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Corso di Laurea Magistrale in International Economics and Commerce

# **Forecasting Analysis of the European Market for Office Furniture**

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## **ABSTRACT**

L'analisi previsionale viene utilizzata principalmente per prevedere le tendenze future del mercato. Esistono, infatti, statistiche attendibili che permettono di ottenere previsioni delle variabili ritenute rilevanti per i processi decisionali delle imprese. La capacità di assumere un comportamento proattivo nei confronti del mercato in cui operano è un fattore chiave per il successo delle aziende, ma l'utilizzo di strumenti e tecniche di previsione richiede conoscenze e modalità specifiche; motivo per cui le imprese si rivolgono spesso ad agenzie specializzate in ricerche di mercato per effettuare questo tipo di previsione. Lo scopo di questa tesi è quello di realizzare un'analisi previsionale del mercato europeo dei mobili per ufficio adottando un approccio quantitativo ed in linea con standard professionali in quanto tale lavoro è il risultato del tirocinio curriculare e della successiva collaborazione con CSIL - Centro Studi Industria Leggera di Milano.

In particolare, verrà utilizzato un approccio VAR per prevedere l'andamento futuro del consumo di mobili per ufficio in Italia, Germania, Francia, Polonia e Unione Europea (28) negli anni 2020-2021. Ma, vista la diffusione della pandemia Covid-19 di quest'anno, i risultati di queste previsioni biennali fanno parte di uno scenario pre Covid-19 la cui accuratezza richiede ulteriori analisi e discussioni cercando di descrivere anche lo scenario post Covid-19. Emergeranno delle differenze nelle previsioni dei due scenari insieme ai principali cambiamenti nell'arredamento degli uffici e all'introduzione di nuove tecnologie e modalità di lavoro.

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## INTRODUCTION

Forecasting analysis plays a crucial role for the planning of the operational activities and for the formulation and achievement of the strategic objectives of the company in order to maximize profits and to limit the negative impact that a turbulent external environment could have on its economic stability. This is why companies often turn to agencies specialized in market researches to carry out this type of forecast.

The aim of this thesis is to implement a forecasting analysis of the European market for office furniture adopting a quantitative approach, in line with professional standards as this work is the outcome of the curricular internship and of the following collaboration with CSIL, Centre for Industrial Studies, based in Milan.

In particular, a VAR (Vector Autoregressive model) approach will be applied to specific time series to predict the future trend of office furniture consumption in Italy, Germany, France, Poland and European Union (28) in the years 2020-2021.

But, given the Covid-19 pandemic spread of this year, the results of these two-years forecasts are part of a scenario without Covid-19 whose accuracy requires further analysis and discussion trying to describe also the post Covid-19 scenario. The differences in the predictions of the two scenarios will emerge together with the major offices' changes and the introduction of new technologies and ways of working caused by the 2020 pandemic spread.

Chapter 1 introduces the office furniture sector in Europe. Both imports and exports data will be provided together with the main exporters, importers and destinations.

Then, the office furniture production breakdown by type will clarify which are the product segments included in the analysis, while information over employment and investment activity will show the concentration level of the sector and the long-term strategies of the EU producers. To conclude the sector overview, a detail of the distribution channels and prices will explain the major trends of this market.

Chapter 2 gets to the heart of the forecast analysis starting with the importance of this process for businesses and their planning. Before moving on to the performed forecast analysis, the list of variables collected with all the relevant information regarding the dataset will be provided. The sources of errors that may result from predicting the future values of a variable will be explained, too. Some basic notions about multivariate systems, such as their definition and representation, will be presented before the application of the VAR model. At this point, it will be possible to show how to implement a forecast analysis in Gretl. A detailed explanation of the followed steps and the obtained results will be provided for all the analysed countries (Italy, Germany, France and Poland) as well as for the European Union.

Finally, because of the spread of Covid-19 in 2020, chapter 3 will describe the impact of this severe pandemic over the European market for office furniture. First of all, the new real GDP projections for 2020-2021 will be shown leading to a comparison with the impact that the 2008-2009 financial crisis had on it as well. Then, the updated European unemployment rate will be illustrated. This post-Covid 19 overview justifies new office furniture consumption forecasts for 2020 and 2021

for Italy, Germany, France, Poland and EU28 as well as new furnishings trends and the relevant introduction of remote working.

This thesis has been realised with the contribution of some documents received by CSIL during my internship, the help of academic textbooks and articles searched on the internet. Moreover, Microsoft Excel has been used for both the preliminary and final treatment of data to perform some basic descriptive analysis and create some graphs; while the implementation of VAR models for time series and forecast analyses took place with Gretl.

On this occasion, a special thanks goes to my supervisor, Dott.ssa C. Pigni, who gave me the opportunity to carry out this work with her by giving me valuable advice. I express my gratitude to CSIL Managing Director, C. S. Pugliese, and International Marketing Director, G. Castellina and to my colleagues Giulia, Stefania and Mauro for the important experience in which they involved me and the support they have been giving me since I met them. Thank you, Stefania, for providing me with all the tools I needed to take the right path and complete my thesis. A big thank you goes to my family, who, with their moral and economic support, have allowed me to get here today, contributing to my personal training.

And last but not least, thank you to my boyfriend, Pier Paolo, for having always supported me over these years. Thank you for listening to me and for all the precious advice you have given me. Thanks also to all those people, friends and relatives, who have always encouraged me to move forward.

## CSIL

CSIL is an independent research and consulting company founded in Milan (Italy), in 1980 and specializing in applied economic research. In 40 years of activity CSIL has become an established research centre for market information, competitiveness analysis, and the diagnosis and design of sector strategies for both public and private business partners. The research activities at CSIL are structured around two distinct but interrelated business areas: *Industry Studies and Market Research* and *Development and Evaluation Studies*. One of CSIL core business unit is specialized in industry studies and market research for the furniture and furnishings sector, customizing a wide range of services in response to specific needs. CSIL's research activity provides useful support to companies and institutions in their process of selection and analysis of market opportunities on a global scale and identifying and shaping their development strategies.

By the way, consistency and complementarity within the research objectives and methodological tools are ensured by:

- a common statistical office providing its services to both the business areas, thus putting at disposal the same set of data and offering the same devices, software and methods for data collection (e.g. e-survey) and elaboration;
- a scientific committee providing the quality control over the methodological approach, ensuring that all the final outputs are of good quality and consistent, and advising on the distribution of tasks and responsibilities.

# **CHAPTER I. THE EUROPEAN MARKET FOR OFFICE FURNITURE**

The first chapter provides an overview of the object of study of this thesis, the office furniture sector in Europe. This market has been chosen thanks to its continuous growth and evolution in recent years. Above all, because of the spread of Covid-19 there were several unexpected changes in the way people work and live.

The total office furniture consumption in Europe reached EUR 9,061 million in 2019. The growth of +3.5% at current prices if compared to 2018 represented the second-best performance registered since 2014.

Office furniture (excluding seating) accounted for around 68% of total production, while the remainder was claimed by the office seating segment. The incidence of the seating segment remained almost at the same level over the period 2017-2018. In order to present the main features of the office furniture market in Europe, the chapter is divided into four paragraphs dedicated to international trade, product segments, employment and investment activity, distribution and prices.

## **1.1 INTERNATIONAL TRADE**

In 2019 the European trade balance dropped significantly but remained positive. It reduced in values thanks to a good performance of imports which increased faster for the second consecutive year (+8.8%) than exports flows (+2.0%). The degree of

openness progressively increased as the imports/consumption ratio reached 42% in 2019 (35% in 2014) and the exports/production ratio stood at about 42% (37% in 2014). The major European producers of office furniture are also the largest net exporters, even if some EU countries markets have witnessed a reduction in their production capacity and the active manufacturers mainly concentrate on supplying their local market.

### 1.1.1 Exports

In 2019 European exports of office furniture amounted to EUR 3,830 million, recording 2.2% growth compared to 2018, corresponding to an average annual increase of 4.8% since 2014 (see Figure I.1). Germany, Italy and Poland are by far the largest office furniture and seating European exporters. Exports of office chairs represent around 31% of total flows, while the remainder is office furniture (excluding seating).

In the office seating segment, 29% of total exports were provided by Germany (EUR 356 million), followed by Poland (12%), Italy (9%) and Sweden (9%).

In 2019 Germany was also the first exporter in the office furniture excluding seating segment, providing goods worth EUR 312 million (16% of total European exports), followed by Italy (15%) and Poland (11%) (see Figure I.2).

It is important to note that Poland exports increased faster than those of its main competitors, recording +13% in 2019 and an average of +12% since 2014.

Figure I.1 - Exports of office furniture and segments in Europe, 2014-2019 (Million EUR and percentages)

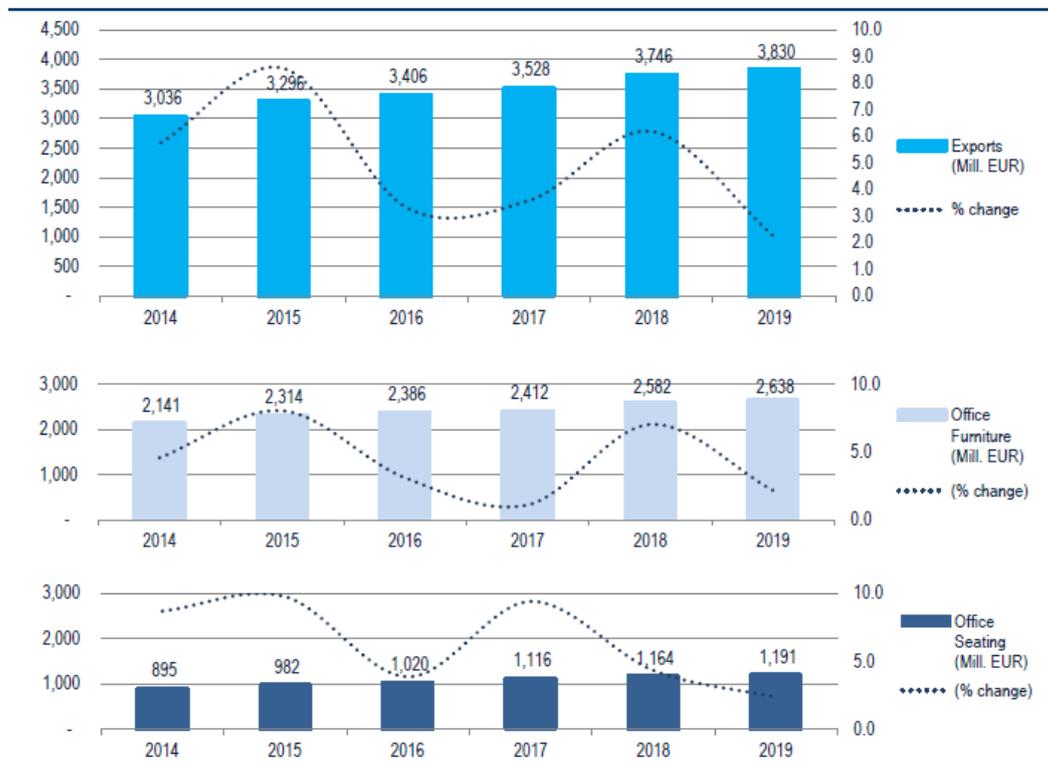
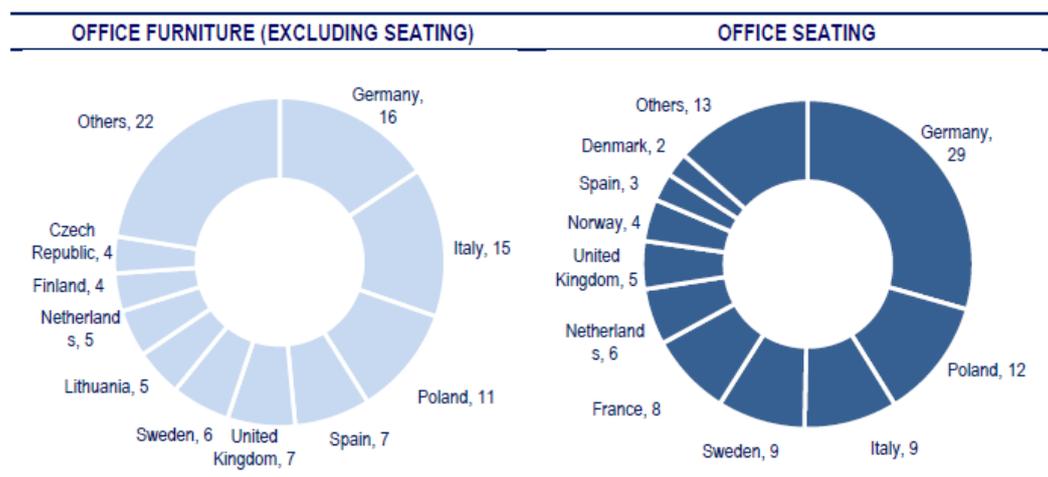


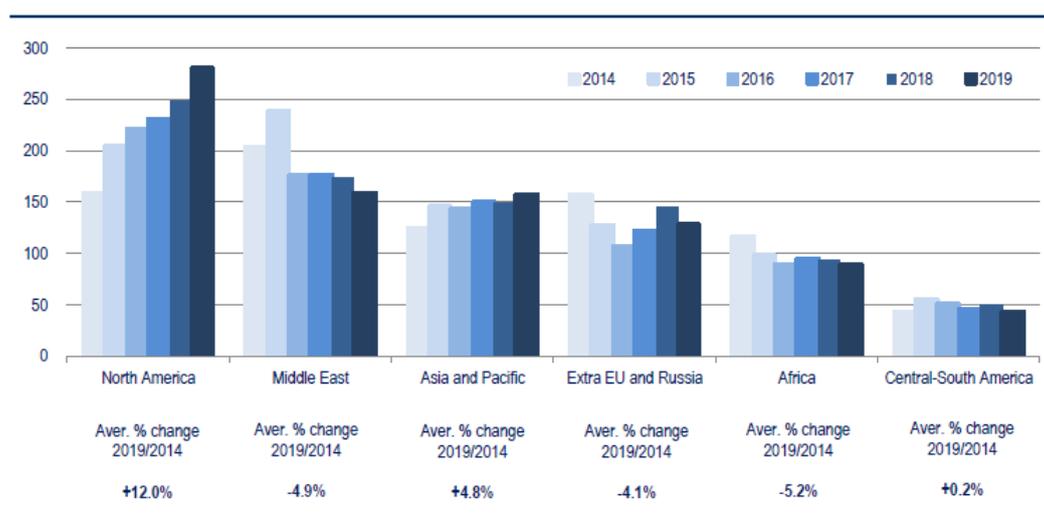
Figure I.2 - Leading exporters by segment in Europe, 2019 (Percentages)



SOURCE: M. SPINELLI, M. AMICO, S. PELIZZARI, *The European market for office furniture*, CSIL, Milano, June 2020, pp.56-57

In 2019 about 22% of total European exports of office furniture were destined for other continents. The main extra-European destinations are: North America, Middle East, Asia and Pacific, Extra EU and Russia, Africa and Central-South America. Looking at the top three destinations, it is possible to note that North America was the best performer between 2014 and 2019 with +12% growth; Middle East has still its importance being at the second place, even if decreased in the recent years; the Asian market had a slow, but increasing, growth over the years (see Figure I.3).

