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*Master's Thesis*

# ***Did Firms Learn from Experience how to Reduce the Negative Impact of a Black Swan Event?***

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# Table of Contents


*Table of Contents* 2

*0. Abstract* 4

*1. Introduction* 5

*2. Literature Review* 7

*2.1. The COVID-19 Pandemic was a Black Swan Event* 8

*2.2. Definition of Ecosystem's Resilience* 9

*2.3. Definition of Ecosystem's Robustness* 10

*3. Theoretical Framework* 11

*4. Methodology* 13

*4.1. Description of the Methodology* 13

*4.2. Description of the Regressions* 14

*4.2.1. Apple's Regression Models* 15

*4.2.2. Samsung's Regression Models* 21

*4.2.3. Toyota's and the Volkswagen Group's Regression Models* 25

*4.2.4 Inditex' and Starbucks' Regression Models* 32

*5. Results and Interpretations* 33

*5.1 Overall Analysis* 33

*5.2. Considerations on Toyota and the Volkswagen Group* 35

*5.3. Considerations on Apple and Samsung Electronics* 37

*5.4. Considerations on Inditex and Starbucks* 40

*5.5. What Are the Elements that Help to Reduce a Negative Variation?* 41

*6. Conclusion* 43

*6.1. Did Firms Learn from Experience?* 43

*6.2. What are the Elements that Characterise the Robustness and Resilience of a Value Chain?* *44*

*7. Appendix* *46*

*8. References* *49*

**Statement of Originality:**

I declare that the text and the work presented in this document are original and that no sources other than those mentioned in the text and its references have been used in creating it.

# 0. Abstract

The following research, through the analysis of the operating results of six multinational enterprises, seeks to answer the following research question: "have firms learned, from previous black swan events, how to face future recessionary shocks?". The research investigates at studying whether previous black swan events have somehow helped companies to develop a sort of experience in facing this kind of recessionary shock. Moreover, the firms that were not impacted negatively by the COVID-19 pandemic will be better analysed in detail, in order to understand what are the factors that determine the resilience and/or the robustness of a firm's value chain.

# 1. Introduction

After the fall of the Berlin Wall and the end of the Cold War, countries around the world started having mutual commercial relationships without any limitations. These were the first steps towards today's the globalised world. Throughout the years, free economical relationships among countries on a global level, have permitted various firms to shape their own optimised network of clients and suppliers. This, in turn, allowed these companies to reach levels of economic efficiency that would be unimaginable without a globalised society. Globalisation, therefore, has enabled multinational enterprises (MNEs) to have an increasingly efficient value chain that enables them to run their activities in the most cost-efficient way (e.g. by maximising their output-input ratio, as suggested by Drucker, 1973).

Unfortunately, during the last few years, some unpredictable institutional and economic events, which are also called *black swan events*, occurred (e.g. the financial crisis in 2008, the war in Crimea in 2014, Brexit in 2016, and the most recent trade war between China and the U.S.). These events brought uncertainty, high levels of currencies' volatility, and economical ambiguity. In addition, the COVID-19 pandemic, aside from the dramatic effects on the physical and psychological well-being of people, caused a severe shock both on the supply and demand side of good and services. For the first time in the era of globalisation, this crisis was also happening on a global level. The COVID-19 pandemic, therefore, wreaked havoc on the global business environment: in spite of being highly efficient, the companies' value chains revealed themselves not to be resistant at all to this kind of negative shock. As a consequence, also the more passionate supporters of globalisation started doubting its resistance.

Nonetheless, despite the negative consequences that an unexpected recessionary event like the pandemic can bring with it, the only positive aspect that can come out of a crisis is learning. As a matter of fact, in the past, many unpredictable events (black swan events) caused economic recessions in various regions of the world. These were, for example, financial crises (in Asia in 1997, in the Western world in 2008) and environmental disasters (e.g. the Japanese earthquake in 2011). Firms, therefore, should ideally develop a sort of experience from previous unexpected events that have brought any kind of disruption of their supply chains or, in general, of value chains of many MNEs. When talking about learning from crises, a good example is Toyota. After the earthquake in Japan in 2011, the car manufacturer developed RESCUE (Reinforce Supply Chain Under Emergency), a database of the company's suppliers' information that identified vulnerabilities and past information of over 650,000 supplier sites (Forbes, 2016). The first question that comes to mind is: was this strategy effective?

The principal aim of this study is to investigate the approach that different MNEs adopted to face previous crises, thus seeking to find out whether throughout the years these approaches have changed thanks to the companies' previous experiences in dealing with black swan events. The annual reports of six multinational enterprises will be used as a basis for the analysis. Through the study of the compositions of their revenues, but also of other operating indexes of the firms (i.e. operating expenses and operating margin), it will be possible to see whether, before the pandemic, some different strategies were already adopted in order to mitigate the negative impact caused by an unpredictable recessionary event. By determining this, it will be easier to understand whether some strategies are more likely to resist a global market characterised by higher volatility of currencies and unpredictable negative variations.

This thesis has been divided into five parts. The first part is the literature review, where the pre-existing literature about these topics is described. In the second part, the theoretical framework, the theoretical gap that the study aims to fill is described, and the research question is formulated. The third part is the methodology. It contains the description of the methodologies adopted in order to develop an empirical analysis. The last two parts are the discussion of the findings and the conclusion, which answers the research question.

# 2. Literature Review

Globalisation has been perceived, until today, as a consolidated phenomenon. Thanks to this phenomenon, different economies in the world started operating beyond their borders and, to different degrees, started connecting with each other. Companies do not restrict themselves to operating in one country and, therefore, can develop a wider range of business activities around the world, on a global level.

The concept of value chain was first introduced by Porter in his work “Competitive-Advantage” (1985). According to him, the value chain of a firm is the process by which that company adds value to a good, including production, marketing, and the provision of after-sales services. Rather than looking at parts or types of accounting costs, Porter's value chain focuses on the systems and how inputs are transformed into products that consumers buy. He also divided this process into two types of activities: primary activities, directly related to the creation, sale, maintenance, and support of a product or service, and *support activities*, whom aim is to support the primary functions above.
Firms, therefore, started operating abroad in order to seek and obtain new economic advantages to provide for their value chains. According to Dunning and Lundan (2008), companies are principally seeking four factors. The first one is *market-advantage,* which is obtained by gaining access to new markets, or following key customers. The second one is the *efficiency-advantage*, which means that firms move outside their domestic country in order to reduce sourcing and production costs, but also to avoid trade barriers. The last two advantages that firms are seeking to gain abroad are the *natural-advantage*, which is the access to raw materials, and the *strategic-advantage*, described in other words as the access to advanced resources. Wernerfelt (1984) stated that a resource can lead to high returns over a longer time period if it is not substitutable and if the firm has control over its production, in a non-monopolistic market. This was the anticipation of Barney's *VRIN model*, theorised in 1991. According to Barney, a product can give a sustained competitive advantage if it is *valuable*, *rare*, *imperfectly imitable* and *non-substitutable*. Despite this, firms are not only joining the global value chain (GVC) to have access to better resources or new markets, but also to be an integral part of the global economy and exploit the knowledge exchange in order to adopt new practices that are not sufficiently internalised.

Following this guideline, firms have been able to outline their activities in all the phases of the production and distribution of the product (or service), allocating them outside their domestic borders, where they are developed in the most efficient way. As a result, multinational enterprises (MNEs) have been seeking economic advantage only through the complexity and distinctiveness of their global value chain for many decades. Along these value chains, also the suppliers chose to allocate themselves at the most cost-efficient point, trying to maximise their output-input ratio. Multinational enterprises have been able to reap the benefits of fragmentation and coordination of their GVC by concentrating on their core competencies, saving money, and achieving greater returns on their assets and investments (Golgeci, Yildiz, Andersson - 2021).

## 2.1. The COVID-19 Pandemic was a Black Swan Event

However, the COVID-19 pandemic caused the breakdown of all the MNEs' networks for the first time in the history of globalisation and revealed the vulnerability of firms' value creation strategies. This breakdown has brought into question (what is) the real efficiency of these strategies?. As a result, the notion of *resilience* has recently been widely used among scholars and has also entered into the policy discourse.

The following question arose: why did the fragility of firms' global value chain come to the surface just after the pandemic? Was it not possible to predict the probability of such an extreme event To answer these questions, it is necessary to define what Nassim Nicholas Taleb theorised in 2007: the so-called Black Swan event.

In order to explain this kind of event, Taleb came up with the example of the black swan. Before the discovery of Australia, people in the known world were convinced that all swans were white. This certainty changed only after the sight of the first black swan, which happened with the discovery of Australia. According to the author, this means that one single observation can invalidate a general statement derived from millennia of confirmatory sightings (Taleb, 2007). He then theorised the Black Swan event by giving it three relevant attributes. First, it has to be an *outlier*, which means that this observation has to differ significantly from the others. Second, it has to carry an *extreme impact*. In the case of the COVID-19 Pandemic, no one would ever imagine that the whole global market had to halt for weeks, even in the first phase of the pandemic. Hence, the "extreme impact".

Third, a black-swan event has to become explainable and predictable only *after* its occurrence. This is, for example, what happened in 2008 when all the economists realised that the financial market, especially in the United States, was not healthy nor stable only after the beginning of the crisis.

The corona pandemic had a massive impact, but it was not the first black swan event that occurred. In the last two decades, in fact, we witnessed many unpredictable, recessionary events, such as the financial crisis in 2008, the Fukushima's nuclear plant disaster due to the previous earthquake. This is the reason why it would have been advisable for firms that operate on a global level to develop new attributes of their business models that take into consideration the eventuality of a Black Swan event. Some attributes had been already theorised by other authors, like the *resilience* of the global value chain. Others are not well known yet, as the *robustness* of the value chain.

## 2.2. Definition of Ecosystem's *Resilience*

When talking about resilience, the first author to quote is Hanley. In fact, in his work "Resilience in Social Economic Systems" (1998), he addressed the problem of giving a precise definition and a contextualisation to this attribute. According to Hanley, the ecological definition of *resilience* as "the preservation of ecosystem functioning in the presence of exogenous change" (Holling, 1973) was not accurate since it did not explain what is wanted to be preserved in an economic system. In fact, it is fundamental to understand that resilience is more than mere recovery from disruption. It requires the adoption of a long-term view and the maintenance of a survival mindset. Moreover, firms' success and survival are driven by another important factor: *competition*. One of the main outcomes of greater competition is the development of *efficiency* as a business strategy.

One of the first authors who tried to theorise the concept of resilience in economics is Ron Martin. In his work, published in 2012, he stated that a resilient economy is assumed to be "self-equilibrating". This means that any shock that disrupts the economy from its equilibrium state activates compensating adjustments that bring it back to that equilibrium (Martin, 2012). (s. *Appendix*, Figure 2.1)

He also conceptualised resilience in terms of four dimensions: *resistance*, *recovery*, *re-orientation,* and *renewal*. *Resistance* is the degree of sensitivity of the reaction of a regional economy to a recessionary shock. *Recovery* is the speed and degree of recovery of a regional economy from a recessionary shock. *Re-orientation* is the extent of adaptation of a regional economy in response to recessionary shock. The last dimension is the R*enewal* dimension, or the extent to which a regional economy renews its growth path. The following question can be asked: will the company go along in the same pre-recession path or will it make a new shift to a new growth trend? According to Martin (2012), another important factor that defines the resilience ability is the growth performance prior to the shock. This is important because an MNE that has a strong growth dynamic is likely to be more resistant to a recessionary shock. Despite constituting an accurate theoretical analysis, Martin's study only tries to give a definition and a contextualisation of the attribute. Unfortunately, the elements that can improve the resiliency of an ecosystem or a firm were not specified in this work.

## 2.3. Definition of Ecosystem's *Robustness*

From Martin's work on the resiliency of the value chain, one step further has been taken by the authors C. Durach, A. Wieland, and J. Machuca. In their work *Antecedents and Dimensions* of Supply Chain Robustness (2014), they conceptualised supply chain robustness as a dimension of supply chain resilience. Moreover, they tried to provide theoretical groundwork for this emerging theory through the identification of the dimensions that can define robustness as an attribute of the value chain. The most important dimensions identified are resistance, as the ability of a value chain to withstand change and avoidance, referred to as the ability of a value chain not to be affected by change (Durach, Wieland, Machuca, 2014). These two dimensions provided the basis for the definition of a robust value chain, which is thus defined by the authors as "the ability to resist or avoid change".

Both the works of Martin and Durach provide clear definitions of value chain *resiliency* and *robustness*, serving as a base for future researchers exploring these dimensions of the value chain and apply the theory to concrete cases.

# 3. Theoretical Framework

In the literature review, studies on different dimensions of the global value chain of an MNE were presented. These works offer a good starting point for future research. In recent studies, new dimensions of the value chain emerged: *robustness* and *resilience.* These dimensions can be good alternatives to *efficiency-seeking* management of the GVC. Nonetheless, although these studies are recent, the reaction of companies to the negative shocks caused by the black swan events were not analysed in depth. This means that, even though robust and resilient value chains have been defined and contextualised, there is no academic proof of their real effectiveness in case of an unpredictable recessionary event. This research set out to define how robust and resilient GVCs react in such a scenario. By analysing the responses to unpredictable shocks with a negative impact on the economy, this study aims to answer the following research questions:

> *Did Firms Learn from Experience how to Reduce the Negative Impact of a Black Swan Event? Which Operating Factors can Mitigate the Negative Impact of a Black Swan Event?*

The operating results presented in the annual reports of six multinational enterprises (MNEs) were used as a basis for the creation of the datasets. The aim was to analyse whether these six firms had already developed strategies in case of unpredictable events even before the outbreak of the COVID-19 pandemic. The aim of these strategies is to increase at least one of the two dimensions described above (resilience and robustness). Once determined whether they did or not, it is going to be found out if a higher degree of resilience and/or robustness in a firm's value chain could help to mitigate the negative impact caused by a black swan event on the operating results. Thus, a correlation between a higher degree of robustness and/or resilience and the reduction in/of the negative impact caused by a black swan event (or a quicker recovery from it) should be found.

If a correlation exists, the empirical analysis of the datasets should reveal what are the operating elements that favour the resilience or robustness of a value chain, without depriving the enterprise from its competitiveness in the global market.

