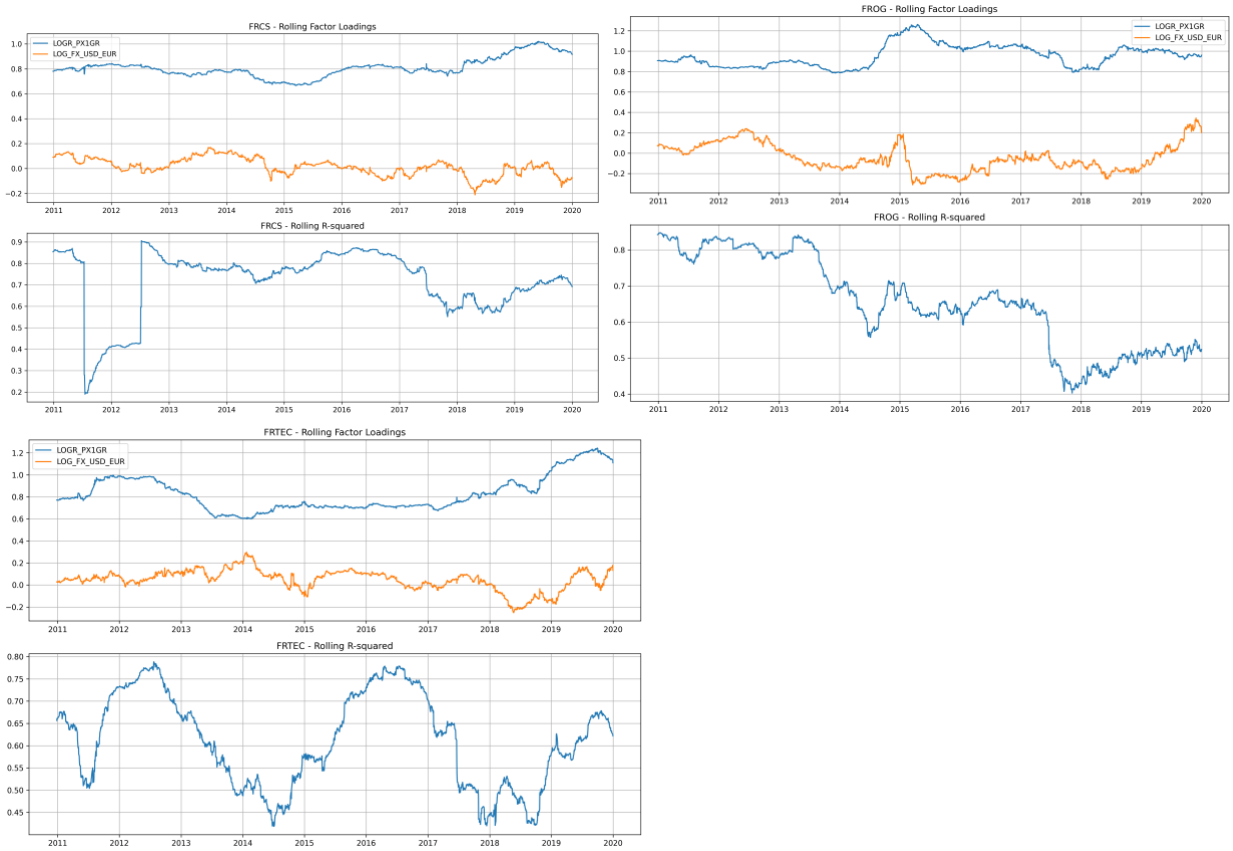












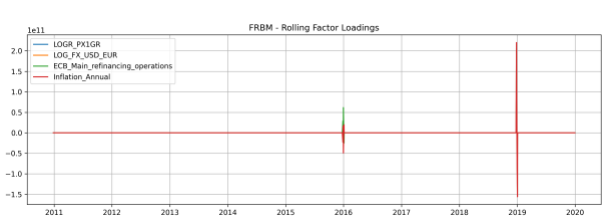
Source: Own elaboration

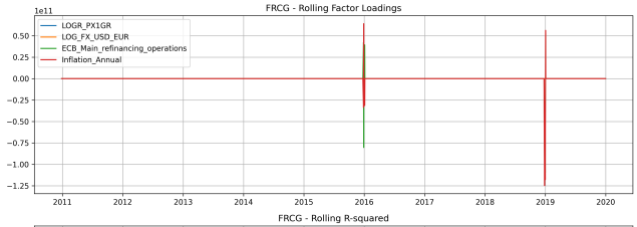
Appendix I - TVP Model Results Complete Table With Control Variables

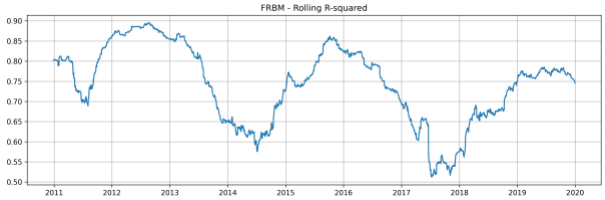
Indexes	Avg. Const Beta	Min Const Beta	Max Const Beta	Avg. Market Beta	Min Market Beta	Max Market Beta	Avg. FX Beta	Min FX Beta	Max FX Beta	Avg. ECB Rate	Min ECB Rate Beta	Max ECB Rate Beta	Avg. Inflation Beta	Min Inflation Beta	Max Inflation Beta	Avg. R^2	Min R^2	Max R^2
FROG	7,56E+06	-1,43E+11	8,71E+10	0,95	0,78	1,26	-0,05	-0,30	0,35	1,58E+07	-1,60E+11	2,62E+11	8,31E+07	-2,09E+11	1,28E+11	0,66	0,42	0,85
FRHC	4,49E+07	-3,18E+10	6,82E+10	0,79	0,58	1,01	0,10	-0,17	0,35	-4,83E+07	-1,25E+11	1,39E+11	1,48E+08	-4,70E+10	1,49E+11	0,61	0,42	0,84
FRUT	-5,82E+07	-7,95E+10	2,13E+10	0,84	0,61	1,02	-0,06	-0,38	0,22	1,05E+08	-9,29E+10	1,46E+11	-8,93E+07	-1,16E+11	9,42E+10	0,55	0,24	0,82