Figure I.3 - Office furniture exports to the main extra-EU destinations, 2014-2019



SOURCE: M. SPINELLI, M. AMICO, S. PELIZZARI, *The European market for office furniture*, CSIL, Milano, June 2020, p.61

### 1.1.2 Imports

Imports showed more marked dynamics than exports with +9.1% growth in 2019 to a value of EUR 3,763 million (see Figure I.4). Office seating represents 41% of

total imports. Imports from Asia-Pacific accounted for 25% of the total (21% in 2014), increasing by 13% and amounting to EUR 930 million in 2019.

Figure I.4 - Imports of office furniture and segments in Europe, 2014-2019 (Million EUR and percentages)



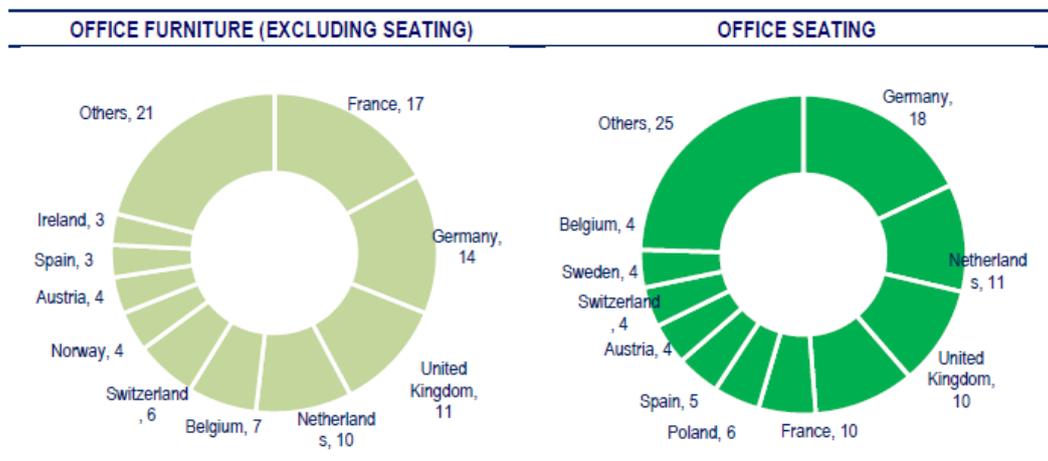
SOURCE: M. SPINELLI, M. AMICO, S. PELIZZARI, *The European market for office furniture*, CSIL, Milano, June 2020, p.63

Major office furniture (excluding seating) importers are France (17%), Germany (14%) and United Kingdom (11%); while major office seating importers are Germany (18%), Netherlands (11%) and UK (10%) (see figure I.5).

71% of these imports come from members of the EU28+Norway and Switzerland. In 2019 almost 92% of office furniture imports from Asia-Pacific originated in China. Imports satisfy an average of 9% of total European consumption.

The level of import penetration is higher for the office seating segment than for office furniture as a whole. In fact, 19% of European consumption of seating originated in China in 2019.

Figure I.5 - Leading importers by segment in Europe, 2019 (Percentages)



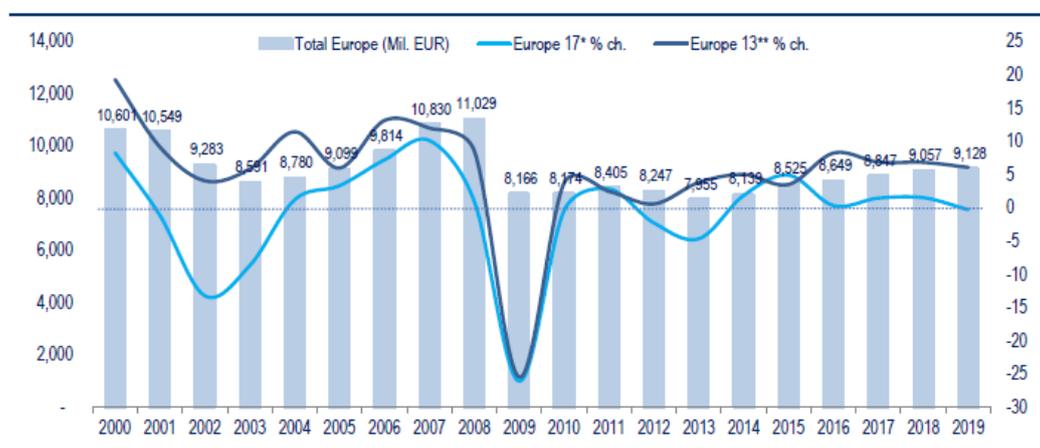
SOURCE: M. SPINELLI, M. AMICO, S. PELIZZARI, *The European market for office furniture*, CSIL, Milano, June 2020, p.64

## 1.2 PRODUCT SEGMENTS

The European production of office furniture registered a good performance over the last three years. With an average growth of 1.6% in the period 2017-2019, it reached a total amount of EUR 9,128 million (see figure I.6).

Over the last twenty years the production activities dropped significantly in 2002 and, more dramatically, in 2009 as a consequence of the financial crisis. With a slow and uncertain recovery in the last decade, the values of office furniture output remain significantly below the previous levels.

Figure I.6 - Office furniture production in Europe, 2000-2019 (Million EUR and percentage change)



SOURCE: M. SPINELLI, M. AMICO, S. PELIZZARI, *The European market for office furniture*, CSIL, Milano, June 2020, p.17

The European production is divided into 32% office seating, 31% operative desking (Height Adjustable and fixed desks) and 37% the rest of office furniture categories (executive furniture, filling systems, walls, partitions and acoustic products, furniture for meeting rooms and communal areas).

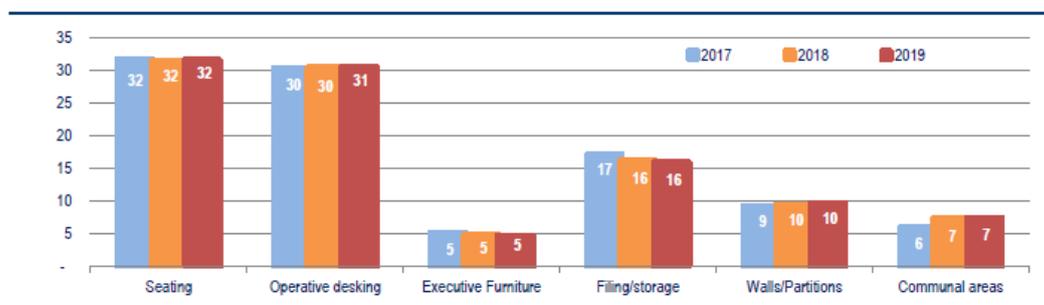
Each single product segment is developing over time as a result of the emergence of new ways of working and new types of work environments. In particular:

- Office seating performed well (1.2% in average) in the last three years reaching EUR 2,881 million. Seating evolution is hardly conditioned by the market entry of higher priced products (like body responsive chairs) and also by the expansion of lounge modular seating. The office swivel chairs market in Europe is estimated at around 12.4 million units sold in 2019, recording 2.9% growth or 344 thousand additional chairs. This value can be broken down in 7 million

swivel chairs imported from extra-European countries (about 80% of them from China) and about 5 million units manufactured in Europe.

- Office desks increased even better: almost 2% on average since 2017 reaching EUR 2,786 million. Growth was primarily driven by the expanding presence of sit-stand/HAT solutions (Height Adjustable Tables) which represent now the 39% of this segment. The use of this kind of product has increased dramatically over the last few years but their presence varies significantly according to each market and region.
- Executive furniture showed a general slowdown (-2.5% in average since 2017) and now representing 5% of total office furniture production.
- Filing and storage segment accounted for 16% of the total equal to EUR 1,456 million in 2019. The products in this segment are mutating in favour of moveable solutions, personal lockers and more technological items.
- Partition, wall-to-wall units and acoustic products claimed roughly 9.7% of total office furniture production in Europe. This segment experienced 3.6% average growth since 2017, reaching a value of EUR 886 million. In particular, the growth of acoustic products (especially Phone Booths/Room in Room Systems) impacted positively on the performance.
- Furniture for meeting rooms and communal areas was the fastest growing segment reaching over 7% of total European output. A 12% growth has been registered over the last two years, reaching a value of EUR 678 million.

Figure I.7 - Office furniture production in Europe. Breakdown by type, 2017-2019 (Percentage shares)



SOURCE: M. SPINELLI, M. AMICO, S. PELIZZARI, *The European market for office furniture*, CSIL, Milano, June 2020, p.71

Office furniture production breakdown by type changes according to the production peculiarities of each European country. For this reason, the office seating share over total office furniture production is higher than the European average in Germany and Poland because the major office seating manufacturing companies are based in these two EU countries. At the same time, the production of walls, partitions and acoustic products is higher than the European average both in Italy (glass partition walls) and Sweden (acoustic products).

### 1.3 EMPLOYMENT AND INVESTMENT ACTIVITY

The European office furniture sector employed a total workforce of 73,100 employees in 2019. Around 54,544 are employed in Western Europe while the remaining (18,582) in Central-Eastern Europe. In particular, number of employees increased in Poland, Czech Republic and other Eastern European countries, while the slowdown continued in Western Europe. 44% of workers is kept by the top 50

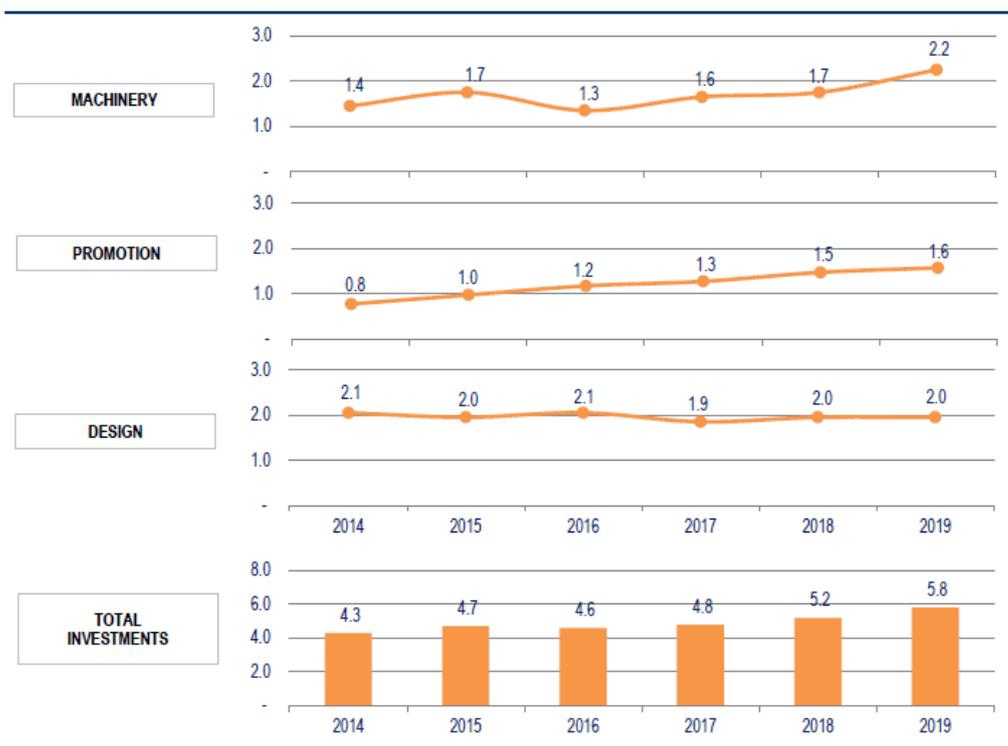
manufacturers. In 2019 turnover per employee in Europe stood at EUR 125,000, increasing by 0.6% compared to the previous year.

Over recent years the sector seems to have absorbed the largest part of its overcapacity, but restructuring activity and M&A process continue to impact the industrial organization and employment levels. As a main consequence of the described situation, the sector concentration increased again: today about 47% of total production is in the hand of the top 20 manufacturers (39% in 2014).

As a general trend, over the recent years, a strong move towards the “sustainability” of furniture production has been noticed starting from the Nordic Countries. As a consequence, today companies are committed to reduce carbon emissions, increase the use of recyclable materials and the percentage of products recyclability, promote green packaging solutions, etc.

The investment activities at industrial level peaked in 2019 with an average 5.9% of revenues dedicated to machinery/automation, design and promotional activities. Investments in machinery has been prominent in the year (2.2% of sector turnover). On the other hand, investments in design and product development represented 2.0% of total turnover in 2019. Promotion represented 1.6% of total turnover in 2019 and has recovered steadily since 2014 (see figure I.8).

Figure I.8 - Expenditure on office furniture investments in Europe, 2014-2019 (Percentages of total turnover)



SOURCE: M. SPINELLI, M. AMICO, S. PELIZZARI, The European market for office furniture, CSIL, Milano, June 2020, p.98

#### 1.4 DISTRIBUTION AND PRICES

In the period 2017-2019 European distribution of office furniture has witnessed slight changes. Direct sales to end-user customers account for about 32% (increased in 2019) of European office furniture sales, while “specialist dealers”<sup>1</sup> represent

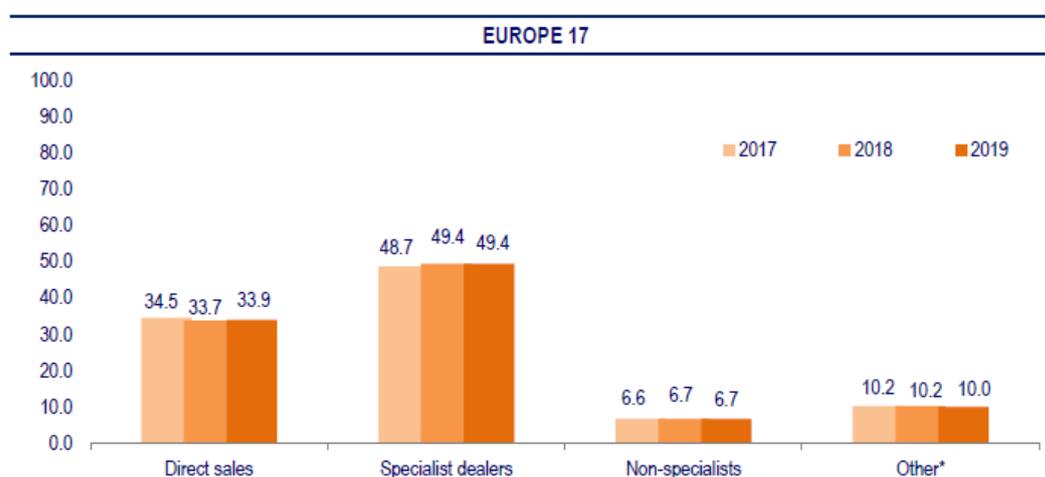
<sup>1</sup> Different kinds of operators can be found in each country. Specialist distributors can be retailers with showrooms as well as contractors specialising in the planning and furnishing of space in the non-residential segment.

50% of total sales (stable). Non-specialists<sup>2</sup> reduced and “other” channel remained almost at the same level over the period considered (see figure I.9).