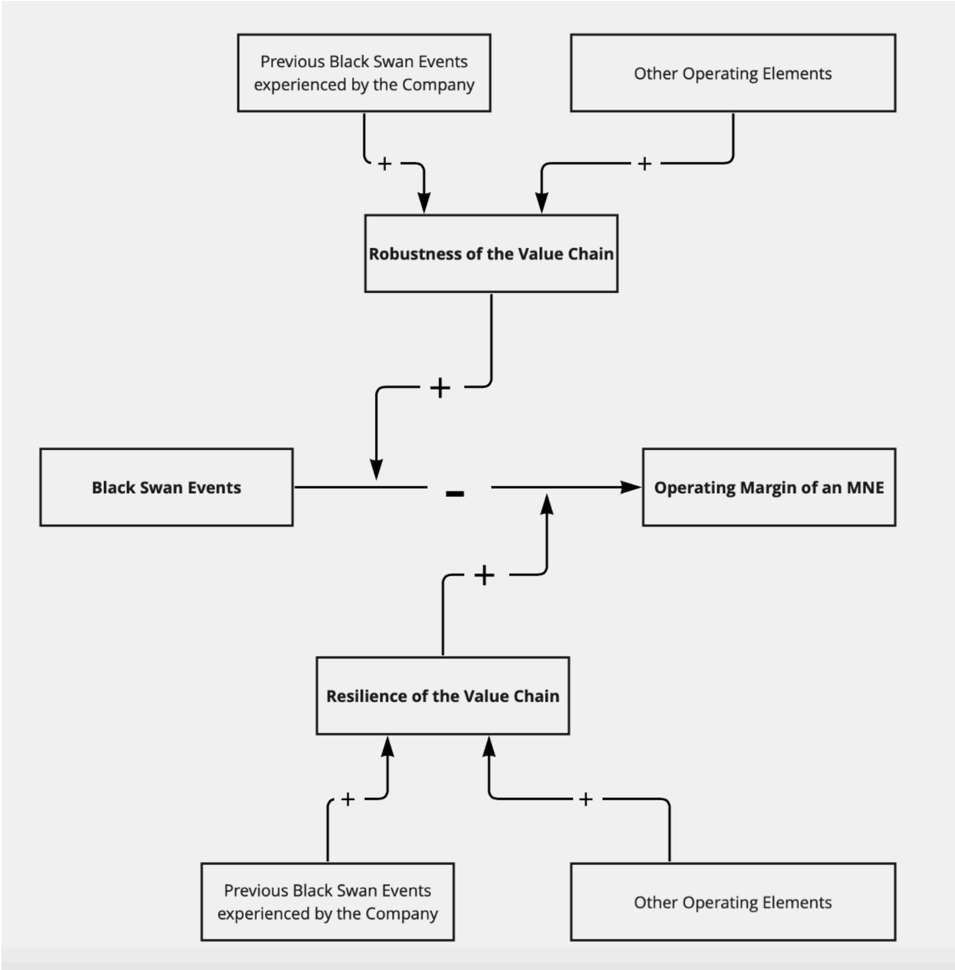



*Figure 3.1 - Theoretical Framework of the Research*

Figure 3.1 describes clearly the framework. It shows that black swan events affect negatively the operating margins of multinational enterprises, but the strategies developed thanks to the experience of previous black swan events, together with other operating elements (such as services) have the ability to improve the resilience and the robustness of the value chain. These two dimensions of a company's value chain should have the effect to mitigate the negative impact caused by a black swan event. On the one hand, robustness is meant as a proactive strategy, which is a strategy active before the impact of an unpredictable recessionary event. Its aim is to reduce that negative variation in the operating margin. On the other hand, resilience is meant as a reactive strategy, which is a strategy that activates after the occurrence of a black swan event. The aim of this strategy is to reduce the recovery after the negative shock on the operating margin.

# 4. Methodology

## 4.1. Description of the Methodology

This research will be performed with a quantitative approach in order to gain deeper insight into what are the consequences of a recessionary black-swan event. In particular, the operating incomes and expenses of several multinational enterprises (MNEs) were analysed in order to obtain this information. All the MNEs selected for the sample operate at least in three different regions of the world. The operating income and expenses are considered to be good indicators to measure how an unpredictable, recessionary event can have an impact on a company in the short run. Moreover, it is important to analyse firms that have relationships with several countries in different regions and different cultures. This heterogeneity is relevant since the quality of the supply chain and the distribution channels will play an important role in the analysis. These elements are important in order to discuss whether the firms developed different management strategies for their global value chain after negative shocks in the revenues caused by black swan events.

The presented data covers a time span that ranges from the fiscal year 2006 to the fiscal year 2021. Over this time frame, there have been many unpredictable events that had negative, shock-like consequences for the economy. Some of these events had a global impact, such as the 2008 financial crisis, and the COVID-19 pandemic. Some of the analysed black-swan events were circumscribed to a particular region, e.g. the 2011 earthquake in Japan with the consequent disaster of the Fukushima nuclear plant, while others were circumscribed just to one firm, such as Volkswagen's "Dieselgate" scandal. By describing these events and the consequences that these had on the revenues of the selected firms, it will be possible to analyse whether these firms have shown some sort of "experience" when dealing with crises in the last two decades. Therefore, it will possible to determine if the negative variations became smaller or if any other strategy was been adopted.

Six multinational enterprises have been selected for this study: Samsung, Toyota, Apple, Volkswagen Group, Starbucks, and Inditex.
Samsung and Apple as well as the Volkswagen Group and Toyota, not only are respectively competitors in their respective sectors, but they also share many intermediary products for their

production process. The most important among these components are without any doubt the semiconductors, but only Samsung produces them. Starbucks and Inditex, on the other hand, operate in sectors where innovation is not the only engine for competitiveness. In addition, in their sectors, it is not necessary to invest large amounts of capital in research and development. Therefore, every company has distinguishing characteristics and will have to adopt strategies, linked to its region, the sector in which it operates, and the black-swan events that had a negative impact on its revenues.

The relevant data was collected by using the annual reports of every firm, for all the years taken into analysis. All the amounts presented in the tables, charts, and regressions are expressed in € million. By doing this, it will be possible to compare the values and also the volatilities of different currencies, in relation to Euros (i.e. USD, Yen, Won). All the currencies and volatilities have been expressed with their annual average (of the year analysed), and are taken from the site exchangerates.org.

Revenues, operating expenses (net of any other operative income different from the revenues), and operating margins have been consulted to collect the desired data. All the data was published in the companies' annual reports. In particular, all the revenues are divided per division or per product. Thus, the sum of all those segments should correspond to the total of the revenues. This is relevant because it will help to determine which segments cause negative shocks (or which resist) in case of a recessionary black-swan event. In the same way, the overall percentage variation of the total revenues of each firm should correspond to the sum of the percentage variations in revenues of every segment that is present in the analysed firm. All the revenues expressed, for every company, are net of any inter-segment operation. Therefore, only the operations external to the firm will be discussed for the analysis.

## 4.2. Description of the Regressions

The last empirical analysis will be performed through regression analysis. All the variables presented in the models are expressed in "€ million". The statistics program that was adopted is "STATA".

For each firm, the dependent variable is "Operating Profit/Loss", which indicates the operating margins recorded each year by the company. The independent variables are all the divisions or products that, summed up, account for a firm's total revenues. Every inter-segment operation within the firm was eliminated. The years taken into account for the analysis comprehend the time frame between the fiscal year 2006 and the fiscal year 2021.

Each regression model includes the variables $\beta_0$, $\alpha_i$, and $u_t$. $\beta_0$ is called the intercept. It represents the value of the independent variable whether all the other coefficients would be equal to 0 (value of Y when X = 0). $u_t$ includes all the model's unobserved factors. These factors are all the independent variables that were not included in the model. The coefficient $\alpha_i$ represents all the time-invariant elements observed in the regression. These time-invariant elements could be, for example, the seasonality of the revenues: in some months customers would tend to buy more (e.g. December, Christmas holidays) and periods of the year where the revenues are lower than usual (e.g. July, August, summer holidays). Another factor that is important to remove for the validity of the research, are the differences between regions in buying one product rather than another. In other words, there will always be a geographical preference in choosing a certain product or a service rather than the another one (e.g Apple sells more in the U.S., and Samsung does the same in Korea). If this trend proves itself to be time-invariant, it would be eliminated by regressing the model in First-Difference.

### 4.2.1. Apple's Regression Models

Apple is an American MNE that operates in the technology sector. The company is specialised in consumer electronics and online services. The independent variables presented in Apple's model are the products that the company offers:

$$operatingmargin_{it} = \beta_0 + \beta_1 iPhone_{it} + \beta_2 mac_{it} + \beta_3 iPod_{it} + \beta_4 accessories_{it} + \beta_5 services_{it} + \alpha_i + u_t$$

The independent variable (IV) *wearable and accessories* ($\beta_4$) includes the products that are not defined in the other variables (i.e. AirPods, cases for iPhone or iPad). The IV *services* includes all the services offered by Apple. The most important are, for example, AppStore, AppleCare, AppleMusic, AppleTV, and ApplePay.

The first regression that was run is a Pooled OLS:

```
. tsset year
       time variable:  year, 2006 to 2021
               delta:  1 unit

. reg operatingmargin iphone mac ipad ipod wearableshomeaccessories services

      Source |       SS           df       MS      Number of obs   =        16
-------------+----------------------------------   F(6, 9)         =    162.53
       Model |  1.0520e+10         6  1.7533e+09   Prob > F        =    0.0000
    Residual |  97086943.3         9  10787438.1   R-squared       =    0.9909
-------------+----------------------------------   Adj R-squared   =    0.9848
       Total |  1.0617e+10        15   707778786   Root MSE        =    3284.4

------------------------------------------------------------------------------
operatingm~n |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      iphone |   .4793173   .1137238     4.21   0.002      .222056    .7365785
         mac |   .3623353   .7361966     0.49   0.634    -1.303057    2.027728
        ipad |   .4986222   .1952921     2.55   0.031     .0568409    .9404035
        ipod |   4.175372   1.622415     2.57   0.030     .5052147     7.84553
wearablesh~s |   .2910366   1.204129     0.24   0.814    -2.432892    3.014965
    services |    .049535   .8003678     0.06   0.952    -1.761023    1.860093
       _cons |  -26906.62   9652.324    -2.79   0.021    -48741.69   -5071.544
------------------------------------------------------------------------------
```

*Figure 4.1. - Apple's Pooled OLS Regression*

As the Figure 4.1. shows, not all the independent variables are statistically significant. In fact, the variables *mac*, *wearables*, and *services* are not. However, it was possible to run an F-test of jointly significance:

```
test iphone mac ipad ipod wearableshomeaccessories services

 ( 1)  iphone = 0
 ( 2)  mac = 0
 ( 3)  ipad = 0
 ( 4)  ipod = 0
 ( 5)  wearableshomeaccessories = 0
 ( 6)  services = 0

       F(  6,     9) =  162.53
            Prob > F =    0.0000
```

*Figure 4.2. - Apple's Jointly Significance Test*

This means that, even though some variables are not statistically significant if taken singularly, the hypothesis $H_0$: “no joint significance” is rejected (Figure 4.2). This can be explained by the presence of unobserved, unit-specific, and time-invariant components ($\alpha_i$), which can create some biases in the regression because they are correlated to the explicative variables. To eliminate this factor, a First Difference regression should be run since by doing this, the time-invariant variable $\alpha_i$ is eliminated

Note of the Author:

*Before continuing the description of the regression models, it is important to notice that the F-test of jointly significance between independent variables is automatically tested by STATA in each regression run. It is possible to see the results of this test under the voice “number of obs” [F(6, 9) is 162.53 in both models, in the same way, Prob > F = 0.0000 in both models]. However, the test will be represented interlay for a better understanding.*

```
. reg d.operatingmargin d.iphone d.mac d.ipad d.ipod d.wearableshomeaccessorie
> s d.services
```

| Source | SS | df | MS | | | |
|---|---|---|---|---|---|---|
| | | | | Number of obs | = | 15 |
| | | | | F(6, 8) | = | 23.09 |
| Model | 1.7003e+09 | 6 | 283377215 | Prob > F | = | 0.0001 |
| Residual | 98192368.8 | 8 | 12274046.1 | R-squared | = | 0.9454 |
| | | | | Adj R-squared | = | 0.9045 |
| Total | 1.7985e+09 | 14 | 128461119 | Root MSE | = | 3503.4 |

| D. operatingm~n | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| iphone D1. | .490793 | .0861115 | 5.70 | 0.000 | .2922195 | .6893665 |
| mac D1. | .7236548 | .6713779 | 1.08 | 0.313 | -.8245454 | 2.271855 |
| ipad D1. | .5586122 | .2507108 | 2.23 | 0.056 | -.019528 | 1.136752 |
| ipod D1. | 2.734757 | 1.789316 | 1.53 | 0.165 | -1.391412 | 6.860926 |
| wearablesh~s D1. | -.5545252 | .8648953 | -0.64 | 0.539 | -2.548977 | 1.439927 |
| services D1. | .8804162 | .5947334 | 1.48 | 0.177 | -.4910414 | 2.251874 |
| _cons | -2311.848 | 1786.628 | -1.29 | 0.232 | -6431.819 | 1808.124 |

*Figure 4.3. - Apple’s First Difference Regression*

After running the First Difference regression (Figure 4.3), as a matter of fact, the coefficients are now different. In particular, it can be observed that the standard errors have decreased in every variable (except for *iPad* and *iPod* variables). However, many variables are still not statistically significant. This can be explained by the lack of observations. A test of joint significance was then run:

```
test d.iphone d.mac d.ipad d.ipod d.wearableshomeaccessories d.services

( 1)  D.iphone = 0
( 2)  D.mac = 0
( 3)  D.ipad = 0
( 4)  D.ipod = 0
( 5)  D.wearableshomeaccessories = 0
( 6)  D.services = 0

      F(  6,     8) =   23.09
           Prob > F =    0.0001
```

*Figure 4.4 - Apple's F. D. Jointly Significance Test*

By running this test (Figure 4.4), it can be seen that the variables are jointly significant since it was not possible to reject $H_0$: "no jointly significance". The coefficients, therefore, are valid.