FRCS	-1,20E+06	-5,38E+10	4,44E+10	0,81	0,67	1,03	0,02	-0,21	0,17	-2,02E+07	-8,15E+10	9,87E+10	-5,63E+07	-7,88E+10	6,50E+10	0,72	0,20	0,91
FRFIN	-4,69E+07	-4,85E+10	5,09E+10	1,09	0,70	1,55	-0,14	-0,54	0,16	1,28E+08	-9,34E+10	1,03E+11	3,30E+07	-7,10E+10	1,10E+11	0,78	0,55	0,89
FRTEC	-2,95E+07	-1,05E+11	7,90E+10	0,83	0,60	1,25	0,05	-0,26	0,29	8,65E+07	-1,45E+11	1,93E+11	3,51E+07	-1,54E+11	1,75E+11	0,61	0,42	0,79
FRBM	-1,49E+07	-4,71E+10	3,34E+10	1,01	0,80	1,29	-0,06	-0,29	0,28	4,40E+07	-1,46E+11	2,06E+11	1,88E+07	-1,56E+11	2,20E+11	0,74	0,51	0,90
FRIN	1,94E+07	-2,00E+10	3,28E+10	0,94	0,78	1,13	0,04	-0,09	0,17	-1,95E+07	-6,22E+10	7,41E+10	6,75E+07	-6,66E+10	7,93E+10	0,87	0,78	0,93
FRCG	1,01E+07	-2,29E+10	4,38E+10	0,85	0,68	1,09	0,06	-0,16	0,34	-6,92E+07	-1,17E+11	5,26E+10	-1,08E+08	-1,25E+11	6,41E+10	0,78	0,62	0,90
Index Average	-7,65E+06	-6,12E+10	5,12E+10	0,90	0,69	1,18	0,00	-0,27	0,26	2,47E+07	-1,14E+11	1,41E+11	1,47E+07	-1,14E+11	1,21E+11	0,70	0,46	0,87