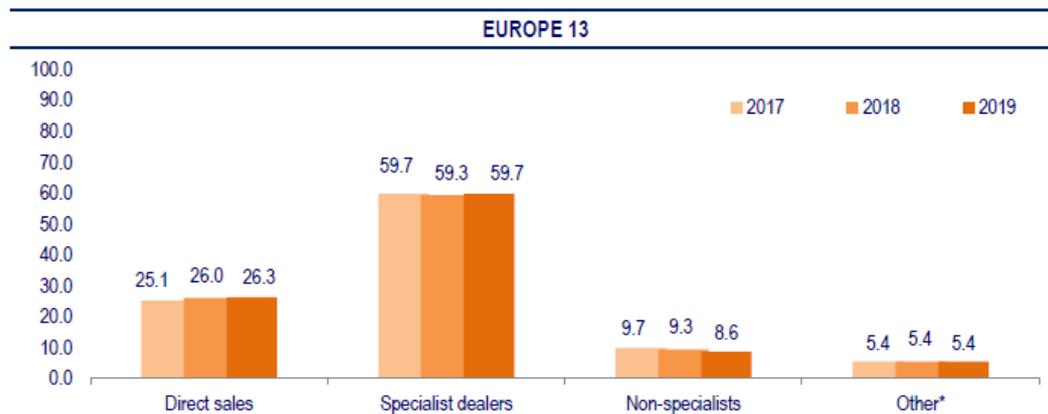
In general, office furniture distribution shows a high degree of specialisation, with direct sales and office furniture specialists accounting for an average of almost 82% of the total. In the other channels, e-commerce is advancing and it includes an increasing number of e-commerce retailers specialised in selling professional furniture but their incidence in the office furniture business is still limited.

In general, the average customer budget for a complete workstation in Europe varies from around EUR 800 for corporate projects (huge quantities) to EUR 1,100 for professionals/individuals (small quantities).

Figure I.9 - Evolution of office furniture distribution channels in Europe, 2017-2019 (Percentages)



<sup>2</sup> This channel includes home furniture stores and dealers selling complementary office products such as stationery or software.



SOURCE: M. SPINELLI, M. AMICO, S. PELIZZARI, The European market for office furniture, CSIL, Milano, June 2020, p.100

\*“Other” includes the large-scale retail trade (large distributors specialising in office supplies, large non-specialist retailers of home furniture), mail order, Ecommerce, etc.

In this first chapter the main figures and characteristics of the European office furniture sector have been discussed. In order to know which are the market dynamics, we moved from international trade to office furniture production and product segments, from employment and investment activity to distribution and prices. So, it is now possible to move toward a practical example with the analysis of the office furniture market in order to make some forecasts in Europe.

## **CHAPTER II. FORECAST ANALYSIS**

After an overview of the Office Furniture sector in Europe in the first chapter, this chapter shows how to make predictions for the sector variables using a VAR (Vector Autoregressive model) approach. The results are used to estimate the future trend of sector variables such as consumption, exports, imports and (indirectly) the production of office furniture by complementing and supporting experts and researchers' opinions. This is because VARs can be flexibly used to obtain forecasts (sometimes different from each other) whose accuracy and validation require subsequent analysis and discussion.

The aim of this chapter is to adopt a quantitative approach, in line with professional standards, to obtain a two-years forecast for the consumption of Office Furniture in Europe. In particular, the analysis of the economy of four countries with significant structural differences, including the office furniture market, and availability of data will be performed (Italy, Germany, France and Poland) together with the European aggregate. Despite the Covid-19 pandemic spread of this year, the results of these two-years forecasts are part of a scenario without Covid-19. Compared to the reality, a “counter-factual scenario” will be analysed in this chapter to understand what could have happened if this disease didn't exist.

Carrying out the forecast analysis as illustrated in this chapter involves the use of:

- Microsoft Excel for the preliminary and final treatment of data (basic descriptive analysis and the creation of some graphs);
- Gretl for the implementation of models for time series and forecast analyses.

The chapter is structured as follows. After a brief introduction to business forecasts, paragraph 2.2 presents the time series collected for the market analysis of office furniture in Europe. Then, introducing the concept of forecasting in time series analysis, the focus is on forecast errors and their cause. Finally, paragraph 2.4 is divided into two parts. The first part covers the basics of VAR models. The second part shows the results of the application of the VAR approach to make predictions for office furniture consumption in Italy, Germany, France, Poland and European Union.

## **2.1 FORECASTING IN BUSINESS PLANNING**

Nowadays, a key factor to companies' success is the ability to assume a proactive behaviour towards the market in which they operate. An attitude that is favoured by the knowledge of both internal and external processes of the company and their correct and quick interpretation. In this context it is therefore essential to anticipate current trends by building, with reliable statistics, forecasts of the phenomena that are relevant for the decision-making processes. To have a plausible idea of how the

future will look like decisively directs the company's planning activities, however considering the presence of the error that will result from the forecast.<sup>3</sup>

Companies often turn to agencies specialized in market research to carry out this type of forecast. Each researcher usually focuses her activity on a specific sector and to write down the final report she needs to carry out quantitative and qualitative analysis. The information is obtained directly from customers or more often from a representative sample of them through online surveys, direct interviews, collection of annual reports and other relevant documents, participation in conferences, trade fairs and exhibitions, events, company visits and so on. This kind of surveys are mainly used to look for new trends and ideas, the likes or dislikes about existing products, what brands are favourites for a certain product, general economic conditions, how the business is going for the biggest companies and which are the generalized predictions of those operating in the sector.

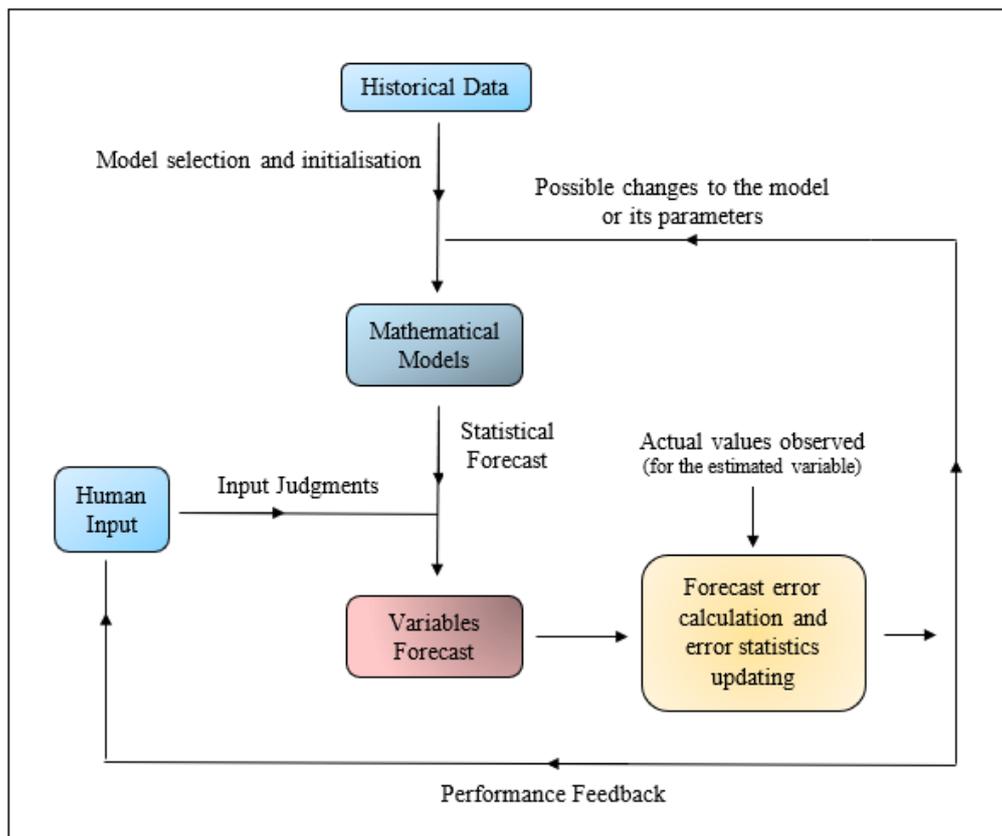
Instead, objective forecasting methods employ mathematical and historical data to make a forecast analysis. Time series methods applied to business forecasting aim to predict industry variables (Consumption, Import, Export, etc.) by investigating their nature and trying to quantitatively estimate the degree of influence of each component on their overall level.

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<sup>3</sup> A. TOMASSONI, *Analisi ed implementazione di modelli per la previsione della domanda: il caso SCM GROUP S.P.A.*, Alma Mater Studiorum, Università di Bologna, Bologna, Degree thesis, A. Y. 2009/10, pp. 11-13

Forecasts are generally based on a combination of what has been observed in the past (called statistical forecast) and “informed” judgments on future events. The overall structure of a generic forecasting system is shown in the following figure.

Figure II.1 - Structure of a generic forecasting system



SOURCE: R. MELLONI, *La previsione della domanda*, p.2 “[http://cdm.unimo.it/home/dimec/melloni.riccardo/DL\\_02\\_Previsione%20della%20domanda.pdf](http://cdm.unimo.it/home/dimec/melloni.riccardo/DL_02_Previsione%20della%20domanda.pdf)”

## 2.2 TIME SERIES

One time series is simply a numerical or graphic representation of the trend of a variable in a predetermined time interval with a given frequency (days, weeks,

months, quarters, years). In a time series, time is often the independent variable and the goal is usually to make a forecast for the future based on the assumption that the levels of the variable recorded in the past are a good indicator of the level it will assume in the future. Table II.1 shows the list of variables collected for this forecast analysis, the units, the source and the temporal and geographical coverage.

Table II.1 - The dataset

VARIABLE	VARIABLE CODE	UNITS	SOURCE	COVERED COUNTRIES	TEMPORAL COVERAGE
<b>Office Furniture Apparent Consumption<sup>4</sup></b>	FurCons	LCU <sup>5</sup> constant prices	CSIL recalculation	Italy, Germany, France, Poland, European Union (28) <sup>6</sup>	Historical Data from 1998 to 2019 (Poland from 1999, EU from 2000)
<b>Office Furniture Production</b>	FurProd	LCU constant prices	CSIL	As above	As above
<b>Office Furniture Import</b>	FurImp	LCU constant prices	CSIL processing	As above	As above
<b>Office Furniture Export</b>	FurExp	LCU constant prices	CSIL processing	As above	As above
<b>Real gross domestic product</b>	GDP_realLC	LCU	IMF	As above	Forecasts until 2021
<b>Real gross domestic product</b>	GDP_realVR	Percent change	IMF	As above	Forecasts until 2021

<sup>4</sup> Apparent Consumption = Production + Import – Export

<sup>5</sup> LCU = local currency unit

<sup>6</sup> This classification still lists the UK as a member of the European Union because historical data cover periods prior to December 31, 2019. For the European aggregate values are expressed in constant euros and not in local currency since not all countries belong to the Eurozone

<b>Nominal gross domestic product</b>	GDP_numUSD	U.S. dollars	IMF	As above	Forecasts until 2021
<b>Gross national savings</b>	GNSPgdp	Percentage of GDP	IMF	As above	Forecasts until 2021
<b>Gross domestic product, deflator</b>	GDP_IND_def	Index	IMF	Italy, Germany, France, Poland	Forecasts until 2021
<b>Nominal gross domestic product</b>	GDP_numLC	LCU	IMF	As above	Forecasts until 2021
<b>Nominal gross domestic product per capita</b>	GDP_numLC_pc	LCU	IMF	As above	Forecasts until 2021
<b>Nominal gross domestic product per capita</b>	GDP_numUSD_pc	U.S. dollars	IMF	As above	Forecasts until 2021
<b>Real gross domestic product per capita</b>	GDP_realLC_pc	LCU	IMF	As above	Forecasts until 2021
<b>Nominal gross domestic product</b>	GDP_numPPP	Purchasing power parity; international dollars	IMF	EU28	Forecasts until 2021
<b>Real gross domestic product per capita</b>	GDP_realPPP_pc	Purchasing power parity; international dollars	IMF	EU28	Forecasts until 2021
<b>Nominal gross domestic product per capita</b>	GDP_numPPP_pc	U.S. dollars	IMF	EU28	Forecasts until 2021
<b>Volume of exports of goods</b>	ExpVGoodP	Percent change	IMF	Italy, Germany, France, Poland	Forecasts until 2021

<b>Volume of Imports of goods</b>	ImpVGoodP	Percent change	IMF	As above	Forecasts until 2021
<b>Inflation</b>	INF_IND_B00	Index	IMF	As above	Forecasts until 2021
<b>Inflation</b>	INF_P	Percent change	IMF	Italy, Germany, France, Poland, EU28	Forecasts until 2021
<b>Total investment</b>	InvTPgdp	Percentage of GDP	IMF	As above	Forecasts until 2021
<b>Real Total Investment</b>	InvT_real	LCU	IMF + recalculation	As above	Forecasts until 2021
<b>Population, total</b>	POP_tot	Thousands	UN	As above	Forecasts until 2021
<b>Population by age 0-14</b>	POP_0_14	Thousands	UN	Italy, Germany, France, Poland	Forecasts until 2021
<b>Population by age 15-64</b>	POP_15_64	Thousands	UN	As above	Forecasts until 2021
<b>Population by age 65 or more</b>	POPOver65	Thousands	UN	As above	Forecasts until 2021
<b>Private final consumption expenditure at 2010 prices</b>	PrCon10	LCU	WB + EIU	As above	Forecasts until 2021
<b>Private final consumption expenditure real change</b>	PrConRealP	LCU	WB + EIU	As above	Forecasts until 2021
<b>Unemployment rate</b>	UNEMPLO_rate	Percentage of total labour force	IMF	As above	Forecasts until 2021

<b>Annual Urban Population at Mid-Year</b>	Urb_pop	Thousands	UN	As above	Forecasts until 2021
<b>Residential building investments</b>	gfcf_res	LCU	EC AMECO database	As above	Forecasts until 2021
<b>Non-residential building investments</b>	gfcf_Nres	LCU	EC AMECO database	Italy, Germany, France, Poland, EU28	Forecasts until 2021
<b>Non-residential building investments delayed by one year</b>	gfcf_NresD1	LCU	EC AMECO database	Italy, Germany, France, Poland, EU28	Forecasts until 2021

In order to carry out the forecasting analysis, it is necessary to consider that:

- The “endogenous” variables for which the forecast can be requested are: the consumption of office furniture (“FurCons”), the exports of office furniture (“FurExp”) and the imports of office furniture (“FurImp”). The production of office furniture is not directly modelled within the VAR as strongly subjected to structural changes in the technology used in the production processes. The production forecast (“FurProd”) is, thus, obtained indirectly through the equation:  $FurProd = FurCons + FurExp - FurImp$
- The other available variables can be used as “exogenous” explanatory variables that can influence the trend of endogenous variables. Among the set of exogenous variables, country specific variables are considered as a proxy for the business cycle (e.g. unemployment and real Gross Domestic Product) and

for the dimension of the country (e.g. total population, population between 15-64 years old). For these exogenous variables forecasted values or scenarios must be known for the whole forecasting horizon. The set of variables to include in the VAR specification may differ between countries because each of them has its own structural and economic specificities. The choice of the variables to be inserted can be based on theoretical models (for example of international trade), in accordance with opinions of industry experts, complementary econometric analyses or on a combination of the two.<sup>7</sup>

### **2.3 SOURCES OF ERRORS**

Predicting the future values of a variable means predicting its expected value conditional on the information that is available today. Typically, the latter includes the past values of the endogenous variables and the past and / or expected values of the exogenous explanatory variables. Future shocks that are not foreseeable to date, but which may affect the trend of the variable in the future, are not included in the information set.