To verify this statement, the author decided to run a test for heteroskedasticity. Another test, the Breusch-Godfrey test, was used to find evidence of first-order autocorrelation. The first test to be run is the test for heteroskedasticity, also known as the Breusch-Pagan test (Figure 4.5). The presence of heteroskedasticity means that the variance of the residuals is not equal over the range of the sample, which might result in invalid results.

```
. predict uhat, res
(1 missing value generated)

. gen uhatsq = uhat^2
(1 missing value generated)

. reg uhatsq d.iphone d.mac d.ipad d.ipod d.wearableshomeaccessories d.services

      Source |       SS           df       MS      Number of obs   =        15
-------------+----------------------------------   F(6, 8)         =      1.42
       Model |  1.9657e+14         6  3.2762e+13   Prob > F        =    0.3159
    Residual |  1.8507e+14         8  2.3134e+13   R-squared       =    0.5151
-------------+----------------------------------   Adj R-squared   =    0.1514
       Total |  3.8164e+14        14  2.7260e+13   Root MSE        =    4.8e+06

------------------------------------------------------------------------------
      uhatsq |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      iphone |
         D1. |   118.6103   118.2199     1.00   0.345    -154.0053    391.2258
             |
         mac |
         D1. |   211.2814   921.7143     0.23   0.824    -1914.196    2336.759
             |
        ipad |
         D1. |  -19.73867   344.1933    -0.06   0.956    -813.4499    773.9725
             |
        ipod |
         D1. |  -1396.326   2456.497    -0.57   0.585    -7061.018    4268.366
             |
wearableshomea~s |
         D1. |  -1475.443   1187.389    -1.24   0.249    -4213.566     1262.68
             |
    services |
         D1. |   1551.759   816.4914     1.90   0.094    -331.0736    3434.592
             |
       _cons |    1902491    2452807     0.78   0.460     -3753692     7558675
------------------------------------------------------------------------------
```

*Figure 4.5 - Apple's Heteroskedasticity Test*

After the regression of the squared residuals, the Breusch-Pagan test was then carried out to determine whether there was any evidence of heteroskedasticity (Figure 4.6).

```
. test d.iphone d.mac d.ipad d.ipod d.wearableshomeaccessories d.services

 ( 1)  D.iphone = 0
 ( 2)  D.mac = 0
 ( 3)  D.ipad = 0
 ( 4)  D.ipod = 0
 ( 5)  D.wearableshomeaccessories = 0
 ( 6)  D.services = 0

       F(  6,     8) =    1.42
            Prob > F =    0.3159
```

*Figure 4.6. - Testing the Hypothesis of non Heteroskedasticity*

Since it was impossible to reject $H_0$: "presence of homoskedasticity", the results may be considered valid.

The last test to be run was the Breusch-Godfrey test, which looks for any evidence of first-order autocorrelation. This test indicates whether the error term $u_t$ is correlated with $u_{t-1}$. Under the assumption of strict exogeneity, the test is carried out by running the regression of the following model:

$$u_t = \alpha_0 + \alpha_1 u_{t-1} + \epsilon_t$$

```
. reg uhat l.uhat

      Source |       SS           df       MS      Number of obs   =        14
-------------+----------------------------------   F(1, 12)        =      2.77
       Model |  17506035.8         1  17506035.8   Prob > F        =    0.1218
    Residual |    75786975        12  6315581.25   R-squared       =    0.1876
-------------+----------------------------------   Adj R-squared   =    0.1199
       Total |  93293010.8        13  7176385.45   Root MSE        =    2513.1

------------------------------------------------------------------------------
        uhat |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        uhat |
         L1. |  -.4764933      .2862    -1.66   0.122    -1.100069    .1470828
             |
       _cons |  -303.7413   677.7453    -0.45   0.662    -1780.421    1172.939
------------------------------------------------------------------------------
```

*Figure 4.7. - Apple's First-Order Autocorrelation Test*

As shown in Figure 4.7, the p-value of the variable *L1.uhat* is 0.122. Hypotheses $H_0$: "no first-order autocorrelation" is accepted (the coefficient of *L1.uhat* is equal to 0). The absence of first-order autocorrelation is also confirmed by the p-value of the F-test (0.1218). This means that a model with or without the lagged residuals (*L1.uhat*) has the same residual variance, thus that variable is not useful for the model.

### 4.2.2. Samsung's Regression Models

Samsung Electronics is a South-Korean multinational electronic corporation. It is the most relevant company of the Samsung Chaebol (Samsung Group). The company owns production plants and distribution channels in 74 countries around the world (Samsung Annual Report 2020). With its intermediary products (e.g. semiconductors, displays, and image sensors), Samsung Electronics also supplies its direct competitors, such as Apple. The following model includes all the divisions that are present in Samsung Electronics' total revenues:

$$op.profit_{it} = \beta_0 + \beta_1 CE_{it} + \beta_2 IM_{it} + \beta_3 DS_{it} + \beta_4 semiconductors_{it} + \beta_5 harman_{it} + \alpha_i + u_t$$

The *Consumer Electronics* division (CE) includes televisions, refrigerators, and air conditioning units. In the *IT and Mobile* division (IM), products such as mobile phones, computers and communication services are included. The *Device Solution* division (DS) (the name of the division was LCD until 2013) contains intermediary products such as LCD and OLED screens, memory cards and LED bulbs. In the *Semiconductor* division, they include operations regarding the business of semiconductors. The last division is *Harman* (acquired in 2016). Harman is the market leader in connected car solutions, and it is specialised in the Internet of the Things and Machine Learning softwares related to the car market.

Firstly, the Pooled OLS regression was run:

```
. tsset year
       time variable:  year, 2006 to 2021
               delta:  1 unit

. reg operatingprofit consumerelectronics informationtechnologymobilecommu semicondu
> ctor devicesolutions harman

      Source |       SS           df       MS      Number of obs   =        16
-------------+----------------------------------   F(5, 10)        =     43.49
       Model |  2.4051e+09         5   481025864   Prob > F        =    0.0000
    Residual |   110608100        10    11060810   R-squared       =    0.9560
-------------+----------------------------------   Adj R-squared   =    0.9341
       Total |  2.5157e+09        15   167715828   Root MSE        =    3325.8

------------------------------------------------------------------------------
operatingprofit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
----------------+-------------------------------------------------------------
consumerelectro~s |  -.4426341   .3621018    -1.22   0.250    -1.249447    .3641791
informationtech~u |   .1039285    .066099     1.57   0.147    -.0433491    .2512062
     semiconductor |   .8076125   .1484301     5.44   0.000     .4768896    1.138335
   devicesolutions |   .7246982   .4094497     1.77   0.107    -.1876126    1.637009
            harman |  -3.455295   1.244222    -2.78   0.020    -6.227595   -.6829953
             _cons |  -8647.573   8370.661    -1.03   0.326    -27298.57    10003.42
------------------------------------------------------------------------------
```

*Figure 4.8. - Samsung's Pooled OLS Regression*

Differently from Apple (described in Figure 4.1), in this regression we can observe that two divisions, *Consumer Electronics* (CE) and *Harman*, have a negative coefficient (Figure 4.8). This means that an increase of one unit in *Consumer Electronics* decreases the *Operating Profit* (the dependent variable) by -0.44 units, ceteris paribus. In the case of *Harman*, an increase of one unit decreases the operating profit by -3.45 units, all else equal. On the one hand, this can be expected since Harman is a branch that operates in an emerging industry (AI and Internet of Things connected to the automotive) that needs a lot of research and investments but, on the other hand, CE is one of Samsung's biggest divisions (it includes televisions and electrical appliances). Therefore, the negative coefficient was an interesting result. The following regression and test can help find viable reasons for the CE's negative coefficient. Nonetheless, these causes can also be exogenous. In fact, the Consumer Electronics division lost part of its sales share between 2013 and 2018. Moreover, the recession in the TV market also began in 2012.

```
test consumerelectronics informationtechnologymobilecommu semiconductor devi
cesolutions harman

 ( 1)  consumerelectronics = 0
 ( 2)  informationtechnologymobilecommu = 0
 ( 3)  semiconductor = 0
 ( 4)  devicesolutions = 0
 ( 5)  harman = 0

       F(  5,    10) =   43.49
            Prob > F =    0.0000
```

*Figure 4.9. - Samsung's Jointly Significance Test*

Even though some variables, as stand-alone factors, are not statistically significant (i.e Consumer Electronics), the F-test shows that they are jointly significant (hypothesis $H_0$ rejected) as shown in Figure 4.9.

Similarly to Apple's model, by running a First Difference regression, it was possible to remove time-invariant, unit-specific factors ($\alpha_i$):

```
. reg d.operatingprofit d.consumerelectronics d.informationtechnologymobilecom
> mu d.semiconductor d.devicesolutions d.harman

      Source |       SS           df       MS      Number of obs   =        15
-------------+----------------------------------   F(5, 9)         =     16.31
       Model |  1.1671e+09         5   233412505   Prob > F        =    0.0003
    Residual |   128821324         9  14313480.4   R-squared       =    0.9006
-------------+----------------------------------   Adj R-squared   =    0.8454
       Total |  1.2959e+09        14  92563132.2   Root MSE        =    3783.3

------------------------------------------------------------------------------
D.           |
operatingp~t |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
consumerel~s |
         D1. |  -.4066341   .4719698    -0.86   0.411    -1.474304    .6610359
             |
informatio~u |
         D1. |   .3155644   .1216811     2.59   0.029     .0403025    .5908262
             |
semiconduc~r |
         D1. |   1.056677    .149308     7.08   0.000     .7189187    1.394435
             |
devicesolu~s |
         D1. |   .2421394   .4303971     0.56   0.587    -.7314866    1.215765
             |
      harman |
         D1. |  -3.162345   2.138345    -1.48   0.173    -7.999618    1.674928
             |
       _cons |  -1393.661    1333.43    -1.05   0.323     -4410.09    1622.768
------------------------------------------------------------------------------
```

*Figure 4.10. - Samsung's First Difference Regression*

The changes are less accentuated than those observed in Apple's case but the model is more precise. In fact, as Figure 4.10 illustrates, the standard errors and p-value are lower. Moreover, the coefficients of variables *IM* and *Semiconductors* increased (Samsung's division, *Semiconductors*, has the biggest share in positively determining the Operating Profit of the firm) and the *DS* coefficient was more than halved. The *CE* division is still negative.

To test the validity of the independent variables, the Breusch-Pagan test and the Breusch-Godfrey test were run:

```
. predict uhat, res
(1 missing value generated)

. gen uhatsq = uhat^2
(1 missing value generated)

. reg uhatsq d.consumerelectronics d.informationtechnologymobilecommu d.semiconducto
> r d.devicesolutions d.harman

      Source |       SS           df       MS      Number of obs   =        15
-------------+----------------------------------   F(5, 9)         =      1.03
       Model |  3.7121e+14         5  7.4241e+13   Prob > F        =    0.4533
    Residual |  6.4625e+14         9  7.1805e+13   R-squared       =    0.3648
-------------+----------------------------------   Adj R-squared   =    0.0120
       Total |  1.0175e+15        14  7.2675e+13   Root MSE        =    8.5e+06

------------------------------------------------------------------------------
      uhatsq |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
consumerelectro~s |
         D1. |   20.63842   1057.109     0.02   0.985    -2370.708    2411.984
             |
informationtech~u |
         D1. |  -424.6892    272.539    -1.56   0.154    -1041.215    191.8368
             |
semiconductor |
         D1. |   93.65858   334.4172     0.28   0.786    -662.8457    850.1628
             |
devicesolutions |
         D1. |   549.2492   963.9949     0.57   0.583    -1631.459    2729.957
             |
      harman |
         D1. |  -8251.643   4789.423    -1.72   0.119    -19086.07    2582.785
             |
       _cons |   1.21e+07    2986591     4.04   0.003      5306266    1.88e+07
------------------------------------------------------------------------------
```

*Figure 4.11. - Samsung's Heteroskedasticity Test*

As described in Figure 4.11, the hypothesis $H_0$: "presence of homoskedasticity" is accepted (p-value = 0.4533), hence the results may be considered valid.

As illustrated in Figure 4.12, the second test (Breusch-Godfrey) seeks to find evidence of first-order autocorrelation, under the assumption of strict exogeneity.

```
. reg uhat l.uhat

      Source |       SS           df       MS      Number of obs   =        14
-------------+----------------------------------   F(1, 12)        =      0.09
       Model |  841044.069         1  841044.069   Prob > F        =    0.7750
    Residual |   118026580        12  9835548.33   R-squared       =    0.0071
-------------+----------------------------------   Adj R-squared   =   -0.0757
       Total |   118867624        13  9143663.39   Root MSE        =    3136.2

------------------------------------------------------------------------------
        uhat |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        uhat |
         L1. |  -.0815521   .2788848    -0.29   0.775    -.6891898    .5260857
             |
       _cons |  -209.0621   838.6979    -0.25   0.807    -2036.428    1618.304
------------------------------------------------------------------------------
```

*Figure 4.12 - Samsung's First-Order Autocorrelation Test*

The p-value of the independent variable *L1.uhat* is 0.775, thus hypothesis $H_0$: "no presence of first-order autocorrelation" was accepted.

## 4.2.3. Toyota's and the Volkswagen Group's Regression Models

The following multinational enterprises analysed are also the two biggest car manufacturers in the world (in terms of production volume), according to OICA (the international organisation of motor vehicle manufacturers).

Toyota Motor Corporation (commonly known as Toyota) is headquartered in Japan. The company produces passenger vehicles and offers related services. Under Toyota, we can find many car brands such as Lexus, Ranz, and Subaru. The following model describes the company's divisions that compose its operating margin.

$$ToyotaOpProfit_{it} = \beta_0 + \beta_1 automotive_{it} + \beta_2 financialservices_{it} + \beta_3 other_{it} + \alpha_i + u_t$$

The first independent variable represents the revenues of passenger vehicles, while the second IV describes the revenues from the services that Toyota offers. These services are financing and leasing services and warranty on cars. The division Others includes two sectors, where Toyota operates, which are different from the company's main business. They are housing and telecommunications.

The Volkswagen Group is headquartered in Wolfsburg, Germany. The company designs, manufactures and distributes passenger and commercial vehicles as a principal business. The Volkswagen Group is also the biggest car manufacturer in the world. The model below introduces the Volkswagen Group's division:

$$VWOpProfit_{it} = \beta_0 + \beta_1 passengercars_{it} + \beta_2 trucks_{it} + \beta_3 financialservices_{it} + \beta_4 powereng_{it} + \alpha_i + u_t$$

The independent variable *Passenger Cars* includes the revenues of the various brands of passenger vehicles and motorcycles that are included in the group. These brands are: Audi, Porsche, Seat, Skoda, Volkswagen, Ducati, and Lamborghini. The variable *Trucks* includes the revenues of the commercial vehicles. This division includes the revenues of MAN, Scania and IC Bus, which all produce trucks and buses. The *Services* division includes services related to the car market, which are quite similar to those offered by Toyota, such as financing and leasing. The last variable, *Power Engineering*, represents the Volkswagen Group's division specialised in the production of engines for ships and turbomachines (a particular typology of engine also used in wind turbines).