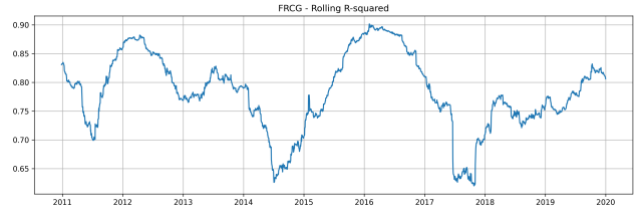
Source: Own elaboration

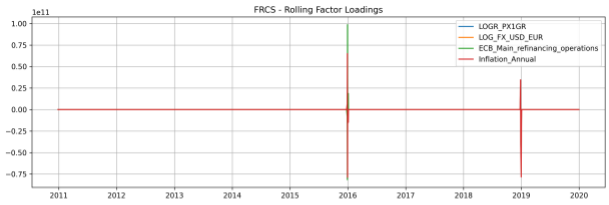
Appendix J - TVP Model Results Graphs With Control Variables

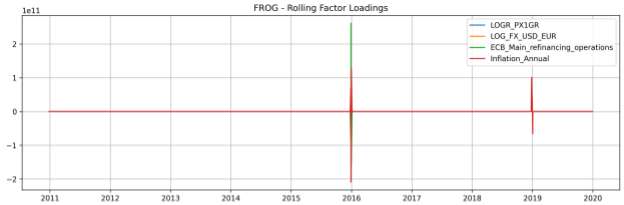


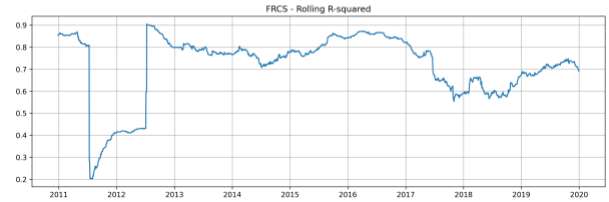