Possible unpredictable future events are not the only source that can invalidate a forecast. Indeed, the sources of error associated with it may have different nature and their correct identification is essential to understand which intervention can reduce their impact on the uncertainty that accompanies the forecast itself.

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<sup>7</sup> F. GIFFONI, with the contribution of E. SIRTORI, E. BACCHIOCCHI, *Guida per l'analisi previsionale*, CSIL, Milano, 2018, p. 4

To this end, Table II.2 lists the forecast errors below.

*Table II.2 - Classification of forecast errors*

<b>TYPE OF ERROR</b>	<b>DESCRIPTION</b>
NOT CORRECTLY SPECIFIED MODEL	This typology represents the most obvious situation to explain the model's inability to provide reliable forecasts. The model is not able to correctly explain the studied phenomenon because, for example, it neglects the salient features. This deficiency in the present will also affect the future trend that the forecast wants to investigate. Based on the analysis of the adaptation of the model to past observations, it is possible to improve its specification, even if there is always a basic compromise based on complexity and simplicity in the final choice of the model to be adopted.
NON-CONSTANT MODEL PARAMETERS	A real phenomenon is typically characterized by a variable generator model (stochastic process) of the data; this because the quantities under study can present both regime changes and structural breaks over time. In such a circumstance, the relationship that justified a given dependence in the past, it is not said that it could remain the same also in the future. So, the forecast obtained with it could be misleading. To identify a model to be used even in the presence of regime changes, it is therefore necessary that the relevant parameters are invariant, which is equivalent to incorporating the change effect in the system relationships, otherwise the final forecast will be distorted.
DATA SAMPLE VARIABILITY	The econometric model, used for the description of a phenomenon under study, is based either on a theory or on an intuition that links the exogenous and endogenous explanatory variables. The parameters of the relations between these quantities are typically not known a priori with certainty, but they are obtained with an estimation method based on the sample of data provided. Therefore, the estimation of the parameters itself is subject to sample variability, so the selection of the sample must be the most representative and significant of the extraction set.

<p style="text-align: center;">EXOGENOUS VARIABLE VALUES UNCERTAINTY</p>	<p>The model is guided by a series of explanatory variables whose future values must be provided as inputs to the system, that is, determined outside the model. Based on the degree of their veracity, the reliability of the forecast itself varies. Therefore, particular care is required in determining these future values, with reference to the forecast interval. The contribution of this uncertainty can be highlighted with a later check, i.e. by comparing the difference between the actual and expected value of the model, but inserting as input the real data of the exogenous variables, i.e. the ex-post measured values.</p>
<p style="text-align: center;">ERROR UNCERTAINTY</p>	<p>Increasing the forecast time horizon, also the uncertainty about innovations that may affect the model increases, that is, the component that the model itself is unable to explain. The uncertainty about future innovations is transmitted to the forecast, therefore there is further confirmation that one cannot predict something indefinitely without increasing the associated error. It should also be borne in mind that in practice the observed error is not a data of the model, but depends on how the model itself is designed. It could therefore be improved, in the presence of autocorrelation (and heteroskedasticity) of the residues and with a more efficient use of the past information, perhaps even reconsidering the model itself.</p>

SOURCE: F. GIFFONI, with the contribution of E. SIRTORI, E. BACCHIOCCHI, Guida per l'analisi previsionale, CSIL, Milano, 2018, p. 4

## 2.4 VAR MODELS FOR FORECASTING ANALYSIS

Moving to the analysis of the time series, the approach that has been adopted in the forecasting analysis is based on VAR models. There are many uses that can be made of VAR estimates. The most common in macro econometrics are three: Forecast, Causality Analysis and Dynamic Analysis.<sup>8</sup> The Causality analysis aims to establish

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<sup>8</sup> R. LUCCHETTI, *Appunti di analisi delle serie storiche*, 2015, p.93

the cause-effect relationships between the variables. The Dynamic analysis aims to analyse shock effects on variables of interest (what is the effect of a monetary shock on GDP?). Dynamic analysis is based on the use of structural VARs and the main tool for dynamic analysis of a VAR process is the impulse response function.

The Forecast analysis aims to predict the future values of the variables and typically uses VAR in a reduced form.

Actually, this document focuses on the use of VARs in forecasting analysis as these models have proven to be especially useful both for the description of the dynamic behaviour of economic and financial time series and for the forecasting. They often provide superior forecasts to those from univariate time series models, like ARIMA models. Furthermore, forecasts from VAR models are quite flexible because they can be made conditional on the potential future paths of specified variables in the model, that can be treated as exogenous variables or scenario.

#### 2.4.1 Multivariate systems: definition and representation

The VAR representation in reduced form is the generalization of the autoregressive model to the multivariate case. In fact, VAR are models for the joint prediction of multiple variables. The VAR was first introduced by the economist Christopher Sims in 1980 and takes the form of a system of  $k$  linear equations in  $k$  unknown factors in which each variable is explained by its own lagged values and by the lags of the remaining  $k-1$  variables.

If the same number of lags,  $p$ , is chosen for each variable, then we speak of a VAR ( $p$ ). Given the short time series available for many of the variables involved in the analysis (from 1998 to 2021, at most), a VAR model with one single lag is used.<sup>9</sup> The following system shows a VAR (1) model with three endogenous variables (e.g. consumption, exports, imports) and four exogenous variables (e.g. foreign demand, exchange rate, investments, etc.). The latter are two deterministic components: a constant ( $c$ ) and a trend ( $t$ ) and two stochastic variables (processes),  $x_1$  and  $x_2$ . In matrix notation, it can be written as:

$$Y_t = A_1 Y_{(t-1)} + \beta X_t + U_t \quad (1)$$

Where  $Y_t$  is the vector of the endogenous variables, and  $A_1$  is the matrix containing the alpha coefficients associated with the lags of the endogenous variables,  $X_t$  is the vector of the exogenous variables,  $\beta$  the matrix of the coefficients associated with the exogenous variables and the vector  $U_t$  contains the residues of the model.

From the equation, it is possible to note that consumption, exports and imports are influenced by their own lags and simultaneously by the lags of other variables (e.g. export at time  $t-1$  affects consumption at time  $t$ ; which depends on past values of imports, etc.). Moreover, it is possible to add additional exogenous variables in the VAR (e.g. foreign demand at time  $t$  influences consumption, which in turn will depend on imports and so on). The VAR poses also the challenge of understanding

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<sup>9</sup> However, when possible, a specification analysis for the optimal number of lags has to be performed, mainly based on the Akaike (AIC) or the Bayesian (BIC) information criteria.

whether or not to add further explanatory variables and, if so, how many and which variables to include.<sup>10</sup> When each equation of the VAR respects the assumptions, the OLS estimators of the regressions' coefficients are consistent and are normally distributed by large samples.

#### 2.4.2 Estimation results

For the purposes of the thesis, the results related to the application of the VAR to one of the three endogenous variables, "FurCons", will be shown. All tests and analyses presented in this section are carried out using logarithms for the variables expressed in real values. The software used for the analysis is Gretl.

The application will proceed in the following steps:

1. Graphic inspection and descriptive analysis
2. Estimation of the VAR via OLS
3. In-sample and out-of-sample forecast

#### ***ITALY***

The variables used for the forecast analysis in Italy are:

- Three endogenous variables for which the forecast is required and available from 1998 to 2019:
  - Consumption of office furniture in local currency (local currency, real values – LCU constant prices) at constant values ("FurCons");

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<sup>10</sup> F. GIFFONI, with the contribution of E. SIRTORI, E. BACCHIOCCHI, *Guida per l'analisi previsionale*, CSIL, Milano, 2018, p. 24

- Exports of office furniture in local currency at constant values (“FurExp”);
  - Imports of office furniture in local currency at constant values (“FurImp”);
- Three exogenous variables that could influence one or more of the three endogenous variables available between 1998 and 2021. These variables are chosen on the basis of interviews with experts and information collected over the country. Several attempts have been carried out to discover which is the best combination of variables. In fact, the choice of the best specification is made by selecting the one that gave the lowest forecast error among those that can be obtained from different combinations of the variables collected in the table of the dataset. In the case of Italy, they are:
- Volume of exports of goods in percent change (“ExpVGoodP”). Italy is the fifth country in the world in terms of volume of office furniture exports and one of the largest European exporters providing 14% of total exports. Its main destinations are France, USA, UK and Germany;<sup>11</sup>
  - Unemployment rate as a percentage of total labour force (“UNEMPLO\_rate”). According to Eurostat annual data (age between 15-74 years), in 2018 - when unemployment in Italy was 10.6% - the

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<sup>11</sup> M. AMICO, M. SPINELLI, *The European market for office furniture*, CSIL, Milano, June 2019, p.14

country had a rate almost four points higher than the EU average (6.8%) and 2.6 points above the Eurozone average (8.2%). Italy is fighting for the different employment rate between men and women, the severe youth unemployment and the North-South gap<sup>12</sup>;

- Total investment as a percentage of GDP (“InvTPgdp”). Italy has been characterized by scarce investments’ incentives. A better business environment, opening of markets, development of capital markets and a tax system more favourable to growth can help improve both quantity and quality investment and to attract foreign direct investment.<sup>13</sup>

➤ *Step 1: Graphic inspection and descriptive analysis*

The graphic inspection consists of an accurate analysis of the variables. In addition to the levels (whether in monetary value or in logarithms), it is possible to study the variables also in first differences to examine, for example, the growth rates.

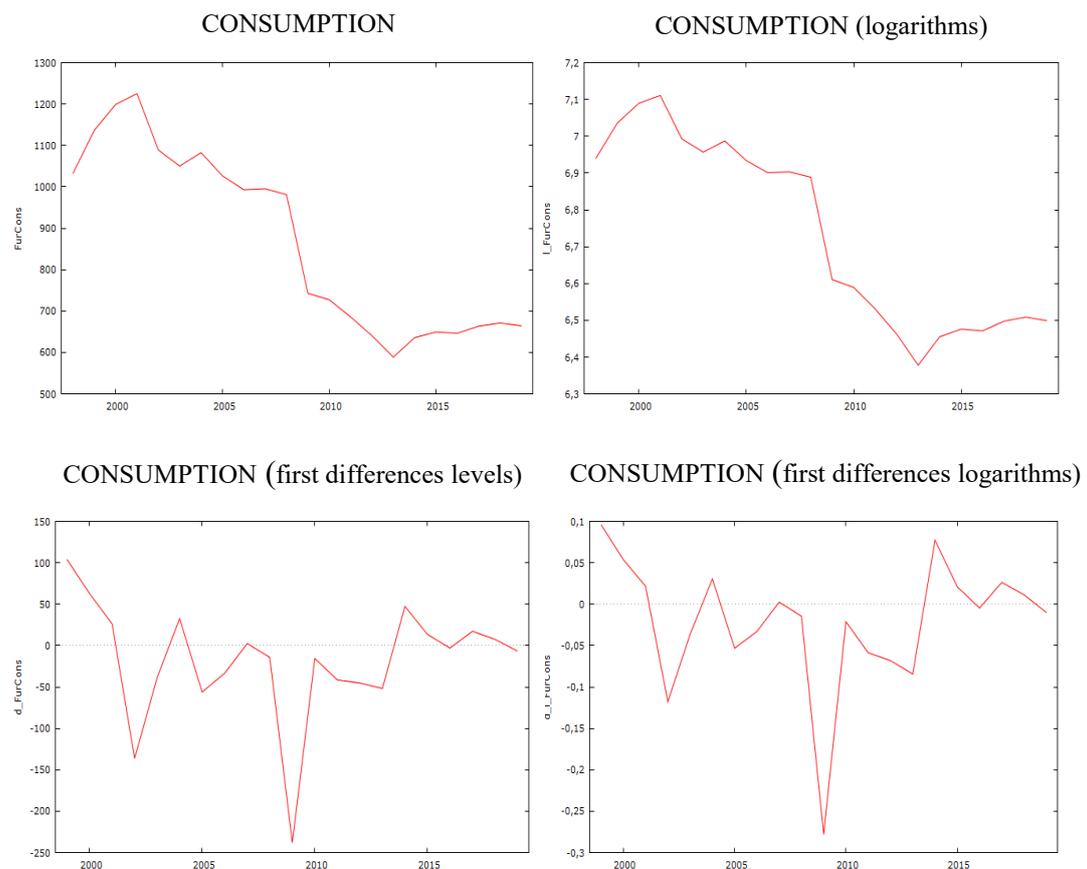
Figure II.2 shows the time series of office furniture consumption in Italy (“FurCons”) in the upper left panel. In the lower left panel, the variable is expressed in first differences, while in the upper right panel it is expressed in logarithms. The first differences of the logarithms (growth rates proxy) are shown in the bottom

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<sup>12</sup> AGI, *I numeri della disoccupazione in Italia*, “[<sup>13</sup> EUROPEAN COMMISSION, \*Gli investimenti in Italia, Investire nel futuro dell’Europa\*, “\[37\]\(https://ec.europa.eu/commission/sites/beta-political/files/italy-country-file\_it.pdf”</a>”</p></div><div data-bbox=\)](https://www.agi.it/fact-checking/tasso_disoccupazione_lavoro_giovani_italia-6769043/news/20191220/#:~:text=I%20dati%20nazionali&text=Seco%20i%20dati%20annuali%20di,8%2C2%20per%20cento).”</a>”</p></div><div data-bbox=)

right panel. From a first graphic inspection and looking at the levels, the series shows a stable trend in the last years (2015-2019). In general, after an increasing trend at the beginning (till 2001), the series is characterized by some ups and downs (this is evident especially if we look at the graph at the bottom left, first differences). It is possible to notice that there are two negative peaks, respectively in 2002 (-11%) and 2009 (-24%), which clearly reflect the effects of the crisis. A positive peak was registered in 2014 (+8%), suggesting some slight change in series dynamics.

Figure II.2 – Office furniture consumption in Italy. Period: 1998-2019



Figures II.3, 4, 5 and 6 show the trend of some exogenous variables (the ones chosen for the forecast and the real GDP). The volume of exports of goods has an overall positive trend with two positive peaks in 2000 and in 2010 and one negative peak in 2009 corresponding to the previously mentioned crisis.

The unemployment rate has been decreasing till 2007. Then, as a consequence of the 2008 crisis, it started increasing. The trend reversed in 2014 when it started decreasing again. Today, the unemployment rate is more or less stable around 10%. The total investment as percentage of GDP presents two negative peaks, respectively in 2009 and 2012 due to the financial crisis. Apart from these two moments, the series has a trend around the zero, as shown in the graph with the first differences. In the last years, the trend is slightly increasing.