The following models represent the pooled OLS regressions for both companies:

```
. tsset year
        time variable:  year, 2006 to 2021
                delta:  1 unit

. reg operatingprofitloss automotive financialservices other

      Source |       SS           df       MS      Number of obs   =        16
-------------+----------------------------------   F(3, 12)        =      7.74
       Model |  613694844         3  204564948     Prob > F        =    0.0039
    Residual |  317247314        12  26437276.1    R-squared       =    0.6592
-------------+----------------------------------   Adj R-squared   =    0.5740
       Total |  930942157        15  62062810.5    Root MSE        =    5141.7

------------------------------------------------------------------------------
operatingprofit~s |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------------+-----------------------------------------------------------
       automotive |   .4624832   .1278822     3.62   0.004     .1838517    .7411146
financialservices |   -2.35646   1.076147    -2.19   0.049    -4.701183   -.0117377
            other |  -.7274691   1.142499    -0.64   0.536     -3.21676    1.761822
            _cons |  -35404.83   10623.31    -3.33   0.006    -58551.03   -12258.62
------------------------------------------------------------------------------
```

*Figure 4.13 - Toyota's Pooled OLS Regression Model*

```
. tsset year
        time variable:  year, 2006 to 2021
                delta:  1 unit

. reg operatingprofit passengercars trucksandbuses powerengineering financialservice
> s

      Source |       SS           df       MS      Number of obs   =        16
-------------+----------------------------------   F(4, 11)        =      2.41
       Model |  252947435         4  63236858.7   Prob > F        =    0.1118
    Residual |  288433579        11  26221234.5   R-squared       =    0.4672
-------------+----------------------------------   Adj R-squared   =    0.2735
       Total |  541381014        15  36092067.6   Root MSE        =    5120.7

-----------------------------------------------------------------------------------
  operatingprofit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------------+----------------------------------------------------------------
    passengercars |   .2517738   .1783445     1.41   0.186    -.1407598    .6443074
   trucksandbuses |   .2400712    .318061     0.75   0.466    -.4599763    .9401188
 powerengineering |  -3.076487   2.217243    -1.39   0.193    -7.956606    1.803632
financialservices |  -.1393469   .3289827    -0.42   0.680    -.8634329    .5847392
            _cons |  -19331.98   15347.48    -1.26   0.234    -53111.56    14447.61
-----------------------------------------------------------------------------------
```

*Figure 4.14 - The Volkswagen Group's Pooled OLS Regression Model*

As Figure 4.13 and Figure 4.14 illustrate, one striking result that emerges from the data is the fact that in both models, the variables *Financial Services* have negative coefficients. This means that an increase of one unit in the revenues of *Financial Services* (e.g. customer financing, car leasing, and insurance activities) resulted in a decrease of 0.139 units in the *Operating Profit* (the dependent variable), ceteris paribus. A negative coefficient can also be seen in the Volkswagen Group's division *Power Engineering* (engines for ships and turbomachinery), even though it must be said that this particular division mostly operates in a difficult market environment, with high expenses and low revenues. Moreover, even though the coefficients of *Automotive* (Toyota) and *Passenger Cars* (the Volkswagen Group) are positive, they do not seem to influence the result of the Operating Margin.

Subsequently, a joint significance test (F-test) was run:

```
. test automotive financialservices other

 ( 1)  automotive = 0
 ( 2)  financialservices = 0
 ( 3)  other = 0

       F(  3,    12) =    7.74
            Prob > F =    0.0039
```

*Figure 4.15. - Toyota's Pooled OLS F-test*

```
. test passengercars trucksandbuses powerengineering financialservices

 ( 1)  passengercars = 0
 ( 2)  trucksandbuses = 0
 ( 3)  powerengineering = 0
 ( 4)  financialservices = 0

       F(  4,    11) =    2.41
            Prob > F =    0.1118
```

*Figure 4.16. - the Volkswagen Group Pooled OLS F-test*

For the first time, by running an F-test of jointly significance, the hypothesis $H_0$: “no jointly significance” is accepted (in the case of the Volkswagen Group, Figure 4.16). The results, therefore, are not valid. In the case of Toyota, represented in Figure 4.15, the variables are statistically jointly significant. At this point in the research process, it was considered interesting to find out whether something changed when working with differences (First Difference regression).

```
. reg d.operatingprofitloss d.automotive d.financialservices d.other

      Source |       SS           df       MS      Number of obs   =        15
-------------+----------------------------------   F(3, 11)        =      6.16
       Model |  353658945          3   117886315   Prob > F        =    0.0103
    Residual |  210647280         11  19149752.7   R-squared       =    0.6267
-------------+----------------------------------   Adj R-squared   =    0.5249
       Total |  564306225         14  40307587.5   Root MSE        =      4376

------------------------------------------------------------------------------
D.           |
operatingp~s |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  automotive |
         D1. |   .5283896   .1281636     4.12   0.002     .2463033    .8104758
             |
financialservices |
         D1. |  -3.304189   1.410319    -2.34   0.039     -6.40828   -.2000982
             |
       other |
         D1. |  -1.767391   .9929206    -1.78   0.103    -3.952794    .4180129
             |
       _cons |   210.7959   1321.467     0.16   0.876    -2697.733    3119.325
------------------------------------------------------------------------------
```

*Figure 4.17. - Toyota’s First Difference Regression Model*

```
. reg  d.operatingprofit d.passengercars d.trucksandbuses d.powerengineering d.finan
> cialservices

      Source |       SS           df       MS      Number of obs   =        15
-------------+----------------------------------   F(4, 10)        =      2.52
       Model |  335759929          4  83939982.2   Prob > F        =    0.1076
    Residual |  333209366         10  33320936.6   R-squared       =    0.5019
-------------+----------------------------------   Adj R-squared   =    0.3027
       Total |  668969295         14  47783521.1   Root MSE        =    5772.4

------------------------------------------------------------------------------
D.operatingprofit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
passengercars |
         D1. |   .6039263   .1955859     3.09   0.011     .1681338    1.039719
             |
trucksandbuses |
         D1. |  -.2384789   .4260218    -0.56   0.588    -1.187715    .7107569
             |
powerengineering |
         D1. |  -2.078792   1.893285    -1.10   0.298    -6.297293     2.13971
             |
financialservices |
         D1. |  -4.721158   2.253411    -2.10   0.063    -9.742072    .2997555
             |
       _cons |   9978.633   5214.032     1.91   0.085    -1638.954     21596.22
------------------------------------------------------------------------------
```

*Figure 4.18. - the Volkswagen Gropu’s First Difference Regression Model*

The biggest difference is presented in the Volkswagen Group's model. Toyota's model, instead, presents the same coefficients, solely with little variations in the coefficients and standard errors. The only exception is presented by the independent variable F*inancial Services,* which has a coefficient of -3.30 (Figure 4.17). Differently from the regression in Figure 4.14, the Volkswagen Group's variable T*rucks and Buses* now has a negative coefficient in Figure 4.18 (regression model in First Difference). In addition to this, the independent variable F*inancial Services* increased considerably its negative coefficient considerably, which went from -0.139 to -4.72 (also, the standard error is considerably higher in Toyota's case).

The results obtained  by running an F-Test are consistent with the predictions of the author:

```
. test d.automotive d.financialservices d.other

 ( 1)  D.automotive = 0
 ( 2)  D.financialservices = 0
 ( 3)  D.other = 0

       F(  3,    11) =    6.16
            Prob > F =    0.0103
```

*Figure 4.19 - Toyota's F.D. F-test*

```
test d.passengercars d.trucksandbuses d.powerengineering d.financialservices

 ( 1)  D.passengercars = 0
 ( 2)  D.trucksandbuses = 0
 ( 3)  D.powerengineering = 0
 ( 4)  D.financialservices = 0

       F(  4,    10) =    2.52
            Prob > F =    0.1076
```

*Figure 4.20 - the Volkswagen Group F.D. F-test*

In general, the results showed that Toyota's independent variables are still statistically jointly significant (Figure 4.19), while those of the Volkswagen Group are not (Figure 4.20). According to the author, there should be a plausible reason that could explain the biases presented in the Volkswagen Group's model. However, it is important to see whether it is possible to find the elements that caused the biased results. The first test that was run was the Breusch-Pagan test, which was needed to verify the presence of homoskedasticity in the observations (see Figure 4.21 and Figure 4.22).

```
. predict uhat, res
(1 missing value generated)

. gen uhatsq = uhat^2
(1 missing value generated)

. reg uhatsq d.automotive d.financialservices d.other
```

| Source | SS | df | MS |
|---|---|---|---|
| Model | 8.4269e+14 | 3 | 2.8090e+14 |
| Residual | 3.0186e+15 | 11 | 2.7442e+14 |
| Total | 3.8613e+15 | 14 | 2.7581e+14 |

| | | |
|---|---|---|
| Number of obs | = | 15 |
| F(3, 11) | = | 1.02 |
| Prob > F | = | 0.4195 |
| R-squared | = | 0.2182 |
| Adj R-squared | = | 0.0050 |
| Root MSE | = | 1.7e+07 |

| uhatsq | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| automotive D1. | -400.8179 | 485.167 | -0.83 | 0.426 | -1468.663 | 667.0274 |
| financialservices D1. | 1491.659 | 5338.801 | 0.28 | 0.785 | -10258.96 | 13242.28 |
| other D1. | 6424.901 | 3758.729 | 1.71 | 0.115 | -1848.006 | 14697.81 |
| _cons | 1.52e+07 | 5002451 | 3.04 | 0.011 | 4210949 | 2.62e+07 |

*Figure 4.21. - Toyota's Heteroskedasticity Test*

```
. predict uhat, res
(1 missing value generated)

. gen uhatsq = uhat^2
(1 missing value generated)

. reg uhatsq  d.passengercars d.trucksandbuses d.powerengineering d.financialservice
> s
```

| Source | SS | df | MS |
|---|---|---|---|
| Model | 1.5577e+15 | 4 | 3.8942e+14 |
| Residual | 1.4397e+16 | 10 | 1.4397e+15 |
| Total | 1.5955e+16 | 14 | 1.1396e+15 |

| | | |
|---|---|---|
| Number of obs | = | 15 |
| F(4, 10) | = | 0.27 |
| Prob > F | = | 0.8904 |
| R-squared | = | 0.0976 |
| Adj R-squared | = | -0.2633 |
| Root MSE | = | 3.8e+07 |

| uhatsq | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| passengercars D1. | -872.9809 | 1285.646 | -0.68 | 0.513 | -3737.579 | 1991.617 |
| trucksandbuses D1. | 512.3131 | 2800.372 | 0.18 | 0.858 | -5727.304 | 6751.931 |
| powerengineering D1. | -3744.61 | 12445.14 | -0.30 | 0.770 | -31474.11 | 23984.89 |
| financialservices D1. | 12100.28 | 14812.36 | 0.82 | 0.433 | -20903.72 | 45104.28 |
| _cons | -1990129 | 3.43e+07 | -0.06 | 0.955 | -7.84e+07 | 7.44e+07 |

*Figure 4.22 - the Volkswagen Group's Heteroskedasticity Test*

For both models, the hypothesis $H_0$: "presence of homoskedasticity" is accepted.

The last test that was run was the test for first-order autocorrelation of the error term (Breusch-Godfrey test):

. reg uhat l.uhat

| Source | SS | df | MS | | | |
|---|---|---|---|---|---|---|
| | | | | Number of obs | = | 14 |
| | | | | F(1, 12) | = | 0.00 |
| Model | 34928.8549 | 1 | 34928.8549 | Prob > F | = | 0.9646 |
| Residual | 204454089 | 12 | 17037840.8 | R-squared | = | 0.0002 |
| | | | | Adj R-squared | = | -0.0831 |
| Total | 204489018 | 13 | 15729924.5 | Root MSE | = | 4127.7 |

| uhat | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| uhat L1. | -.0129066 | .2850549 | -0.05 | 0.965 | -.633988 | .6081747 |
| _cons | -172.1215 | 1103.342 | -0.16 | 0.879 | -2576.096 | 2231.853 |

*Figure 4.23. - Toyota's First-Order Autocorrelation Test*

. reg uhat l.uhat

| Source | SS | df | MS | | | |
|---|---|---|---|---|---|---|
| | | | | Number of obs | = | 14 |
| | | | | F(1, 12) | = | 0.31 |
| Model | 8056394.51 | 1 | 8056394.51 | Prob > F | = | 0.5890 |
| Residual | 313669430 | 12 | 26139119.1 | R-squared | = | 0.0250 |
| | | | | Adj R-squared | = | -0.0562 |
| Total | 321725824 | 13 | 24748140.3 | Root MSE | = | 5112.6 |

| uhat | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| uhat L1. | -.1555045 | .2801032 | -0.56 | 0.589 | -.765797 | .454788 |
| _cons | -236.1935 | 1366.418 | -0.17 | 0.866 | -3213.362 | 2740.975 |

*Figure 4.24. - the Volkswagen Group First-Order Autocorrelation Test*

As can be seen from Figure 4.23 and Figure 4.24, both models failed to reject hypothesis $H_0$: "no first-order autocorrelation". Thus the error term is not correlated over time. In conclusion, the results should not be biased.

The two models that have been analysed in this chapter revealed that the Volkswagen model's results are somewhat biased. This can be explained by the fact that the model is influenced by other factors. In other words, there could be endogenous variables in the model that create biases when the regression is run.

### 4.2.4 Inditex' and Starbucks' Regression Models

Inditex and Starbucks are the last two firms that will be analysed in the thesis. Inditex (Industria de Diseño Textil) is a Spanish clothes manufacturer, headquartered in Arteixo, Galicia. The company, through its branches, operates in 6,477 different stores, spread over 93 countries all over the world (Inditex annual report, 2021). The clothing brands that are included in the Inditex's group are Massimo Dutti, Berschka, Oysho, Pull & Bear, Stradivarius, and, most important, Zara.

The other MNE that will be analysed in this chapter is Starbucks. The brand is an American coffeehouse chain headquartered in Seattle, Washington. The company has 38,833 stores, where they serve coffee supplied by different producers spread in over 30 different countries (Starbucks annual report, 2021).

Both firms offer only one type of product, which are clothes in the case of Inditex and coffee in the case of Starbucks. Even if the product is divided in divisions, each division sells the same product. For example, Inditex divides its total revenues per brand, but the variations in revenues in the case of a black swan event are the same because the offered product is the same. Thus, a regression model where the operating margin is defined only by the revenues of one type of product would be superfluous for this analysis. Despite this, the data collected from the annual reports of the time frame between 2006 and 2021(s. Appendix) gives important insights for the discussion.

# 5. Results and Interpretations

Upon analysis of the collected data and the regressions run, a number of interesting insights can be provided.

## 5.1 Overall Analysis

Table 5.1 and Table 5.2, which were created on the basis of the author's calculations, take into consideration the two biggest unpredictable recessionary global events: the financial crisis of 2008 and the COVID-19 pandemic. These tables represent the percentage variations in revenues, operating expenses, and operating margin of the years before, during, and after these two black-swan events.