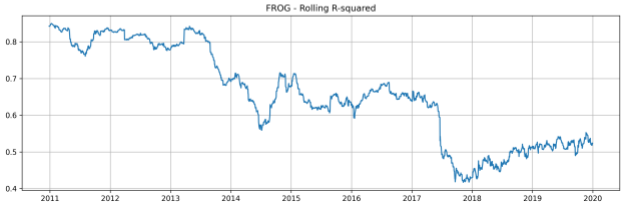


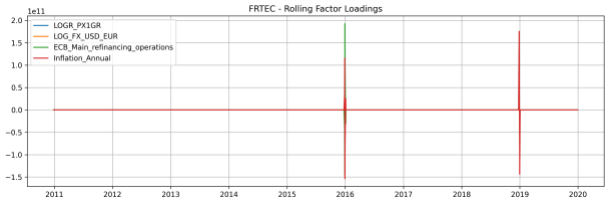


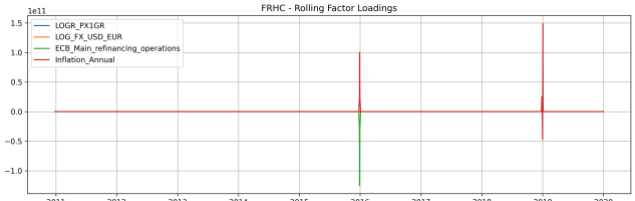


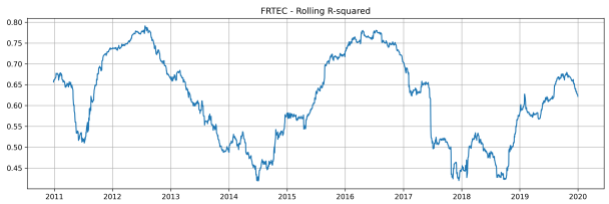


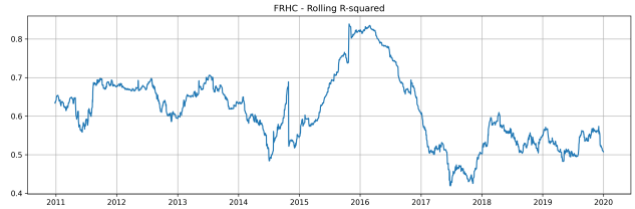


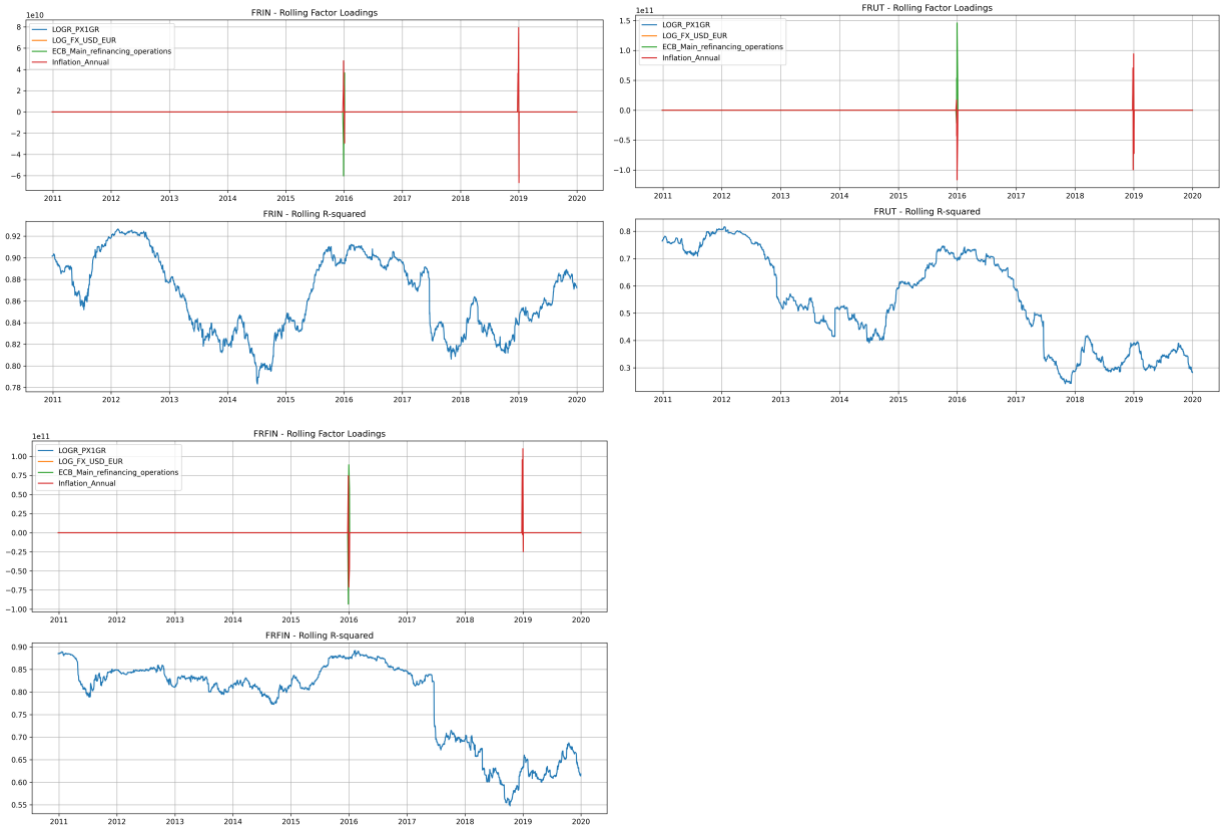












Source: Own elaboration