As shown in the upper panels of figure II.6, the real GDP in Italy had an increasing trend till 2007. Then, as a consequence of the financial crisis, the real GDP had two negative peaks, respectively in 2009 and in 2012. As shown in the lower graphs with the first differences, in 2013, the trend reversed and it has been increasing till 2017. In the last two years (2018-2019) the real GDP was characterized by a negative trend even if 2020-2021 forecasts show a positive recovery.

Figure II.3 - Volume of exports of goods in Italy. Period: 1998-2021

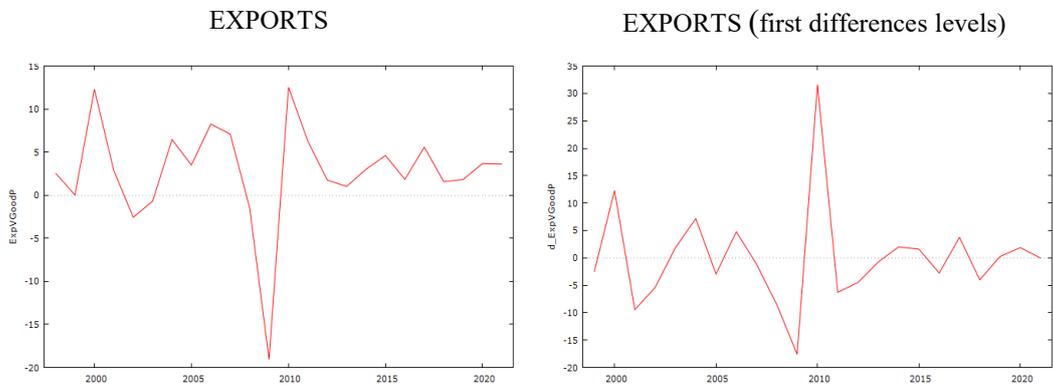


Figure II.4 - Unemployment rate in Italy. Period: 1998-2021

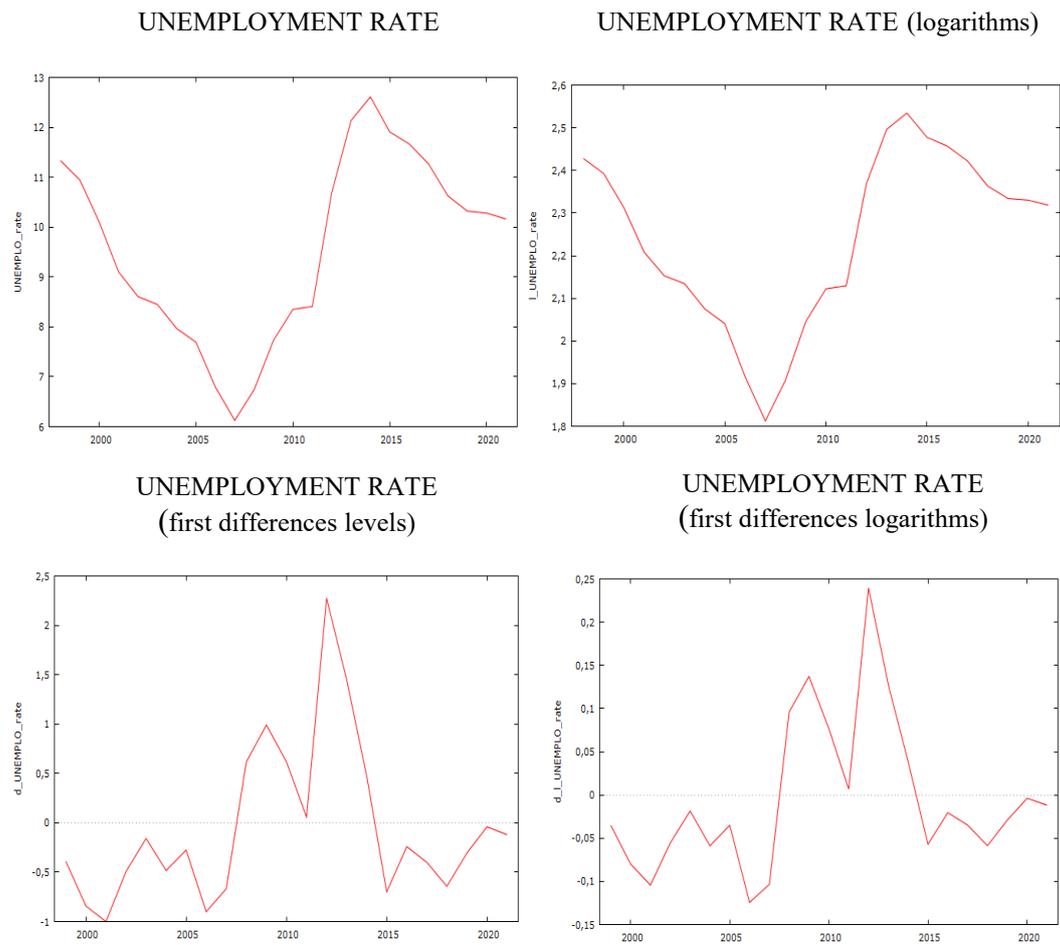


Figure II.5 - Total investment in Italy. Period: 1998-2021

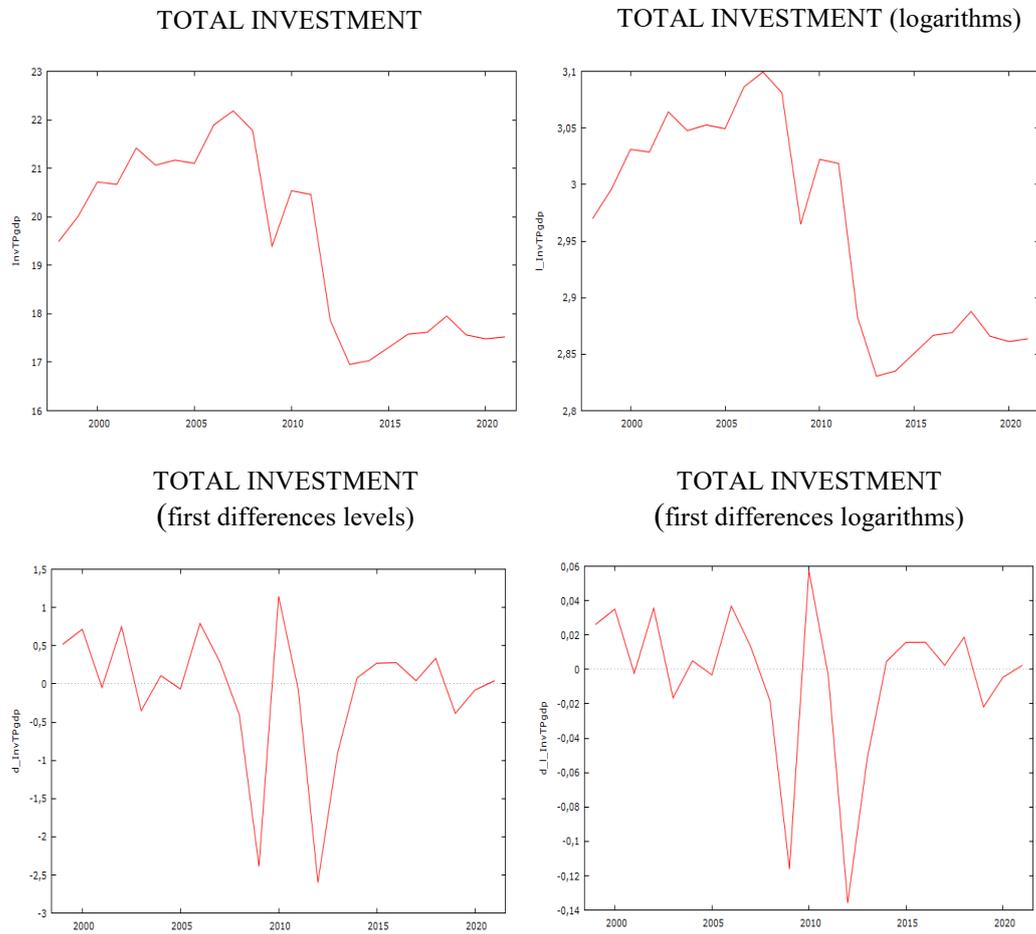
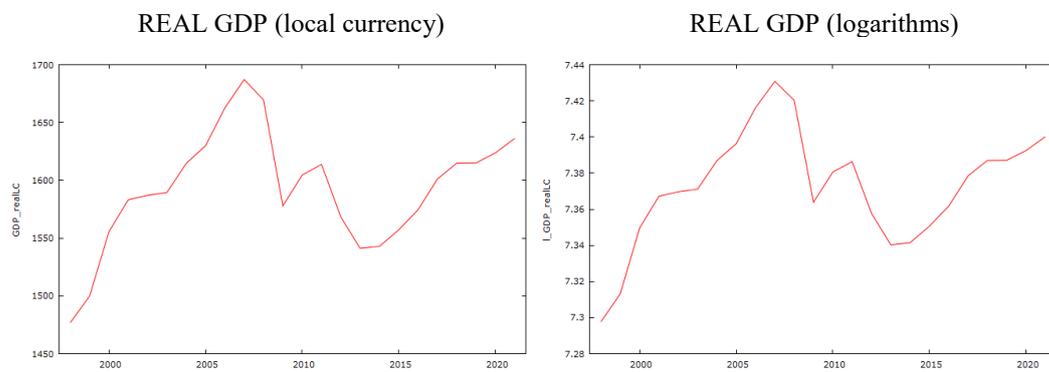
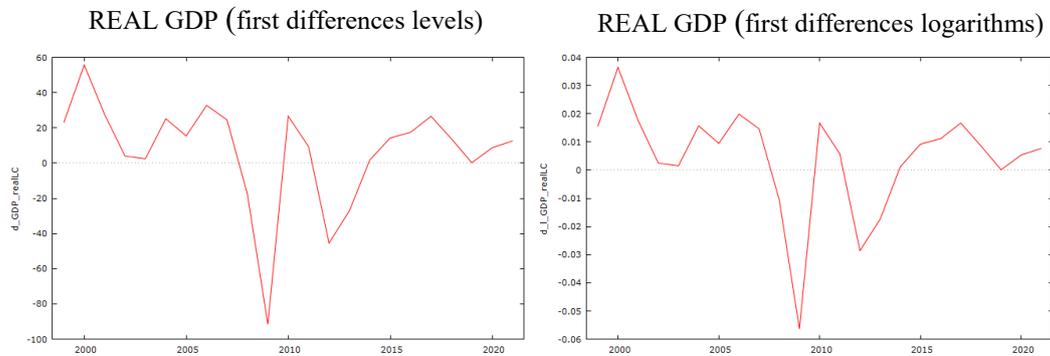


Figure II.6 - Real GDP in Italy. Period: 1998-2021

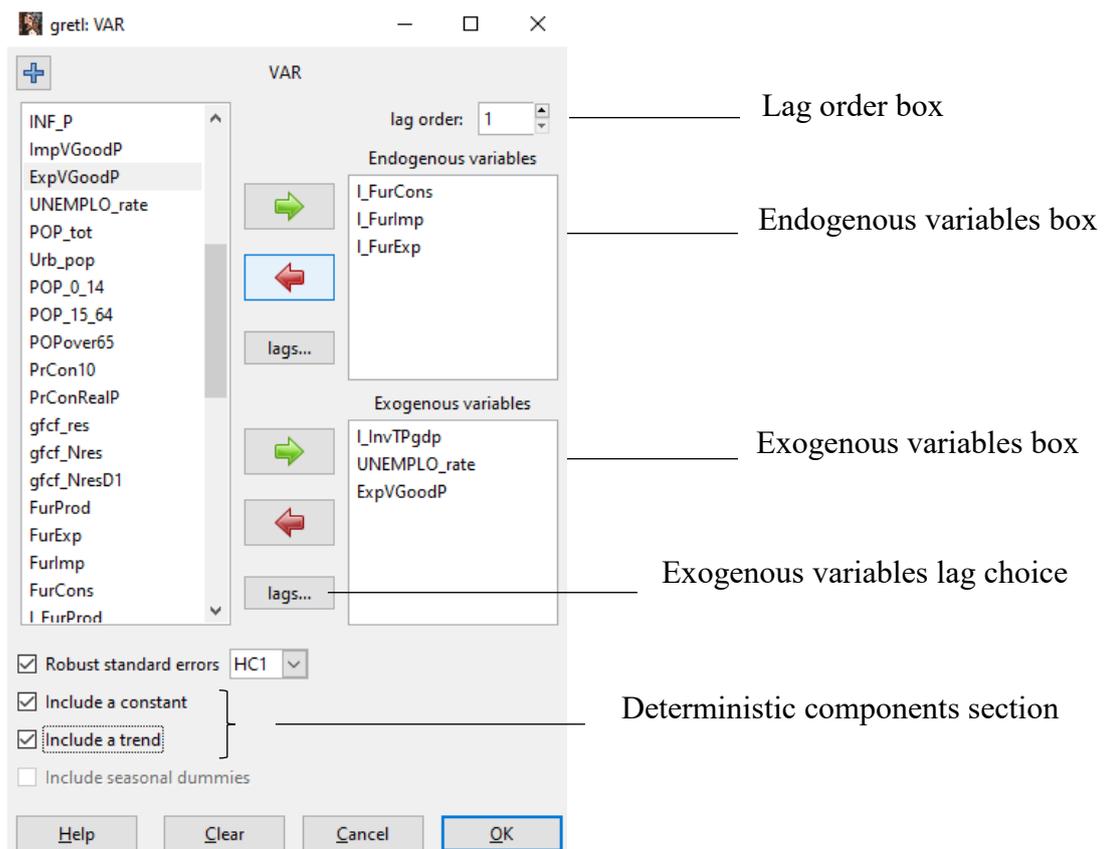




➤ Step 2: Estimation of the VAR via OLS

The VAR model can be estimated in Gretl, as shown in the figure II.7.

Figure II.7 - VAR model in Gretl



The Gretl output is the following:

```

VAR system, lag order 1
OLS estimates, observations 1999-2019 (T = 21)
Log-likelihood = 105.57292
Determinant of covariance matrix = 8.6284975e-009
AIC = -7.7688
BIC = -6.5751
HQC = -7.5098
Portmanteau test: LB(5) = 55.6405, df = 36 [0.0194]

```

Equation 3: l\_FurCons

	coefficient	std. error	t-ratio	p-value	
const	-1.56082	1.22656	-1.273	0.2255	
l_FurExp_1	0.570002	0.159899	3.565	0.0035	***
l_FurImp_1	-0.208311	0.0915377	-2.276	0.0404	**
l_FurCons_1	0.776576	0.165189	4.701	0.0004	***
UNEMPLO_rate	0.0174900	0.0248195	0.7047	0.4934	
ExpVGoodP	0.0120183	0.00290101	4.143	0.0012	***
InvTPgdp	0.00130121	0.0369054	0.03526	0.9724	
time	0.00778956	0.00677063	1.150	0.2707	
Mean dependent var	6.727344	S.D. dependent var	0.256156		
Sum squared resid	0.020157	S.E. of regression	0.039377		
R-squared	0.984640	Adjusted R-squared	0.976369		
F(7, 13)	119.0497	P-value(F)	9.18e-11		
rho	-0.365214	Durbin-Watson	2.604709		

F-tests of zero restrictions:

All lags of l_FurExp	F(1, 13) =	12.707 [0.0035]
All lags of l_FurImp	F(1, 13) =	5.1788 [0.0404]
All lags of l_FurCons	F(1, 13) =	22.101 [0.0004]

As already said, given the short time series available for many of the variables involved in the analysis, a VAR model with one single lag is used. It is based on observations from 1999 to 2019 (T=21). A constant term and a time trend have been generally included in the set of exogenous variables.