Financial Crisis of 2008

| | from F.Y. 2007 to F.Y. 2008 | | |
|---|---|---|---|
| | Total Revenues | Operating Expenses | Operating Margin |
| Volkswagen | 5% | 5% | 3% |
| Toyota | 17% | 17% | 7% |
| Samsung | 8% | 11% | -9% |
| Apple | 26% | 25% | 37% |
| Starbucks | 11% | 11% | 8% |
| Inditex | 10% | 13% | 2% |
| | **from F.Y. 2008 to F.Y. 2009** | | |
| | **Total Revenues** | **Operating Expenses** | **Operating Margin** |
| Volkswagen | -8% | -4% | -71% |
| Toyota | -8% | 2% | -123% |
| Samsung | -2% | 4% | -44% |
| Apple | 19% | 16% | 29% |
| Starbucks | -1% | -2% | 17% |
| Inditex | 7% | 6% | 9% |
| | **from F.Y. 2009 to F.Y. 2010** | | |
| | **Total Revenues** | **Operating Expenses** | **Operating Margin** |
| Volkswagen | 21% | 16% | 285% |
| Toyota | 3% | 1% | 135% |
| Samsung | 4% | -1% | 74% |
| Apple | 88% | 70% | 152% |
| Starbucks | 15% | 6% | 165% |
| Inditex | 13% | 10% | 25% |

Data: Authors' calculation, using data available from the reports of the firms

COVID-19 Pandemic

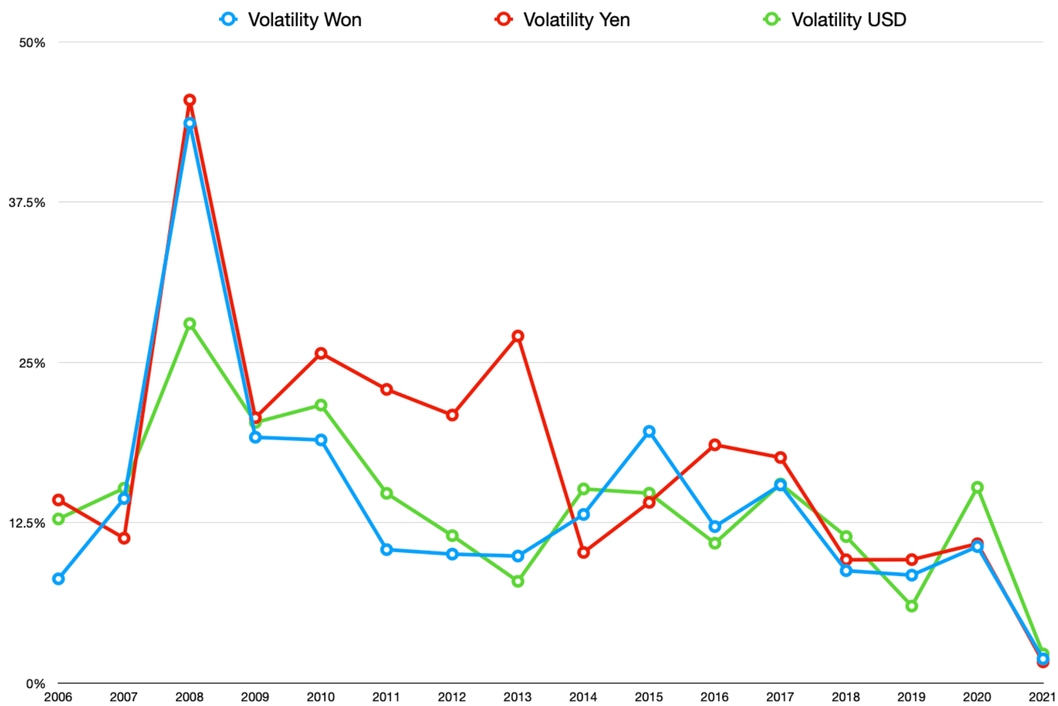
| | from F.Y. 2018 to F.Y. 2019 | | |
|---|---|---|---|
| | Total Revenues | Operating Expenses | Operating Margin |
| Volkswagen | 7% | 6% | 20% |
| Toyota | 10% | 10% | 10% |
| Samsung | 1% | -2% | 8% |
| Apple | 2% | 6% | -5% |
| Starbucks | 13% | 14% | 11% |
| Inditex | 8% | 0% | 39% |
| | **from F.Y. 2019 to F.Y. 2020** | | |
| | **Total Revenues** | **Operating Expenses** | **Operating Margin** |
| Volkswagen | -11% | -10% | -43% |
| Toyota | -1% | -1% | -1% |
| Samsung | -6% | 9% | -53% |
| Apple | 4% | 4% | 2% |
| Starbucks | -13% | -4% | -62% |
| Inditex | -28% | -23% | -40% |
| | **from F.Y. 2020 to F.Y. 2021** | | |
| | **Total Revenues** | **Operating Expenses** | **Operating Margin** |
| Volkswagen | 11% | 8% | 99% |
| Toyota | -12% | -12% | -13% |
| Samsung | -1% | -4% | 26% |
| Apple | 25% | 16% | 54% |
| Starbucks | 16% | 3% | 192% |
| Inditex | 36% | 30% | 58% |

Data: Authors' calculation, using data available from the reports of the firms

*Table 5.1. - Impact and Recovery from Financial Crisis in 2008*
*Table 5.2. - Impact and Recovery from COVID-19 Pandemic*

The results highlight three notable findings. First, Toyota is the only analysed company that had a negative impact during the pandemic, which was much lower than the impact the company had in 2008. As a matter of fact, the revenues fell by 8% and the operating margin recorded a negative variation of 123% (2008), while in 2020 the Japanese car manufacturer recorded a negative variation of just 1% both in the revenues and the margin. Unfortunately, Toyota also recorded a negative variation the following year (-12% in revenues and -13% in the operating margin). Volkswagen, in contrast to its Asian competitor, scored a positive variation both in revenues (+11%) and in the operating margin (+99%) in 2021. The second notable finding is that Apple has never recorded a negative variation, neither during the financial crisis of 2008 nor during the COVID-19 pandemic. Third, Inditex not only did not have any repercussions during the financial crisis but in 2008, the Spanish group also registered a 7% increase in revenues and a 9% increase in the operating margin. On the other hand, as expected, the only negative variation that the company has recorded was during the first lockdown year, in 2020, when the principal distribution channel closed.

The exchange rates between currencies also play an important role in this analysis. In particular, as concerns their volatilities. Figure 5.1 indicates the average annual volatility (in percentage) of the South-Korean Won, the Japanese Yen, and the United States Dollar.




Data: Authors' calculation, using data available from exchangerates.org

*Figure 5.1. - Average Annual Volatility of Currencies*

As expected, the highest peak in average annual volatility was reached in 2008. It is interesting to note that, although the 2008 financial crisis started in the United States, the U.S. Dollar recorded lower volatility than the two Asian currencies (the average annual volatility of the U.S. Dollar was 28.03% against 43.65% of the South-Korean Won and 45.46% of the Japanese Yen). In addition, the Yen kept a high volatility level also in the following years. This fact can be explained by the natural disasters that the country suffered in 2011, which have brought uncertainty to the Japanese economy even after the 2008 events. After 2014, the currencies seemed to stabilise, even though the Won and the Yen presented greater variations in volatility than the U.S. Dollar. As concerns the years to come, it can be expected that, in the following years, the Asian firms, led by their experience in dealing with different types of crises, should be more skilled in avoiding negative fluctuations of the currency. By now, they should have developed financial tools that help mitigate these negative fluctuations. Thus, they will probably have smaller variations compared to the Western countries. In fact, recent data shows that in 2020 the U.S. Dollar registered a higher average annual volatility (15.27%) than the Japanese Yen (10.87%) and the South-Korean Won (10.65%).

## 5.2. Considerations on Toyota and the Volkswagen Group

The following chart shows the operating margins that were recorded by Toyota and the Volkswagen Group between the fiscal year 2006 and the fiscal year 2021.

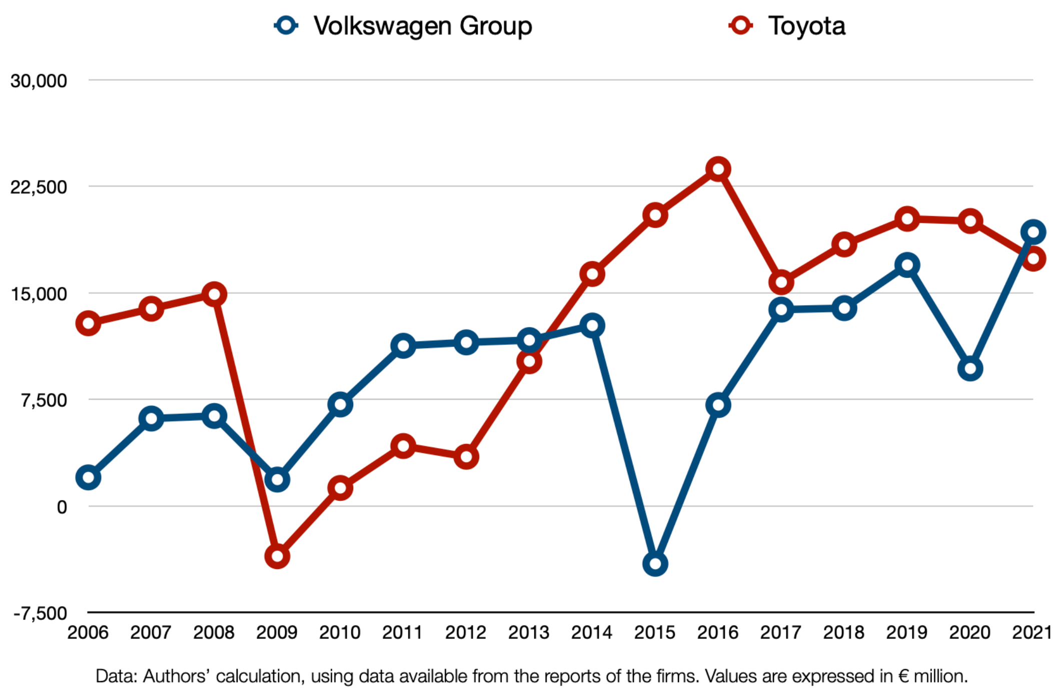



*Figure 5.2. - Toyota's and the Volkswagen Group's Operating Margin from 2006 to 2021*

The results of the present study show some clear trends. Prior to the 2008 financial crisis, Toyota's operating margin was far bigger (€14,897 million in the F.Y. 2008) than the margin of the Volkswagen Group (€6,333 million in F.Y. 2008). This situation changed drastically in 2008. In fact, as Table 5.1 shows, Toyota lost 123% of its operating margin (€ -3,538 million in F.Y. 2009). This sum is much larger compared to the Volkswagen Group, which "only" lost the 71% of its margin (€ 1,856 million in F.Y. 2009). The Volkswagen Group's management strategies revealed themselves to be not only more robust than Toyota's, but also more resilient. In fact, the German car manufacturer recovered its loss in just one year (€ 7,141 million in F.Y. 2010). Toyota, not only did not recover from the negative impact experienced (€ 1,266 million in F.Y. 2010), but its recovery was also made more difficult by the environmental disaster that happened in 2011 in Japan (earthquake with magnitude 9.1). This tragic event had enormous consequences on all the Asian archipelago, provoking the closure of many production plants and the nuclear accident in Fukushima (the tsunami cooled three reactors of the plant, causing the melting of all the three cores). This critical situation, however, was a groundbreaking moment for the firm. In fact, in 2012, the operating margin of Toyota started increasing more than in the previous years and reached its peak in 2015, the same year in which the Volkswagen Group's scandal known as the "Dieselgate" happened. Nonetheless, the Volkswagen Group's value chain showed to be incredibly resilient, recovering from this shock in just two years. The variations caused by the coronavirus pandemic are revealing: as Table 5.2 shows, Toyota's value chain revealed itself to be more robust than that of its European competitor. Even though the previous table (Table 5.2) showed that Toyota recorded negative variations also during the following year (in fact, Volkswagen Group's value chain is still more resilient), those variations still are smaller than those of Volkswagen Group.

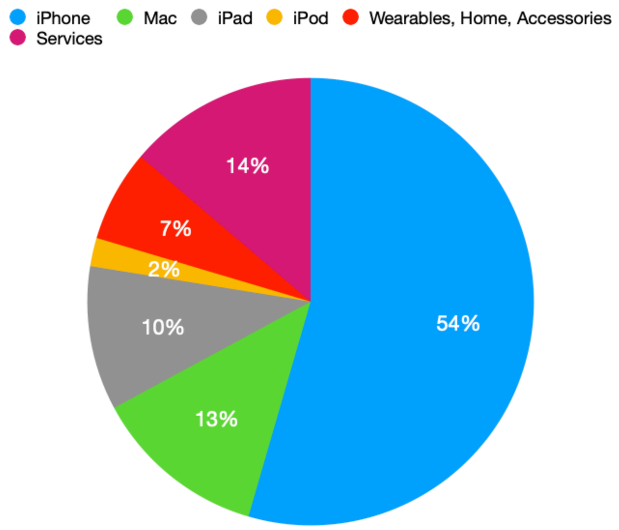
It is possible to conclude that Toyota learned more from experience than its German competitor. Not only Toyota had a greater negative shock on its operating margin rather than the Volkswagen Group, but the Japanese car manufacturer experienced an unexpected natural disaster that brought an additional (economic) recession in Japan. As a consequence, the firm developed a more robust global value chain than the Volkswagen Group, as the findings demonstrate.

## 5.3. Considerations on Apple and Samsung Electronics

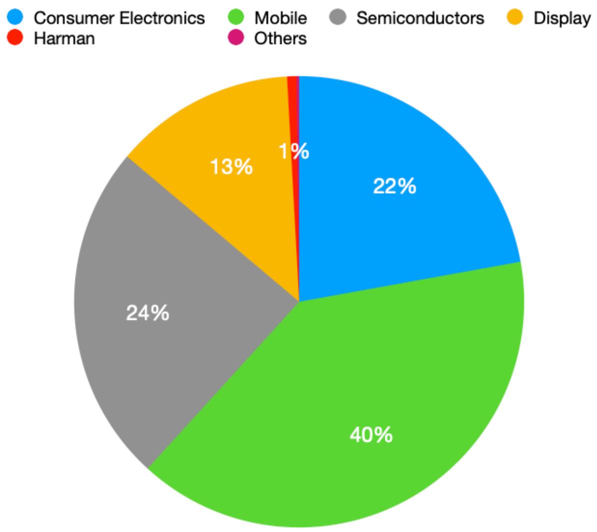
The purely efficiency-seeking strategies for the management of the global value chain of a firm (ability to keep the best possible ratio of outputs to inputs in a value creation system) seemed not to be so efficient in the long run. Moreover, these strategies could result in unfair procedures (e.g. "Dieselgate"). Nonetheless, there are firms that, even though they are principally adopting efficiency-seeking strategies, do not feel the negative economic impact that a black-swan event could have, even in the long run. The American multinational technology company, Apple, serves as a good example.

Apple outsources most of its production. This means that the company does not pursue an internalisation politics of its production process. Moreover, it only offers a small range of products (i.e. five products plus one division for Apple's Services). Despite this limited product range, Apple recorded a negative variation in the operating margin, as well as in revenues, only in 2016. The causes were not even related to any recessionary shock, but only to the fact that, in 2016, the revenues of iPhone decreased by 11.5%, which corresponds to the 101% negative overall variation of the total revenues. That year, the only division that recorded a positive variation in revenues was Apple's Services (+23%) (source: Apple's 2016 annual report).

Samsung's position, however, is somewhat different. On the one hand, the South-Korean company offers a greater range of products in different branches of the technological sector. On the other hand, differently from Apple, the Asian company internalised many phases of its production process, besides producing intermediary products that are sold also to Samsung's direct competitors (e.g. Samsung supplies Apple with OLED displays that are used both for iPhones and iPads). Among these intermediary products, the most important are the semiconductors. Samsung, together with TMSC (Taiwan Semiconductor Manufacturing Company), is one of the only two producers of the most innovative nano chips in the world (that are smaller than 7 nanometres). Moreover, by looking back at Samsung's First Difference regression model (Figure 4.10), it emerges that the *Semiconductors* independent variable had a coefficient of 1.05 in relation to the operating margin of the firm. This means that, ceteris paribus, an increase of one unit in semiconductors increases Samsung's operating margin by 1.05 units. This result is impressive, not only because the independent variable has the highest coefficient observed, but also because the *iPhone* variable, which describes all the revenues of the iPhone in one year (Apple's most sold product), has a coefficient of 0.49 (Figure 4.3).




Data: Authors' calculation, using data available from the reports of the firms




Data: Authors' calculation, using data available from the reports of the firms

*Figure 5.4. - Composition of Apple's Revenues from 2006 to 2021*
*Figure 5.5. - Composition of Samsung's Revenues from 2006 to 2021*

The pie charts represented above show the share that each product (in the case of Apple, Figure 5.4) and division (in the case of Samsung, Figure 5.5) had in the overall revenues of the companies from 2006 to 2021. It is interesting to observe that, even though the commercialisation of the iPhone began in 2007, it accounts for the 54% of Apple's overall revenues. As a matter of fact, in 2007 iPhone division recorded revenues for €89 million, in 2021 iPhone division revenues had a value of €157,613 million. Other Apple products have, more or less, the same share of revenues (except for the iPod, whose production was halted in 2015). On the other hand, Samsung's Mobile division accounts for 40% of the company's total revenues (as a matter of fact, Samsung is the second bigger seller of mobile phones). Despite this, the intermediary products considered together (i.e. Semiconductors, Displays, and Harman) had an overall share in revenues of 38%. Consumer Electronics, which includes electrical appliances and televisions, has a share of 22%.

The trend chart below (Figure 5.6) represents the operating margins both of Apple and Samsung, in the period ranging from 2006 to 2021.

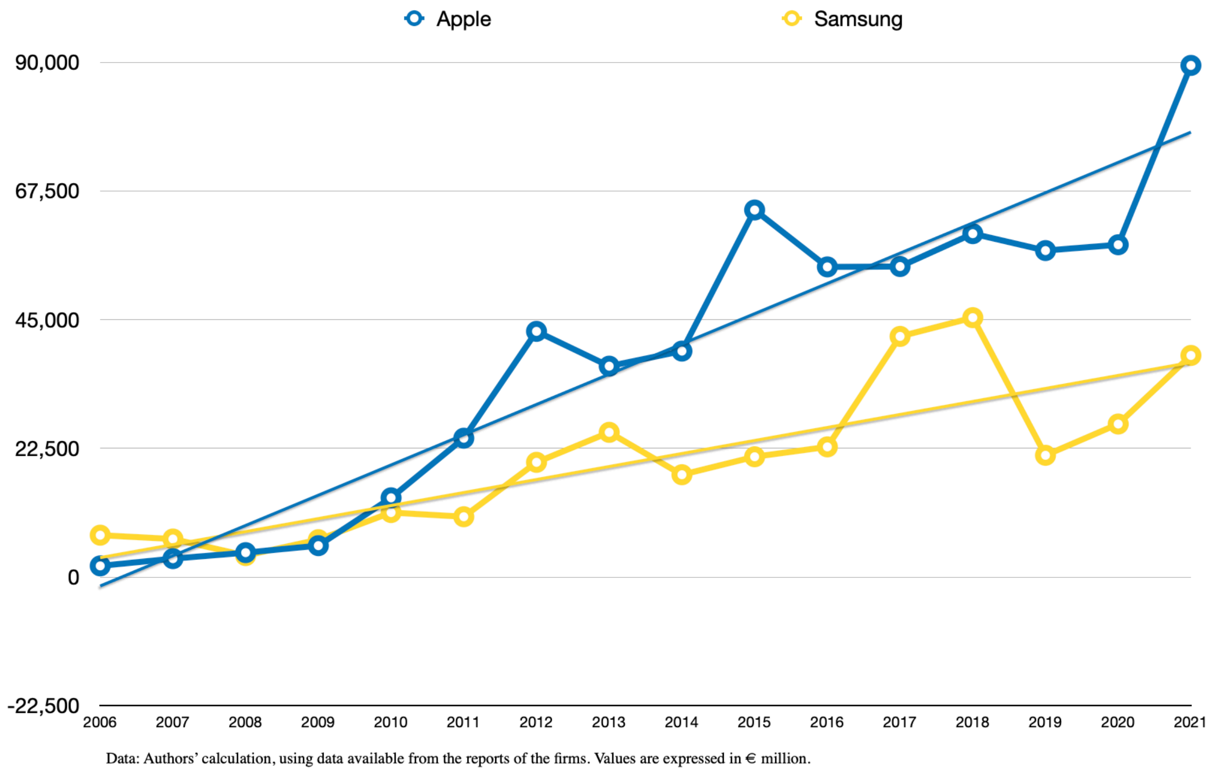


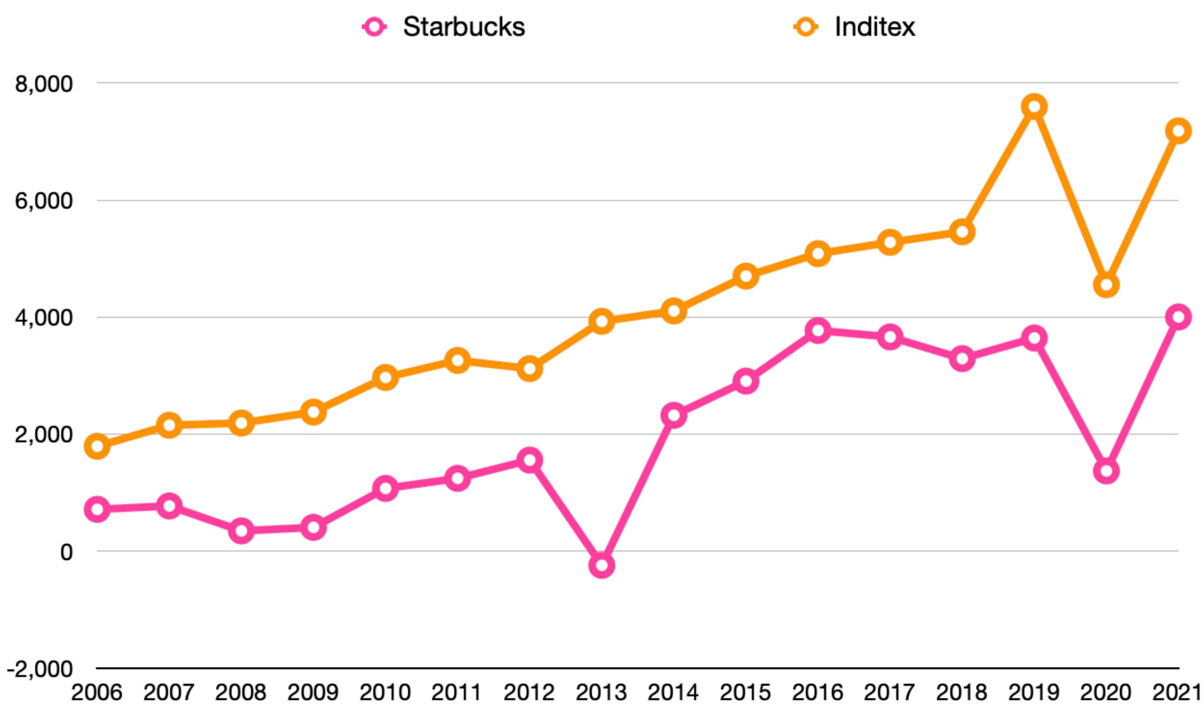

*Figure 5.6. - Apple's and Samsung Electronics' Operating Margin from 2006 to 2021*

Figure 5.6 reveals that both the companies did not experience a recession neither during the 2008 financial crisis nor during the COVID-19 pandemic. Samsung suffered a fall in the operating margin in 2019 (before the pandemic) due to the semiconductors division that, in the same year, lost 29% of its revenues compared to the previous year. The reason behind this fall is the rising of another competitor of Samsung: Intel. That year, in fact, Intel became the first producer in the world of semiconductors, overtaking Samsung. Another interesting finding regards the fact that, after 2009, Apple's operating margin increased a lot (in comparison to Samsung's margin), as can be seen in Figure 5.6. This finding is particularly relevant because it shows how purely efficiency-seeking management of the GVC can result in really good returns, also during a black-swan event. This is especially true if the product is perceived by the customers as the most innovative in its sector. On the one hand, diversification strategies of the suppliers and distribution channels, as well as the internalisation of the production phases have the main effect of increasing the robustness but also the resiliency of a value chain. On the other hand, these strategies also increase the operating expenses of a firm, thus reducing its operating margin.

# 5.4. Considerations on Inditex and Starbucks

Further observations can be made on the operating margins of European clothes manufacturer Inditex (Industria de Diseño Textil) and the American multinational chain of coffee-houses known as Starbucks. These two companies operate in two very different sectors, but both have some common elements. First, both firms sell their products principally through official retailers. Second, both the sectors where Inditex and Starbucks operate do not require major investments in research and development in order to maintain competitiveness.

The following trend chart (Figure 5.7) illustrates the operating margins of the two MNEs, from 2006 to 2021.




Data: Authors' calculation, using data available from the reports of the firms. Values are expressed in € million.

*Figure 5.7. - Inditex' and Starbucks' Operating Margin from 2006 to 2021*

As it can be seen, both companies followed a regular pace of growth through the years. The only significant negative variation, connected to a black swan event, was recorded during the 2020 pandemic, therefore when all the principal distribution channels of the two firms were closed due to the lockdown. Starbucks' negative variation of the operating margin, that was recorded in 2013, was due to a litigation charge (that is an extraordinary operating expense) of €2,096 million ($2,784 million) as a result of the conclusion of the arbitration with the American brand Kraft (source: Starbucks 2013 annual report). It is not possible, therefore, to analyse any "experience effect" resulting from previous unpredictable recessionary events. Despite this, there is also another factor to take into consideration. The trend that both companies are following results from the fact that Inditex and Starbucks' products cannot be included in Barney's VRIN model (s. Literature Review). As a matter of fact, these companies operate in sectors where the operating incomes and expenses are strictly connected (in other words, the cost of sales represents almost the total value of the operating expenses). Thus, these MNEs for many years have been able to develop highly efficient value chains for many years without perceiving any unpredictable recessionary shock in revenues. This does not mean that Starbucks and Inditex do not need to adopt strategies to increase the robustness and resiliency of their value chains. Future research might explore whether Inditex and Starbucks changed their GVC management, especially as concerns the distribution channels that both firms adopt.

## 5.5. What Are the Elements that Help to Reduce a Negative Variation?

The final part is dedicated to the operating factors that can help to reduce the negative shock that a black swan event can cause. The first important element that makes a difference in terms of resiliency is the category of intermediary products. These are unfinished goods that are made from raw materials and then employed during the production process to manufacture the final goods. Manufacturing this type of products increases the resiliency of a firm's supply chain. In fact, a company such as Samsung not only can produce these intermediary products for its own production process, but it can also sell them to other firms (e.g. Samsung supplies Apple with displays). As a matter of fact, Samsung's division *Semiconductors* has a coefficient of 1.05 on the whole operating margin of the company (Figure 4.10). This means that an increase of one point in the revenues of the division *Semiconductors* directly increases the operating margin of Samsung by 1.05 points, all else equal. Samsung's division device solutions also has a positive coefficient of 0.24. So, not only this category of products helps to increase the resiliency of a company's supply chain (after a crisis, they are the first products to be sold because they are the key elements of the production) but it also helps a company to have high levels of competitiveness by selling the intermediary products to the other firms that need their unfinished goods. Thus, outsourcing the principal components of the products is not thought to be the most efficient choice in the long run.

Another important factor that is relevant in terms of the robustness of a value chain are the firm's services. In the last years, many companies have understood this and they started offering their own firm-specific services (just think about how many different subscriptions a person can choose from to listen to music?).