As shown in the Gretl output for the equation “l\_FurCons”<sup>14</sup>, the coefficients associated with the lags of the endogenous variables are all statistically significant, whereas among the exogenous variables, only the volume of exports of goods is highly significant.

The R-squared is 98.46%, meaning that the accuracy of the model is high.

Since the p-value for the F-test is 0.00015, the sample data provide sufficient evidence to conclude that the regression model fits the data better than the model with no independent variables.

➤ *Step 3: In-sample and out-of-sample forecast*

The aim of this analysis is to have a two-years consumption forecast from 2020 to 2021. To make this forecast it is necessary to make an in-sample forecast from 2016 to 2019 to calculate the forecast error. In fact, only for these 4 years there are both the values predicted by the model and the ones actually observed. Then, the values that the variable will assume in the 2020-2021 period are predicted (out-of-sample forecast). Note that the forecast error for the 2020-2021 period cannot be calculated because the observed values of the variable in this period are not present.

As follows the prediction values are expressed in logarithms.

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<sup>14</sup> For the purposes of the thesis, the output of the equations “l\_FurImp” and “l\_FurExp” is omitted.

For 95% confidence intervals,  $t(13, 0.025) = 2.160$

	l_FurCons	prediction	std. error	95% interval
2016	6.471296	6.496631	0.030982	6.429699 - 6.563563
2017	6.497496	6.535301	0.053724	6.419237 - 6.651366
2018	6.508749	6.519868	0.082203	6.342280 - 6.697456
2019	6.498665	6.493522	0.113564	6.248182 - 6.738862
2020		6.486398	0.147502	6.167739 - 6.805056
2021		6.482577	0.184500	6.083989 - 6.881164

In the following table logarithms are transformed into local currency, real values. Moreover, the comparison between forecasted and observed office furniture consumption values is shown together with the year on year variation.

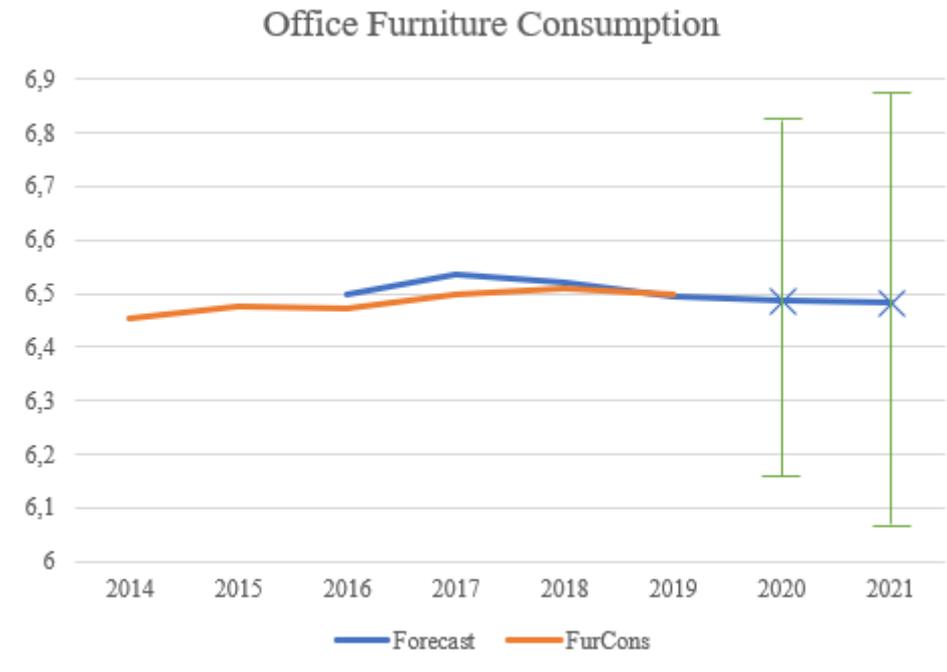
Table II.3 - Office furniture consumption in Italy: forecasted values vs observed values

	Forecast (log)	Forecast (real)	% change	FurCons (real) observed	% change
2016	6.4966	662.9045		646.3207	
2017	6.5353	689.0412	3.9427	663.4779	2.6546
2018	6.5199	678.4888	-1.5315	670.9867	1.1317
2019	6.4935	660.8468	-2.6002	664.2544	-1.0033
2020	6.4864	656.1556	-0.7099		
2021	6.4826	653.6532	-0.3814		

As a result of the forecast, it is possible to state that in the years 2020-2021 office furniture consumption in Italy will remain quite stable, with a decreasing negative trend. Growth rates have been marked down in Italy due to weak domestic demand.<sup>15</sup>

<sup>15</sup> M. AMICO, M. SPINELLI, *The European market for office furniture*, CSIL, Milano, June 2019, p.21

Figure II.8 - Consumption forecast in Italy (in-sample and out-of-sample)



Residuals and forecasting error analysis help to evaluate the goodness of the forecasts and the model. For each forecast, the residuals represent the annual deviations of the predicted values from those observed and Gretl returns the following error measures:

Y	Residuals
2016	0.0253
2017	0.0378
2018	0.0111
2019	-0.0051

1. Mean error, that is the average of forecast errors. The error at a given horizon  $s$  is the difference between the estimated and the real values:

$$\frac{1}{S} \sum_{s=T+1}^{T+S} (\hat{x}_s - x_s)$$

2. Root mean squared error (RMSE), that is the square root of the mean of the squared forecast errors:

$$RMSE = \sqrt{\frac{1}{S} \sum_{s=T+1}^{T+S} (\hat{x}_s - x_s)^2}$$

3. Mean absolute error (MAE), that is the absolute value of the mean of the forecast errors:

$$MAE = \frac{1}{S} \sum_{s=T+1}^{T+S} |\hat{x}_s - x_s|$$

4. Mean absolute percentual error (MAPE), that is the absolute percentage value of the mean of the forecast errors. This error is expressed as a percentage:

$$MAPE = 100 * \left( \frac{1}{S} \sum_{s=T+1}^{T+S} \frac{|\hat{x}_s - x_s|}{x_s} \right)$$

All these indicators can be used to measure the forecasts accuracy.<sup>16</sup>

However, MAPE is the most informative one and the one taken into consideration in all the here analysed cases. For each analysis, the presented specification is the one that produces the smallest forecast errors.

Figure II.9 - Forecast errors for Italy

Forecast evaluation statistics using 4 observations

Mean Error	-0.017279
Root Mean Squared Error	0.023565
Mean Absolute Error	0.019851
Mean Percentage Error	-0.26626
Mean Absolute Percentage Error	0.30583
Theil's U	1.315
Bias proportion, UM	0.53767
Regression proportion, UR	0.19784
Disturbance proportion, UD	0.26449

<sup>16</sup> F. GIFFONI, with the contribution of E. SIRTORI, E. BACCHIOCCHI, *Guida per l'analisi previsionale*, CSIL, Milano, 2018, pp. 13-14

On the following pages, the same forecast analysis is shown for Germany, France, Poland and European Union (28) omitting the theoretical concepts.

### ***GERMANY***

The variables used for the forecast analysis in Germany are:

- Three endogenous variables for which the forecast is required and available from 1998 to 2019 (“FurCons, FurExp and FurImp”), as seen for Italy.
- Three exogenous variables that could influence one or more of the three endogenous variables available between 1998 and 2021. In this case, they are:
  - Volume of imports of goods in percent change (“ImpVGoodP”). Germany is the second country in the world in terms of volume of office furniture imports from China, Poland, Sweden and Austria. The level of import penetration is higher for the office seating segment than for office furniture as a whole.<sup>17</sup>
  - Unemployment rate as a percentage of total labour force (“UNEMPLO\_rate”). According to Eurostat annual data (age between 15-74 years), Germany is one of the EU countries with the lowest unemployment rate (3.1%) and the second with the lowest youth unemployment rate (5.8%) according to October 2019 data.<sup>18</sup>

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<sup>17</sup> M. AMICO, M. SPINELLI, *The European market for office furniture*, CSIL, Milano, June 2019, p.67

<sup>18</sup> LABPARLAMENTO, *Dati Eurostat: disoccupazione ai minimi dal luglio 2008*, “<https://www.labparlamento.it/thinknet/dati-eurostat-disoccupazione-ai-minimi-dal-luglio-2008/>”

- Non-residential building investments in local currency (“gfcf\_Nres”). In 2019, foreign investments in non-residential properties increased by 19% in Germany for a value of EUR 12 billion. It was a record for the country, which for the first time exceeded the 2007 figure. Berlin and Munich recorded investments of over EUR 10 billion each in 2019.<sup>19</sup>

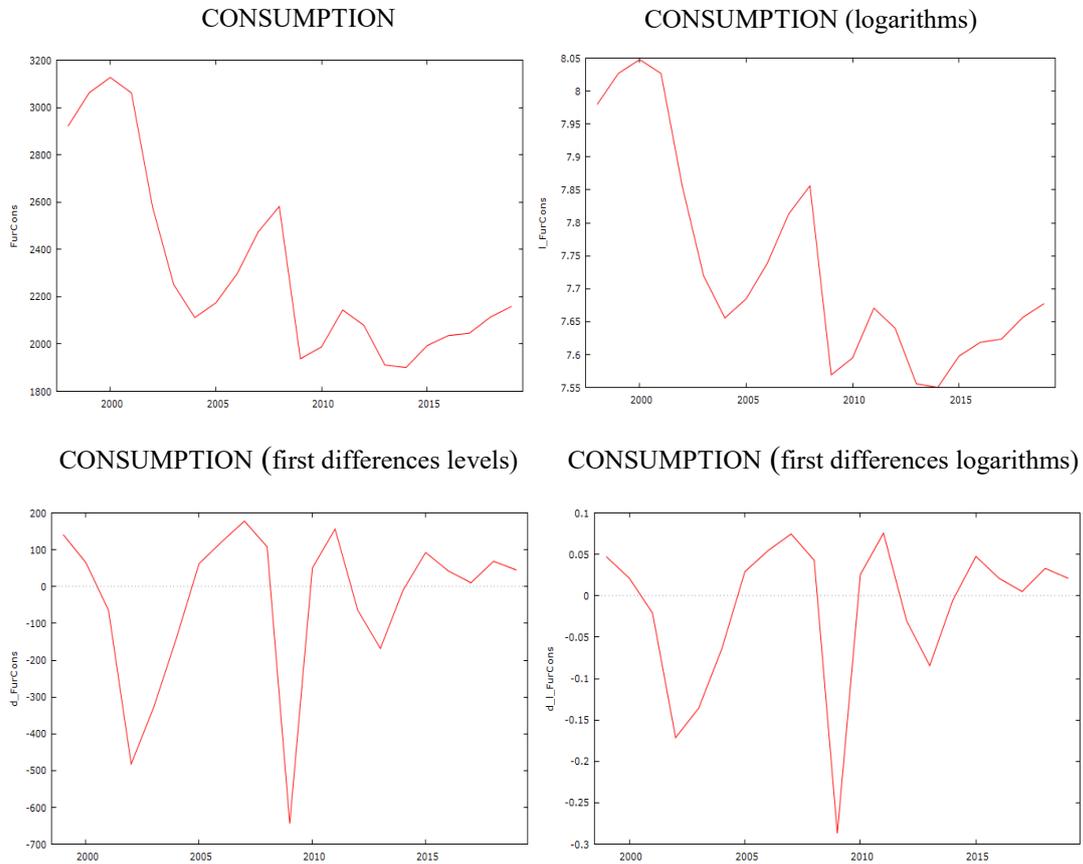
➤ *Step 1: Graphic inspection and descriptive analysis*

Figure II.10 shows the time series of office furniture consumption in Germany (“FurCons”) in the upper left panel. In the lower left panel, the variable is expressed in first differences, while in the upper right panel it is expressed in logarithms. The first differences of the logarithms (growth rates proxy) are shown in the bottom right panel. From a first graphic inspection and looking at the levels, the series is characterized by some ups and downs. In general, after a positive trend at the beginning (till 2000), the series shows a negative trend till 2004, four years of growth (2005-2008) and then it decreases again as a consequence of the crisis. In the last years (2015-2019) the series has an increasing trend. Especially if we look at the graphs at the bottom (first differences), it is possible to notice that there are three negative peaks, respectively in 2002 (-16%), 2009 (-25%) and 2013 (-8%), which clearly reflect the effects of the crisis.

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<sup>19</sup> IDEALISTA, *Investimenti in immobili non residenziali: 2019 da record in Europa*, “<https://www.idealista.it/news/finanza/investimenti/2020/02/10/138366-investimenti-in-immobili-non-residenziali-2019-da-record-in-europa>”

Figure II.10 - Office furniture consumption in Germany. Period: 1998-2019



Figures II.11, 12, 13 and 14 show the trend of some exogenous variables (the ones chosen for the forecast and the real GDP). The volume of imports of goods has an overall positive trend with one positive peak in 2010. However, the series presents three negative peaks respectively in 2001, 2009 and 2012 corresponding to the previously mentioned crisis. The unemployment rate has an overall decreasing trend, apart from the period 2002-2004 in which it increased. In 2019, the unemployment rate reached its lowest level (3.21%), even if the forecasted values

of the next two years are slightly increasing. Non-residential building investments are characterized by some ups and downs, as shown in the first differences graphs at the bottom, with three negative peaks respectively in 2002, 2009 and 2012 corresponding to the already mentioned crisis. As shown in the upper right panel, at the beginning the series was characterized by a decreasing trend (till 2005), while to date it has been increasing since 2015. Real GDP has an increasing trend apart from the negative peak registered in 2009 as a consequence of the financial crisis.