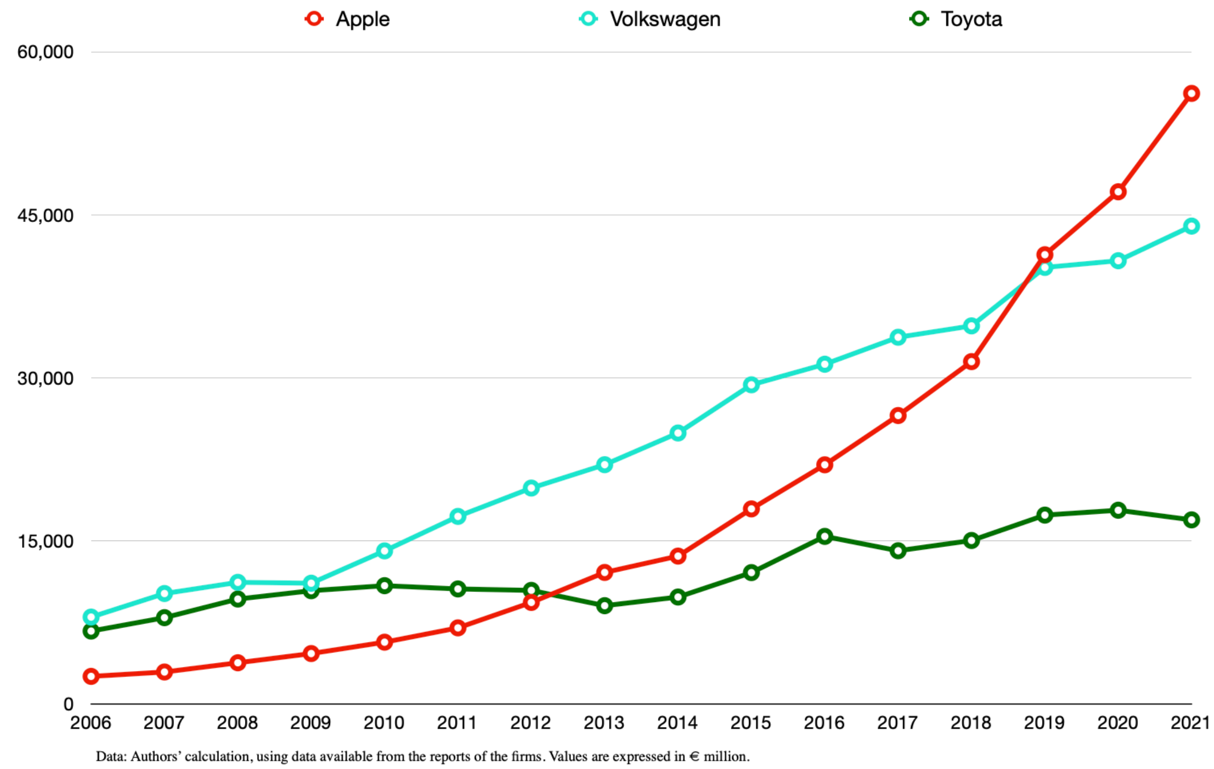



*Figure 5.8. - Revenues of the Services Division from 2006 to 2021*

The chart above (Figure 5.8) shows the trend of the category services for each firm in the last 16 years. Three companies were analysed: Apple, which offers music and film subscriptions, Toyota and the Volkswagen Group which offer leasing and financing and insurance services. After the financial crisis in 2008, not only did they start to grow, but this trend continued and their growth increased more sharply (except for Toyota) after 2018, without being affected neither by the corona crisis. The division Services is also an important operating shield against the fluctuations of the exchange rates. In fact, the money earned through the selling of services is easily transferable from the moment of payment. Despite this, the segment financial services in Toyota and Volkswagen Group still has a high coefficient but negative coefficient. This does not hold true for Apple, whose services division has a positive coefficient of 0.88 in defining the operating margin. The negative coefficients of Toyota and the Volkswagen Group are particularly striking since their services divisions experienced revenues growth almost every year (especially true for the Volkswagen Group). This surprising result can be explained by the fact that, since the services divisions have always enjoyed increases in revenues also during the recession periods (e.g. financial crisis of 2008 for both, 2015 "Dieselgate" scandal for Volkswagen, 2011 earthquake in Japan for Toyota), the models explained these decrease in operating profits with the increase of financial services. This resulted in a negative coefficient. It must be noted that, even though the coefficient is negative, the financial services division has always been a division that scored an increase in revenues (every year). The robustness of this division, meant as the maintaining of a good pace even during recessions, is therefore undeniable.

# 6. Conclusion

## 6.1. Did Firms Learn from Experience?

The current study highlighted the presence of multinational enterprises (MNEs) that, before the occurrence of the COVID-19 pandemic, realised and accepted the possibility that a black swan event could halt part or the whole production and distribution. The purpose of this study was to assess whether companies, driven by previous experiences, adopted some different strategies on their value chain in order to mitigate the negative impact given by an unpredictable recessionary event. The awareness demonstrated by these firms originates primarily from previous black swan events that had already halted their production and/or distribution in the past. Led by experience, these firms have been able to develop new strategies that increased the level of *resilience* (the ability to recover from a negative exogenous shock) and *robustness* (the ability to withstand or avoid a negative exogenous shock).

Toyota was a clear example of an enterprise that learned from the previous crises. The Japanese car manufacturer, in fact, has been able to strengthen those aspects of its value chain that showed weaknesses during the pre-pandemic crises (e.g. suppliers' diversification, financial services). As a matter of fact, during the COVID-19 pandemic, Toyota's supply chain revealed itself to be much more robust than it was in the past (the negative variation in revenues and operating margin was much smaller than, for example, the negative impact experienced in the financial crisis in 2008).

Through the analysis of Samsung and Apple, we learned that an efficiency-seeking value chain can also withstand the recessionary shocks originating from a black swan event (as in the case of Apple). Even though Samsung's strategies are characterised by strong attributes of resilience and robustness, the operating margin of Apple is every year greater (as can be seen in Figure 5.6 s. Discussion).

Lastly, let us consider those companies that produce goods but do not fit into Barney's "VRIO Model" (s. Literature Review). On the one hand, these firms will perceive less or no negative variations in the case of a black swan event. On the other hand, the shock of the distribution channels caused by the lockdown in early 2020 did impact these companies considerably, especially since they have never experienced anything similar. It has also been forecasted that these companies will now adopt strategies aimed at increasing (especially) the *robustness* of their value chains, in particular the distribution side.

## 6.2. What are the Elements that Characterise the Robustness and Resilience of a Value Chain?

Research suggests that the most effective strategy to mitigate the negative shocks caused by black swan events is the internalisation of the production process. As indicated by the findings, this strategy was especially used by Samsung. Moreover, the manufactured intermediary products can also be supplied to the firm's competitors, thereby increasing the resilience of the value chain of the firm that produces them. This was confirmed empirically by the high positive coefficients of intermediary products (i.e. "Semiconductors" and "Display Solutions") in Samsung's regression model.

Unfortunately, there was no empirical evidence that the diversification of the supplied goods would improve the robustness of a company's value chain in the short run. As a matter of fact, this is a strategy that pays back in the long run. As suggested by the results of this study, having many different divisions can increase the operating expenses rather than the operating margin in the beginning. Future researchers could therefore focus more on the correlation between goods diversification in a firm and the robustness and resilience of its value chain.

The evidence from this investigation suggested that, in the short run, services sold by a MNE are a factor that reduces the overall negative variation in revenues caused by a black swan event. We learned that every firm sells its own specific services, but all of the supplied services have rarely perceived a negative shock in revenues due to the occurrence of a black swan event. Thus it can be concluded that, especially in the short run, selling services increase the robustness of an MNE's value chain.

# 7. Appendix

Apple Dataset

| | Revenues per product: | | | | | | | | | Currency (EUR/ USD): | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Values are expressed in "€ million" | iPhone | Mac | iPad | iPod | Wearables, Home, Accessories | Services | Total Revenues | Operative Expenses | Operating Margin | Average | Volatility |
| 2006 | 0 | 5,872 | 0 | 6,111 | 875 | 2,519 | 15,378 | 13,425 | 1,953 | 1.256 | 12.80% |
| 2007 | 89.78 | 7,528 | 0 | 6,062 | 919.7 | 2,922 | 17,522 | 14,304 | 3,218 | 1.370 | 15.20% |
| 2008 | 1,254 | 9,711 | 0 | 6,226 | 1,129 | 3,773 | 22,094 | 17,825 | 4,268 | 1.470 | 28.03% |
| 2009 | 4,845 | 9,885 | 0 | 5,804 | 1,054 | 4,621 | 26,210 | 20,716 | 5,493 | 1.394 | 20.32% |
| 2010 | 18,974 | 13,171 | 3,736 | 6,235 | 1,366 | 5,667 | 49,152 | 35,297 | 13,854 | 1.327 | 21.68% |
| 2011 | 35,461 | 15,649 | 15,341 | 5,616 | 1,756 | 6,984 | 80,807 | 53,490 | 24,274 | 1.392 | 14.8% |
| 2012 | 62,579 | 18,056 | 25,213 | 4,366 | 2,160 | 9,325 | 121,701 | 78,745 | 42,955 | 1.286 | 11.5% |
| 2013 | 68,734 | 16,178 | 24,081 | 3,322 | 4,296 | 12,086 | 128,697 | 91,800 | 36,869 | 1.328 | 7.94% |
| 2014 | 76,743 | 18,118 | 22,786 | 1,720 | 4,584 | 13,591 | 137,543 | 98,037 | 39,505 | 1.329 | 15.14% |
| 2015 | 139,676 | 22,946 | 20,925 | 0 | 9,069 | 17,936 | 210,554 | 146,382 | 64,171 | 1.110 | 14.81% |
| 2016 | 123,486 | 20,624 | 18,634 | 0 | 10,056 | 21,994 | 194,795 | 140,573 | 54,222 | 1.107 | 10.91% |
| 2017 | 125,061 | 22,876 | 17,364 | 0 | 11,383 | 26,530 | 202,861 | 148,575 | 54,286 | 1.130 | 15.53% |
| 2018 | 141,150 | 21,578 | 15,922 | 0 | 17,747 | 31,490 | 227,887 | 164,857 | 60,032 | 1.181 | 11.43% |
| 2019 | 127,125 | 22,982 | 19,000 | 0 | 21,858 | 41,331 | 232,298 | 175,217 | 57,080 | 1.120 | 6.01% |
| 2020 | 120,754 | 25,085 | 20,792 | 0 | 26,836 | 47,123 | 240,591 | 182,495 | 58,096 | 1.141 | 15.27% |
| 2021 | 157,613 | 28,891 | 26,159 | 0 | 31,500 | 56,178 | 300,342 | 210,893 | 89,449 | 1.218 | 2.28% |

All the Data are Taken from the Company's Annual Reports

Samsung Electronics' Dataset

| | | | Sales per Division: | | | | | | | Currency (EUR/ KRW): | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Values are expressed in "€ million" | Consumer Electronics (+device appliances in 2006/07) | Information Technology & Mobile Communications | Semiconductor | Device Solutions (LCD until 2013) | Harman | Others (-elimination) | Total Revenues | Operating Expenses | Operating Profit | Annual Average | Volatility |
| 2006 | 21,951 | 16,892 | 19,043 | 11,606 | 0 | 2,110 | 71,604 | 62,120 | 7,321 | 1,198.74 | 8.132% |
| 2007 | 26,209 | 18,668 | 17,540 | 13,402 | 0 | 1,554 | 77,374 | 68,824 | 6,651 | 1,273.13 | 14.39% |
| 2008 | 26,281 | 21,533 | 13,924 | 13,403 | 0 | 413 | 75,555 | 71,798 | 3,757 | 1,605.36 | 43.65% |
| 2009 | 27,280 | 23,441 | 15,155 | 12,575 | 0 | 0 | 78,451 | 71,916 | 6,534 | 1,771.72 | 19.17% |
| 2010 | 30,656 | 26,134 | 24,549 | 19,514 | 0 | 0 | 100,853 | 89,572 | 11,281 | 1,533.21 | 18.96% |
| 2011 | 31,455 | 32,650 | 24,007 | 18,980 | 0 | 0 | 107,093 | 96,546 | 10,546 | 1,540.73 | 10.41% |
| 2012 | 33,449 | 58,534 | 24,088 | 22,785 | 0 | 0 | 138,856 | 118,799 | 20,057 | 1,448.28 | 10.06% |
| 2013 | 34,633 | 76,387 | 25,747 | 20,520 | 0 | 0 | 157,287 | 131,987 | 25,299 | 1,453.98 | 9.91% |
| 2014 | 32,824 | 69,797 | 26,402 | 18,392 | 0 | 0 | 147,414 | 129,524 | 17,890 | 1,398.82 | 13.15% |
| 2015 | 32,391 | 77,506 | 32,941 | 16,936 | 0 | 0 | 159,773 | 138,741 | 21,032 | 1,255.86 | 19.63% |
| 2016 | 32,037 | 73,490 | 35,237 | 16,379 | 0 | 0 | 157,142 | 134,366 | 22,759 | 1,284.74 | 12.21% |
| 2017 | 30,662 | 79,338 | 53,918 | 22,713 | 1,254 | 0 | 187,886 | 145,815 | 42,070 | 1,275.11 | 15.45% |
| 2018 | 28,328 | 73,435 | 62,355 | 20,903 | 2,711 | 0 | 187,734 | 142,384 | 45,350 | 1,298.49 | 8.77% |
| 2019 | 30,410 | 77,895 | 45,448 | 19,473 | 3,392 | 0 | 176,618 | 155,332 | 21,286 | 1,304.51 | 8.42% |
| 2020 | 32,302 | 70,520 | 50,651 | 19,229 | 3,320 | 0 | 176,026 | 149,271 | 26,755 | 1,345.29 | 10.65% |
| 2021 | 38,664 | 78,726 | 67,407 | 20,575 | 4,321 | 0 | 209,693 | 170,969 | 38,745 | 1,333.4 | 1.89% |

All the Data are Taken from the Company's Annual Reports

## the Volkswagen Group's Dataset

| Values are expressed in "€ million" | Revenues per Segment: Passenger Cars (& Light Commercial Vehicles, from 2019) | Trucks and Buses (Scania from 03/2008 and Navistar from 07/2021) | Power Engineering | Financial Services | Total Revenues | Operating Expenses | Operative Profit |
|---|---|---|---|---|---|---|---|
| 2006 | 96,897 | 0 | 0 | 7,978 | 104,875 | 102,866 | 2,009 |
| 2007 | 98,752 | 0 | 0 | 10,145 | 108,897 | 102,746 | 6,151 |
| 2008 | 102,632 | 0 | 0 | 11,176 | 113,808 | 107,475 | 6,333 |
| 2009 | 87,706 | 6,385 | 0 | 11,095 | 105,187 | 103,331 | 1,856 |
| 2010 | 104,627 | 8,179 | 0 | 14,069 | 126,875 | 119,734 | 7,141 |
| 2011 | 129,707 | 11,723 | 662 | 17,244 | 159,337 | 148,066 | 11,271 |
| 2012 | 148,021 | 20,567 | 4,234 | 19,854 | 192,676 | 181,165 | 11,511 |
| 2013 | 145,734 | 25,418 | 3,851 | 22,004 | 197,007 | 185,337 | 11,671 |
| 2014 | 150,423 | 23,383 | 3,732 | 24,920 | 202,458 | 189,761 | 12,697 |
| 2015 | 158,044 | 22,116 | 3,775 | 29,357 | 213,292 | 217,361 | -4,069 |
| 2016 | 159,500 | 22,923 | 3,593 | 31,251 | 217,267 | 210,164 | 7,103 |
| 2017 | 168,445 | 25,221 | 3,283 | 33,733 | 230,682 | 216,864 | 13,818 |
| 2018 | 160,802 | 36,656 | 3,608 | 34,782 | 235,849 | 221,929 | 13,920 |
| 2019 | 182,031 | 26,444 | 3,997 | 40,160 | 252,632 | 235,672 | 16,960 |
| 2020 | 156,310 | 22,156 | 3,640 | 40,778 | 222,884 | 213,209 | 9,675 |
| 2021 | 179,500 | 23,459 | 3,278 | 43,963 | 250,200 | 230,925 | 19,275 |