Figure II.11- Volume of imports of goods in Germany. Period: 1998-2021

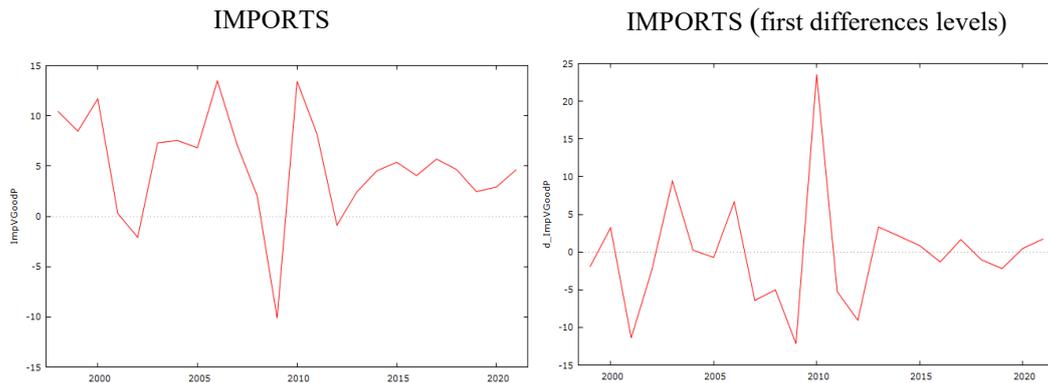
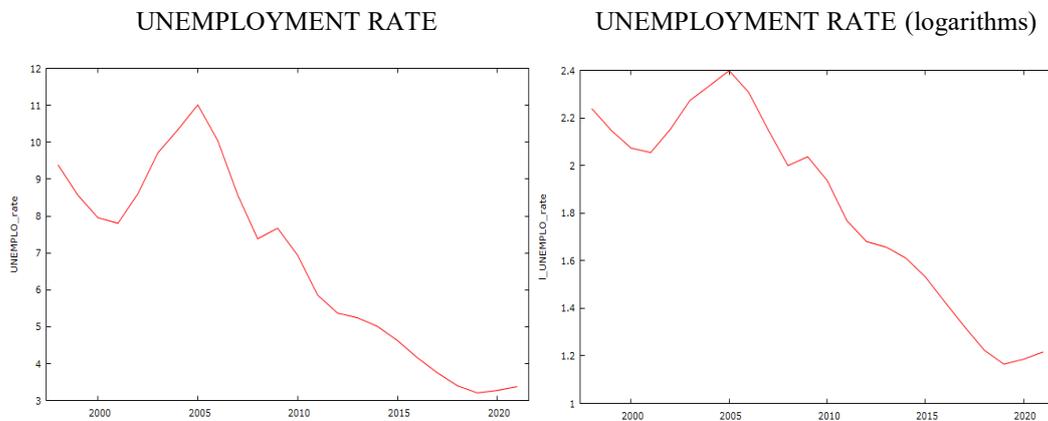


Figure II.12 - Unemployment rate in Germany. Period: 1998-2021



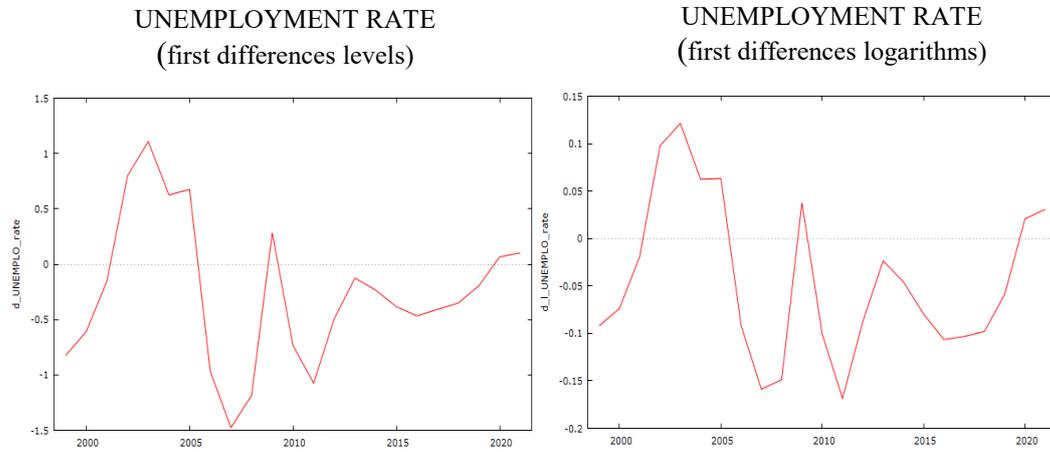


Figure II.13 - Non-residential building investments in Germany. Period: 1998-2021

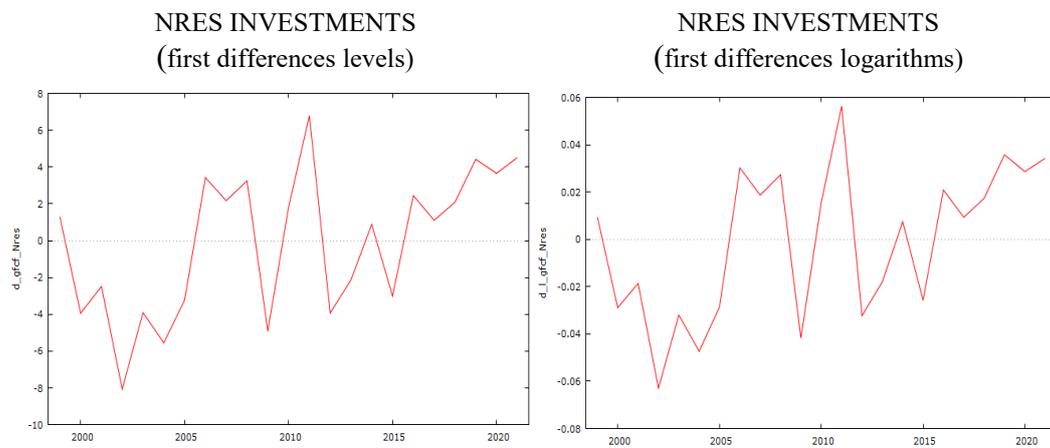
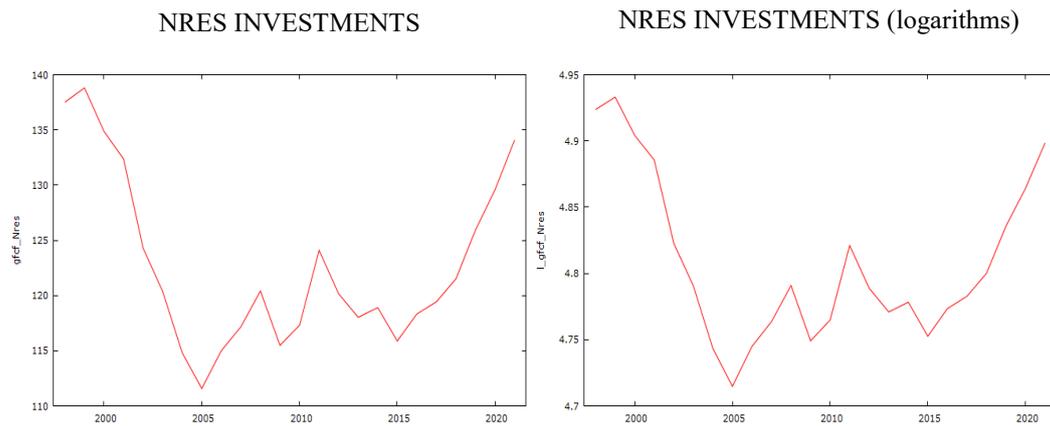
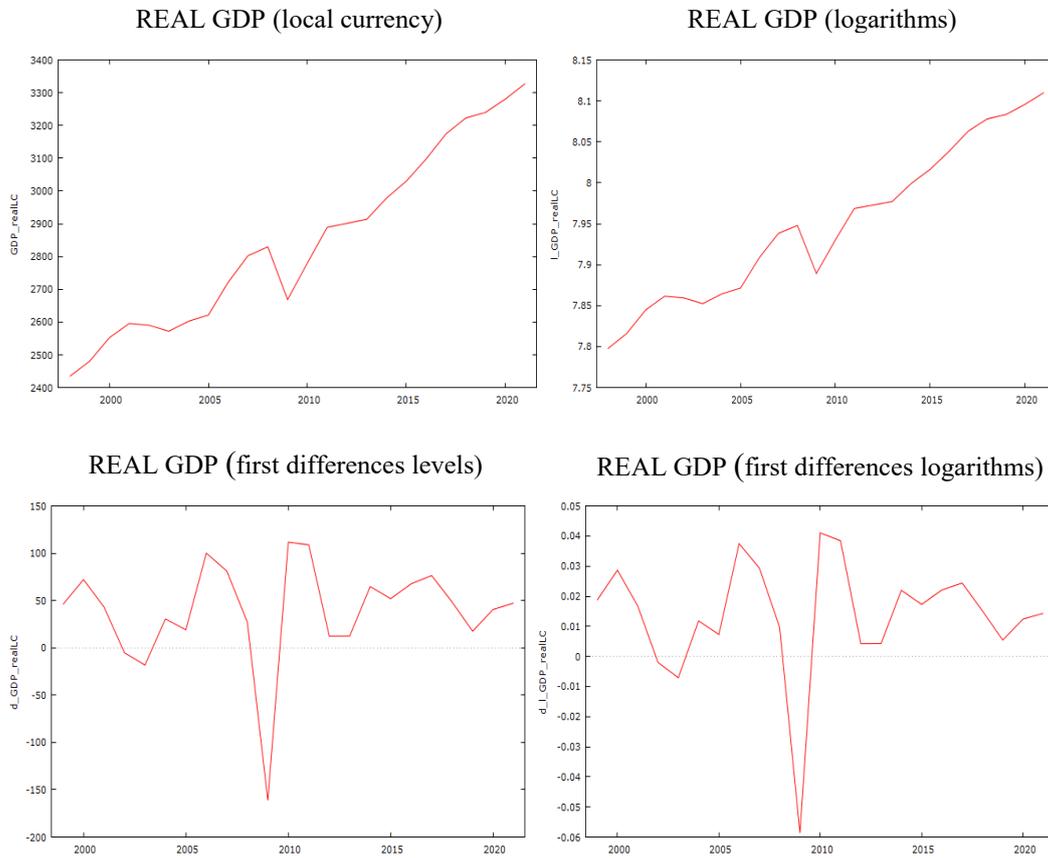


Figure II.14 - Real GDP in Germany. Period: 1998-2021



➤ *Step 2: Estimation of the VAR via OLS*

The Gretl output is the following:

```

VAR system, lag order 1
OLS estimates, observations 1999-2019 (T = 21)
Log-likelihood = 130.72577
Determinant of covariance matrix = 7.8628306e-010
AIC = -10.1644
BIC = -8.9706
HQC = -9.9053
Portmanteau test: LB(5) = 51.4879, df = 36 [0.0455]
    
```

Equation 3: l\_FurCons

	coefficient	std. error	t-ratio	p-value	
const	1.09286	1.99802	0.5470	0.5937	
l_FurExp_1	0.626349	0.343704	1.822	0.0915	*
l_FurImp_1	0.148024	0.332253	0.4455	0.6633	
l_FurCons_1	0.0880042	0.534276	0.1647	0.8717	
ImpVGoodP	0.0108888	0.00402367	2.706	0.0180	**
UNEMPLO_rate	-0.00104924	0.0266800	-0.03933	0.9692	
gfcf_Nres	0.00923597	0.00550509	1.678	0.1173	
time	-0.0156494	0.0191262	-0.8182	0.4280	
Mean dependent var	7.722754	S.D. dependent var	0.156548		
Sum squared resid	0.041583	S.E. of regression	0.056557		
R-squared	0.915162	Adjusted R-squared	0.869480		
F(7, 13)	20.03339	P-value(F)	5.24e-06		
rho	0.121883	Durbin-Watson	1.748054		

F-tests of zero restrictions:

All lags of l_FurExp	F(1, 13) = 3.3210 [0.0915]
All lags of l_FurImp	F(1, 13) = 0.19849 [0.6633]
All lags of l_FurCons	F(1, 13) = 0.027132 [0.8717]

As shown in the Gretl output for the equation “l\_FurCons”, among the coefficients associated with the lags of the endogenous variables, the one of exports of office furniture is statistically significant, whereas among the exogenous variables, only the volume of imports of goods is highly significant.

The R-squared is 91.52%, meaning that the accuracy of the model is quite high.

Since the p-value for the F-test is 0.013, the sample data provide sufficient evidence to conclude that the regression model fits the data better than the model with no independent variables.

➤ *Step 3: In-sample and out-of-sample forecast*

As follows the prediction values are expressed in logarithms.

For 95% confidence intervals,  $t(13, 0.025) = 2.160$

	l_FurCons	prediction	std. error	95% interval
2016	7.618560	7.609400	0.044499	7.513267 - 7.705534
2017	7.623507	7.631881	0.061812	7.498344 - 7.765418
2018	7.656488	7.660810	0.076204	7.496182 - 7.825438
2019	7.677418	7.685185	0.090073	7.490594 - 7.879775
2020		7.694463	0.104151	7.469459 - 7.919467
2021		7.710249	0.118805	7.453588 - 7.966911

In the following table logarithms are transformed into local currency, real values.

Moreover, the comparison between forecasted and observed office furniture consumption values is shown together with the year on year variation.

*Table II.4- Office furniture consumption in Germany: forecasted values vs observed values*

	Forecast (log)	Forecast (real)	% change	FurCons (real) observed	% change
2016	7.6094	2017.0675		2035.6287	
2017	7.6319	2062.9267	2.2736	2045.7235	0.4959
2018	7.6608	2123.4767	2.9352	2114.3186	3.3531
2019	7.6852	2175.8725	2.4674	2159.0374	2.1150
2020	7.6945	2196.1542	0.9321		
2021	7.7102	2231.0977	1.5911		

As a result of the forecast, it is possible to state that in the next two years office furniture consumption in Germany will increase by 1% in 2020 and 1.6% in 2021.