All the Data are Taken from the Company's Annual Reports

## Toyota Motor Corporation's Dataset

| Values are expressed in "€ million" | Automotive | Financial Services | Other | Total Revenues | Operating Expenses | Operating profit/ (loss) | Currency (EUR/ JPY): Annual Average | Volatility |
|---|---|---|---|---|---|---|---|---|
| 2006 | 132,276 | 6,690 | 5,023 | 143,989 | 131,133 | 12,856 | 146.1 | 14.28% |
| 2007 | 135,859 | 7,923 | 4,686 | 148,468 | 134,590 | 13,879 | 161.3 | 11.3% |
| 2008 | 158,531 | 9,637 | 4,332 | 172,500 | 157,604 | 14,897 | 152.4 | 45.46% |
| 2009 | 142,367 | 10,405 | 4,782 | 157,554 | 161,094 | -3,538 | 130.3 | 20.69% |
| 2010 | 147,530 | 10,869 | 4,613 | 163,012 | 161,403 | 1,266 | 116.5 | 25.71% |
| 2011 | 156,032 | 10,567 | 4,483 | 171,082 | 166,865 | 4,217 | 111.02 | 22.9% |
| 2012 | 165,183 | 10,435 | 5,331 | 180,949 | 177,488 | 3,462 | 102.7 | 20.9% |
| 2013 | 157,122 | 9,026 | 4,127 | 170,275 | 159,932 | 10,184 | 129.7 | 27.06% |
| 2014 | 169,044 | 9,823 | 4,122 | 182,989 | 166,665 | 16,325 | 140.4 | 10.19% |
| 2015 | 186,141 | 12,071 | 4,515 | 202,727 | 182,253 | 20,474 | 134.34 | 14.09% |
| 2016 | 215,385 | 15,403 | 5,195 | 235,983 | 212,272 | 23,711 | 120.36 | 18.58% |
| 2017 | 197,633 | 14,082 | 6,168 | 217,883 | 202,138 | 15,745 | 126.66 | 17.59% |
| 2018 | 202,080 | 15,027 | 8,230 | 225,337 | 206,930 | 18,406 | 130.38 | 9.62% |
| 2019 | 221,394 | 17,364 | 8,769 | 247,527 | 227,320 | 20,207 | 122.11 | 9.63% |
| 2020 | 220,261 | 17,813 | 7,594 | 245,668 | 225,618 | 20,051 | 121.83 | 10.87% |
| 2021 | 194,803 | 16,925 | 3,797 | 215,526 | 198,121 | 17,405 | 126.27 | 1.66% |

All the Data are Taken from the Company's Annual Reports

## Inditex' Dataset

| Values are expressed in "€ million" | Total Revenues | Operating Expenses | Operating Profit |
|---|---|---|---|
| 2006 | 8,196.265 | 6,406.579 | 1,789.686 |
| 2007 | 9,434.67 | 7,285.827 | 2,148.843 |
| 2008 | 10,406.96 | 8,220.104 | 2,186.856 |
| 2009 | 11,083.514 | 8,709.325 | 2,374.189 |
| 2010 | 12,526.595 | 9,560.388 | 2,966.207 |
| 2011 | 13,792.612 | 10,534.94 | 3,257.672 |
| 2012 | 15,946.143 | 12,033.186 | 3,116.84 |
| 2013 | 16,724.439 | 12,798.469 | 3,925.971 |
| 2014 | 18,116.534 | 14,013.462 | 4,103.073 |
| 2015 | 20,900.439 | 16,201.28 | 4,699.159 |
| 2016 | 23,310.532 | 18,227.111 | 5,083.42 |
| 2017 | 25,336 | 20,058 | 5,277 |
| 2018 | 26,145 | 20,688 | 5,457 |
| 2019 | 28,286 | 20,688 | 7,598 |
| 2020 | 20,402 | 15,851 | 4,552 |
| 2021 | 27,716 | 20,533 | 7,183 |

All the Data are Taken from the Company's Annual Reports

## Starbucks' Dataset

| | Revenues divided per division: | | | | | Currency (EUR/ USD): | |
|---|---|---|---|---|---|---|---|
| Values are expressed in "€ million" | Company-Operated Retails | Specialty | Total Revenues | Operating Expenses | Operating Profit/ Loss | Average | Volatility |
| 2006 | 5,241 | 958 | 6,199 | 5,488 | 711 | 1.256 | 12.80% |
| 2007 | 5,838 | 1,031 | 6,869 | 6,098 | 769 | 1.370 | 15.20% |
| 2008 | 5,967 | 1,095 | 7,063 | 6,720 | 343 | 1.470 | 28.03% |
| 2009 | 5,868 | 1,143 | 7,011 | 6,608 | 403 | 1.394 | 20.32% |
| 2010 | 6,754 | 1,313 | 8,068 | 6,999 | 1,069 | 1.327 | 21.68% |
| 2011 | 6,919 | 1,485 | 8,405 | 7,163 | 1,241 | 1.392 | 14.8% |
| 2012 | 8,191 | 2,150 | 10,341 | 8,788 | 1,553 | 1.286 | 11.5% |
| 2013 | 8,880 | 2,333 | 11,213 | 11,459 | -246 | 1.328 | 7.94% |
| 2014 | 9,765 | 2,610 | 12,376 | 10,057 | 2,319 | 1.329 | 15.14% |
| 2015 | 10,743 | 1,232 | 11,976 | 9,072 | 2,904 | 1.110 | 14.81% |
| 2016 | 15,215 | 4,039 | 19,255 | 15,486 | 3,769 | 1.107 | 10.91% |
| 2017 | 15,620 | 4,191 | 19,811 | 16,152 | 3,659 | 1.130 | 15.53% |
| 2018 | 16,672 | 4,258 | 20,930 | 17,642 | 3,288 | 1.181 | 11.43% |
| 2019 | 19,236 | 4,432 | 23,668 | 20,027 | 3,641 | 1.120 | 6.01% |
| 2020 | 16,796 | 3,815 | 20,611 | 19,243 | 1,368 | 1.141 | 15.27% |
| 2021 | 20,202 | 3,656 | 23,859 | 19,859 | 4,000 | 1.218 | 2.28% |

All the Data are Taken from the Company's Annual Reports

# 8. References


1. *Ando M., Kimura F. (2012) - "How Did the Japanese Exports Respond to Two Crises in the International Production Network?: The Global Financial Crisis and the East Japan Earthquake"*
2. *Apple's Form 10-K - Financial Year 2006*
3. *Apple's Form 10-K - Financial Year 2007*
4. *Apple's Form 10-K - Financial Year 2008*
5. *Apple's Form 10-K - Financial Year 2009*
6. *Apple's Form 10-K - Financial Year 2010*
7. *Apple's Form 10-K - Financial Year 2011*
8. *Apple's Form 10-K - Financial Year 2012*
9. *Apple's Form 10-K - Financial Year 2013*
10. *Apple's Form 10-K - Financial Year 2014*
11. *Apple's Form 10-K - Financial Year 2015*
12. *Apple's Form 10-K - Financial Year 2016*
13. *Apple's Form 10-K - Financial Year 2017*
14. *Apple's Form 10-K - Financial Year 2018*
15. *Apple's Form 10-K - Financial Year 2019*
16. *Apple's Form 10-K - Financial Year 2020*
17. *Apple's Form 10-K - Financial Year 2021*
18. Barney J. (1991) - "Firm Resources and Sustained Competitive Advantage"
19. Dunning J., Lundan S. (2008) - "Multinational Enterprises and the Global Economy"
20. Durach C. F., Wieland A. (2014) - "Antecedents and Dimensionsof Supply Chain Robustness: a Systematic Literature Review"

21. exchangerates.org
22. Gereffi G., Lee J. (2016) - “Economic and Social Upgrading in Global Value Chains and Industrial Clusters: Why Governance Matters”
23. Golgeci I., Yildiz H.E., Andersson U.R. (2020) - “The Rising Tensions Between Efficiency and Resilience in Global Value Chains in the Post-COVID-19 World”
24. Hanley N. (1998) - “Resilience in Social and Economic Systems: a Concept that Fails the Cost-Benefits Test?”
25. Inditex Group Consolidated Annual Accounts - Financial Year 2006
26. Inditex Group Consolidated Annual Accounts - Financial Year 2007
27. Inditex Group Consolidated Annual Accounts - Financial Year 2008
28. Inditex Group Consolidated Annual Accounts - Financial Year 2009
29. Inditex Group Consolidated Annual Accounts - Financial Year 2010
30. Inditex Group Consolidated Annual Accounts - Financial Year 2011
31. Inditex Group Consolidated Annual Accounts - Financial Year 2012
32. Inditex Group Consolidated Annual Accounts - Financial Year 2013
33. Inditex Group Consolidated Annual Accounts - Financial Year 2014
34. Inditex Group Consolidated Annual Accounts - Financial Year 2015
35. Inditex Group Consolidated Annual Accounts - Financial Year 2016
36. Inditex Group Consolidated Annual Accounts - Financial Year 2017
37. Inditex Group Consolidated Annual Accounts - Financial Year 2018
38. Inditex Group Consolidated Annual Accounts - Financial Year 2019
39. Inditex Group Consolidated Annual Accounts - Financial Year 2020
40. Inditex Group Consolidated Annual Accounts - Financial Year 2021
41. Lee J., Wong E. (2021) - “Suez Canal blockage: an analysis of legal impact, risks and liabilities to the global supply chain”

42. Martin R. (2012) - “Regional Economic Resilience, Hysteresis and Recessionary Shocks”
43. Miroudot S. (2020) - “Resilience versus Robustness in Global Value Chains: Some Policy Implications”
44. OICA (2020) - World Motor Vehicle Production
45. Porter M. E. (1980) - Competitive Strategy
46. Samsung Electronics, Financial Report - Financial Year 2006
47. Samsung Electronics, Financial Report - Financial Year 2007
48. Samsung Electronics, Financial Report - Financial Year 2008
49. Samsung Electronics, Financial Report - Financial Year 2009
50. Samsung Electronics, Financial Report - Financial Year 2010
51. Samsung Electronics, Financial Report - Financial Year 2011
52. Samsung Electronics, Financial Report - Financial Year 2012
53. Samsung Electronics, Financial Report - Financial Year 2013
54. Samsung Electronics, Financial Report - Financial Year 2014
55. Samsung Electronics, Financial Report - Financial Year 2015
56. Samsung Electronics, Financial Report - Financial Year 2016
57. Samsung Electronics, Financial Report - Financial Year 2017
58. Samsung Electronics, Financial Report - Financial Year 2018
59. Samsung Electronics, Financial Report - Financial Year 2019
60. Samsung Electronics, Financial Report - Financial Year 2020
61. Samsung Electronics, Financial Report - Financial Year 2021
62. Starbucks’ Form 10-K - Financial Year 2006
63. Starbucks’ Form 10-K - Financial Year 2007
64. Starbucks’ Form 10-K - Financial Year 2008
65. Starbucks’ Form 10-K - Financial Year 2009

66. Starbucks' Form 10-K - Financial Year 2010

67. Starbucks' Form 10-K - Financial Year 2011

68. Starbucks' Form 10-K - Financial Year 2012

69. Starbucks' Form 10-K - Financial Year 2013

70. Starbucks' Form 10-K - Financial Year 2014

71. Starbucks' Form 10-K - Financial Year 2015

72. Starbucks' Form 10-K - Financial Year 2016

73. Starbucks' Form 10-K - Financial Year 2017

74. Starbucks' Form 10-K - Financial Year 2018

75. Starbucks' Form 10-K - Financial Year 2019

76. Starbucks' Form 10-K - Financial Year 2020

77. Starbucks' Form 10-K - Financial Year 2021

78. Taleb N. N. (2007) - the Black Swan

79. Tang C.S. (2007) - "Robust strategies for Mitigating Supply Chain Disruptions"

80. Toyota Motor Corporation's Financial Summary - Financial Year 2006

81. Toyota Motor Corporation's Financial Summary - Financial Year 2007

82. Toyota Motor Corporation's Financial Summary - Financial Year 2008

83. Toyota Motor Corporation's Financial Summary - Financial Year 2009

84. Toyota Motor Corporation's Financial Summary - Financial Year 2010

85. Toyota Motor Corporation's Financial Summary - Financial Year 2011

86. Toyota Motor Corporation's Financial Summary - Financial Year 2012

87. Toyota Motor Corporation's Financial Summary - Financial Year 2013

88. Toyota Motor Corporation's Financial Summary - Financial Year 2014

89. Toyota Motor Corporation's Financial Summary - Financial Year 2015

90. Toyota Motor Corporation's Financial Summary - Financial Year 2016

91. Toyota Motor Corporation's Financial Summary - Financial Year 2017

92. Toyota Motor Corporation's Financial Summary - Financial Year 2018

93. Toyota Motor Corporation's Financial Summary - Financial Year 2019

94. Toyota Motor Corporation's Financial Summary - Financial Year 2020

95. Toyota Motor Corporation's Financial Summary - Financial Year 2021

96. (the) Volkswagen Group's Annual Report - Financial Year 2006

97. (the) Volkswagen Group's Annual Report - Financial Year 2007

98. (the) Volkswagen Group's Annual Report - Financial Year 2008

99. (the) Volkswagen Group's Annual Report - Financial Year 2009

100. (the) Volkswagen Group's Annual Report - Financial Year 2010

101. (the) Volkswagen Group's Annual Report - Financial Year 2012

102. (the) Volkswagen Group's Annual Report - Financial Year 2013

103. (the) Volkswagen Group's Annual Report - Financial Year 2014

104. (the) Volkswagen Group's Annual Report - Financial Year 2015

105. (the) Volkswagen Group's Annual Report - Financial Year 2016

106. (the) Volkswagen Group's Annual Report - Financial Year 2017

107. (the) Volkswagen Group's Annual Report - Financial Year 2018

108. (the) Volkswagen Group's Annual Report - Financial Year 2019

109. (the) Volkswagen Group's Annual Report - Financial Year 2020

110. (the) Volkswagen Group's Annual Report - Financial Year 2021

111. Webb J. , Forbes (2016) - Toyota's 'Quake-Proof' Supply Chain That Never Was

112. Wernerfelt B. (1984) - "A Resource-Based View of the Firm"