Growth rates have been marked down in Germany due to soft private consumption, weak industrial production and subdued foreign demand, but, on the other hand,

Brexit might increase the demand for office construction as corporations move across the Canal.<sup>20</sup>

Figure II.15 - Consumption forecast in Germany (in-sample and out-of-sample)

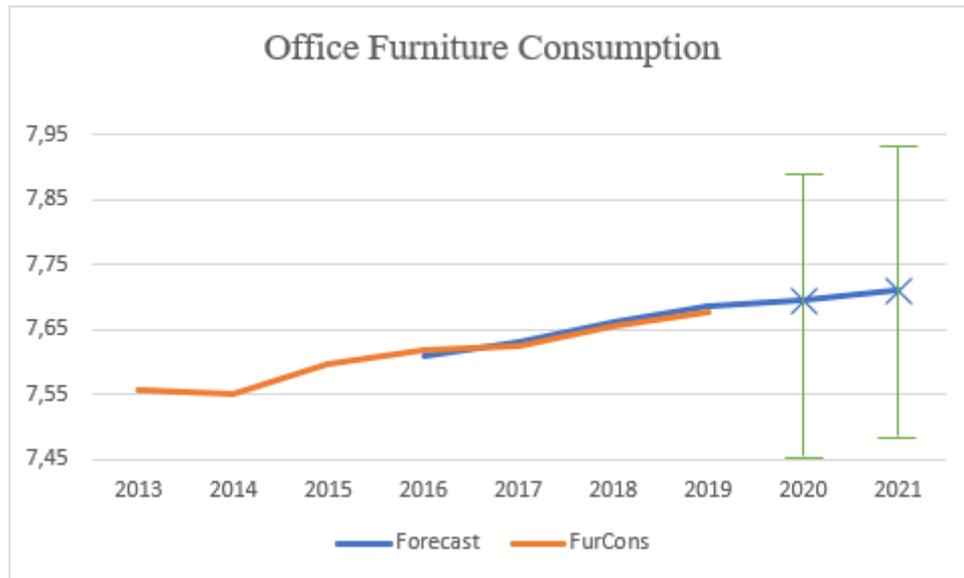


Figure II.16 - Forecast errors for Germany

Forecast evaluation statistics using 4 observations

Mean Error	-0.0028258
Root Mean Squared Error	0.0076327
Mean Absolute Error	0.0074057
Mean Percentage Error	-0.036808
<b>Mean Absolute Percentage Error</b>	<b>0.096923</b>
Theil's U	0.31008
Bias proportion, UM	0.13707
Regression proportion, UR	0.43278
Disturbance proportion, UD	0.43015

Y	Residuals
2016	-0.0092
2017	0.0084
2018	0.0043
2019	0.0078

<sup>20</sup> M. AMICO, M. SPINELLI, *The European market for office furniture*, CSIL, Milano, June 2019, p.21

## ***FRANCE***

The variables used for the forecast analysis in France are:

- Three endogenous variables for which the forecast is required and available from 1998 to 2019 (“FurCons, FurExp and FurImp”), as previously seen.
- Three exogenous variables that could influence one or more of the three endogenous variables available between 1998 and 2021. In this case, they are:
  - Volume of imports of goods in percent change (“ImpVGoodP”). France is the third country in the world in terms of volume of office furniture imports from Italy, Germany, China and Spain. Over the last decades this market has witnessed a reduction in its production capacity and the active manufacturers mainly concentrate on supplying their local market.<sup>21</sup>
  - Unemployment rate as a percentage of total labour force (“UNEMPLO\_rate”). The unemployment rate in France dropped drastically, by 0.4 points, in the fourth quarter of 2019, reaching 8.1% of the active population and reaching lowest level since the end of 2008, according to data published by the statistical institute Insee.<sup>22</sup>

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<sup>21</sup> M. AMICO, M. SPINELLI, *The European market for office furniture*, CSIL, Milano, June 2019, p.53

<sup>22</sup> IL SOLE 24 ORE, *Francia: forte calo tasso disoccupazione a 8,1% IV trim da 8,5%, minimo da 2008*, “[https://www.ilsole24ore.com/radiocor/nRC\\_13.02.2020\\_08.00\\_353148](https://www.ilsole24ore.com/radiocor/nRC_13.02.2020_08.00_353148)”

- Non-residential building investments delayed by one year in local currency (“gfcf\_NresD1”). 2019 was a record year for France (+19%), with investments of over EUR 40 billion for the first time, driven by all asset categories and regions.<sup>23</sup>

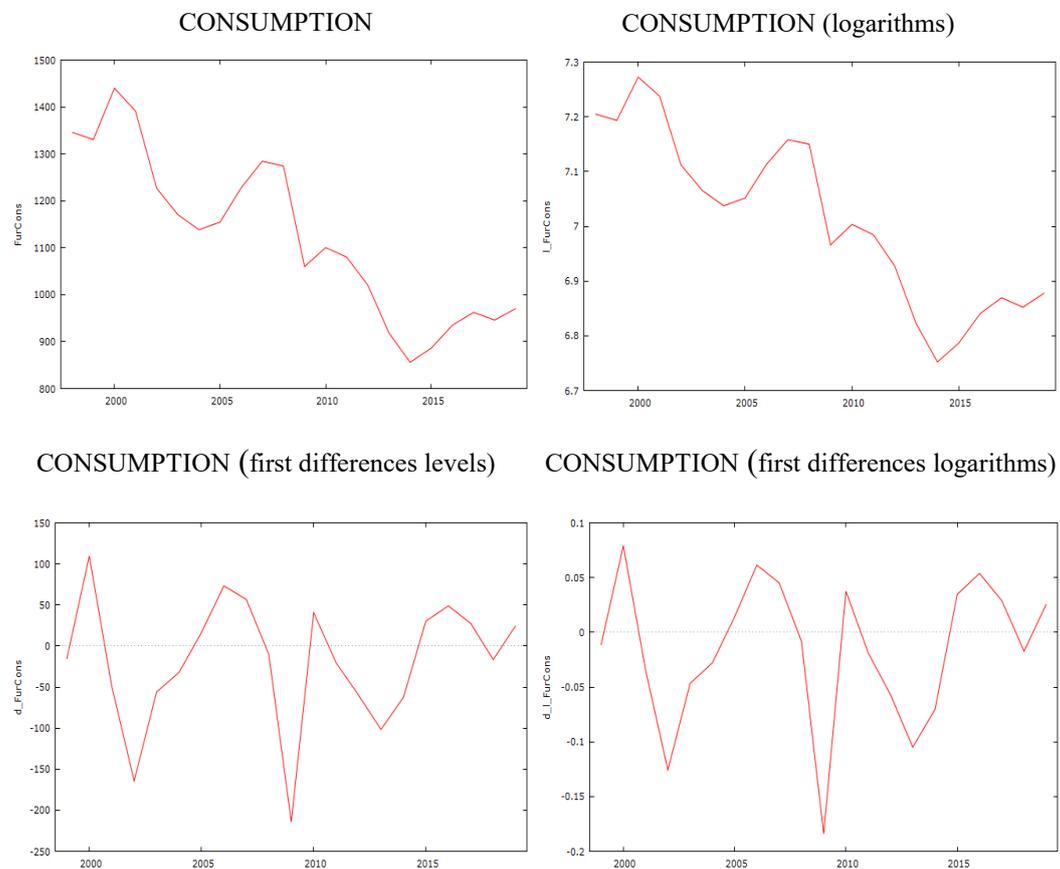
➤ *Step 1: Graphic inspection and descriptive analysis*

Figure II.17 shows the time series of office furniture consumption in France (“FurCons”) in the upper left panel. In the lower left panel, the variable is expressed in first differences, while in the upper right panel it is expressed in logarithms. The first differences of the logarithms (growth rates proxy) are shown in the bottom right panel. From a first graphic inspection and looking at the levels, after an initial growth, the series is characterized by a general negative trend with some ups and downs. Especially if we look at the graphs at the bottom (first differences), it is possible to notice that, after one positive peak in 2000 (+8%), there are three negative peaks, respectively in 2002 (-12%), 2009 (-17%) and 2013 (-10%), which clearly reflect the effects of the crisis. In 2014, there was a change in the series dynamics and, as shown in the upper panels, consumption had an increasing trend in the last years (2014-2019), apart from a little decrease in 2018 (-2%).

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<sup>23</sup> MONITORIMMOBILIARE, *Immobili non residenziali: investimenti record in Europa, 281 mld nel 2019*, “[https://www.monitorimmobiliare.it/immobili-non-residenziali-investimenti-record-in-europa-281-mld-nel-2019\\_2020251548](https://www.monitorimmobiliare.it/immobili-non-residenziali-investimenti-record-in-europa-281-mld-nel-2019_2020251548)”

Figure II.17 - Office furniture consumption in France. Period: 1998-2019



Figures II.18, 19, 20 and 21 show the trend of some exogenous variables (the ones chosen for the forecast and the real GDP). The volume of imports of goods has an overall positive trend with two positive peaks in 2000 and 2010. However, the series presents three negative peaks respectively in 2001, 2009 and 2012 corresponding to the previously mentioned crisis. The unemployment rate had a decreasing trend till 2008 when it started increasing. There were two negative peaks in 2000 and 2007 and one positive peak in 2009. The trend reversed in 2016 when it started

decreasing again. Non-residential building investments (delayed by one year) are characterized by some ups and downs, as shown in the first differences graphs at the bottom, with two negative peaks respectively in 2003 and 2010, corresponding to the already mentioned crisis, and some positive peaks. As shown in the upper right panel, the series is characterized by a general increasing trend. Real GDP has a positive increasing trend apart from the negative peak registered in 2009 as a consequence of the financial crisis.

Figure II.18 - Volume of imports of goods in France. Period: 1998-2021

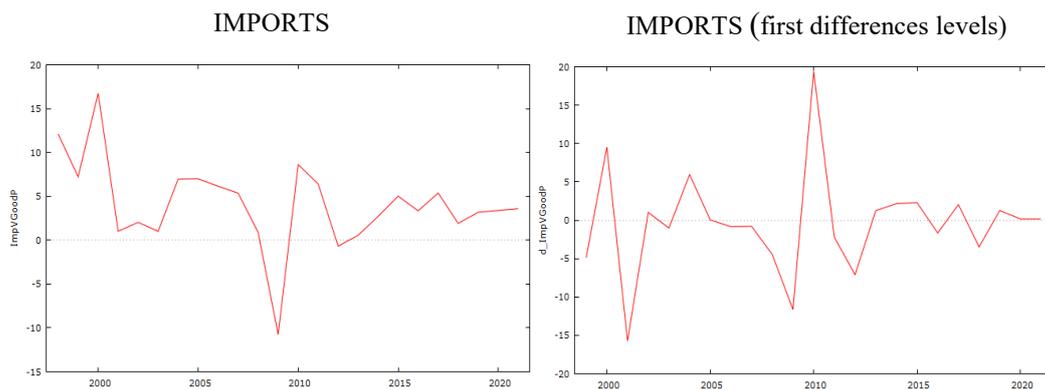
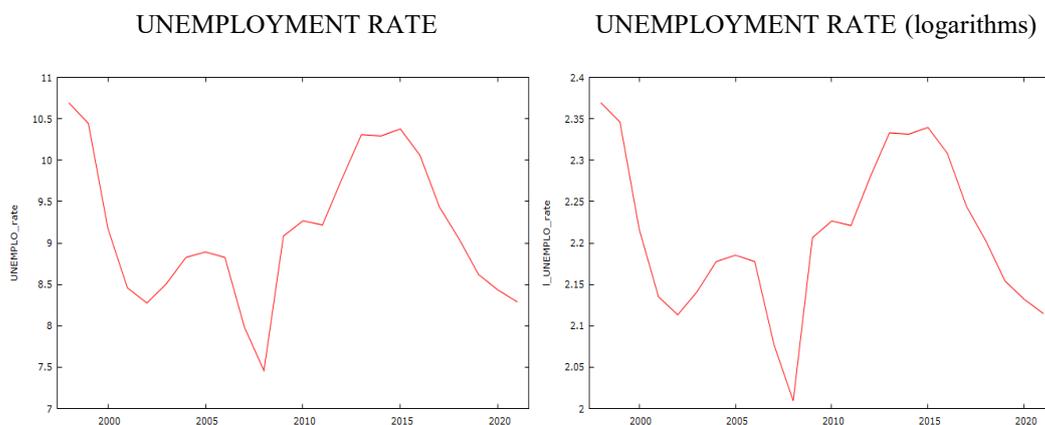


Figure II.19 - Unemployment rate in France. Period: 1998-2021



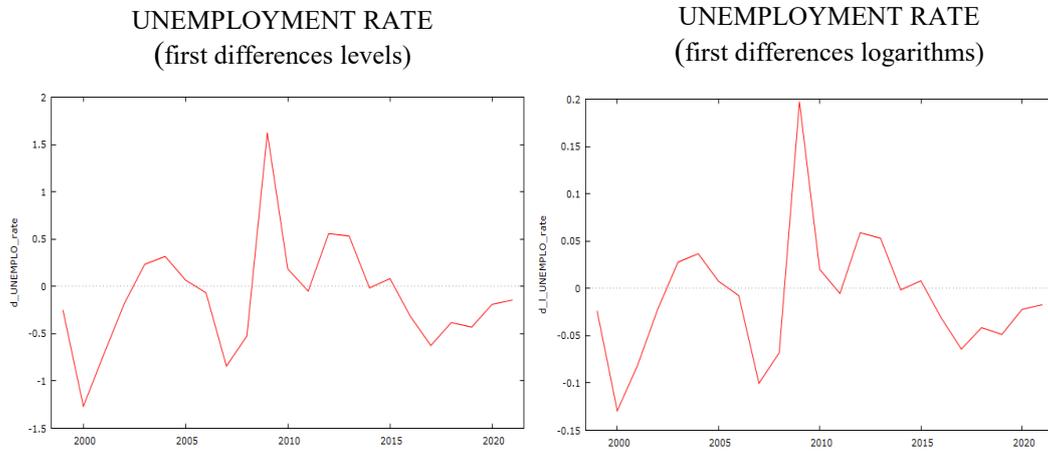


Figure II.20 - Non-residential building investments (delayed by one year) in France. Period: 1998-2021

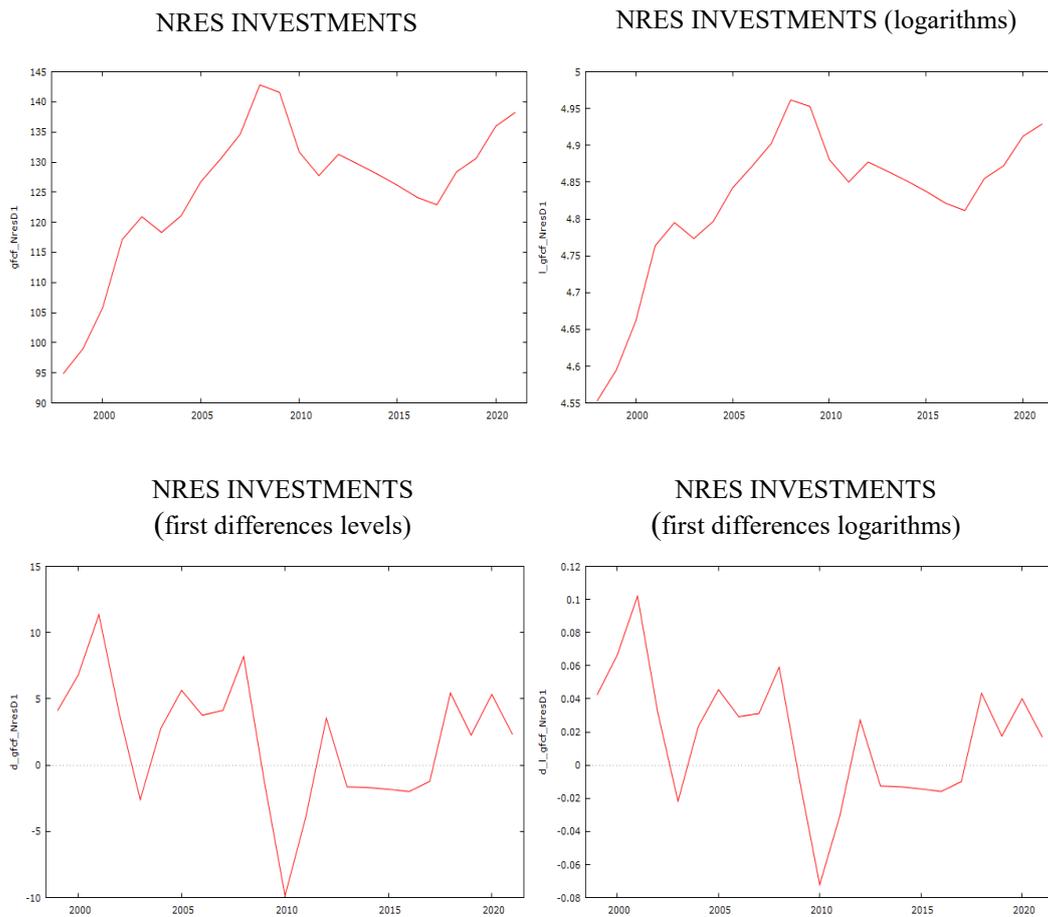
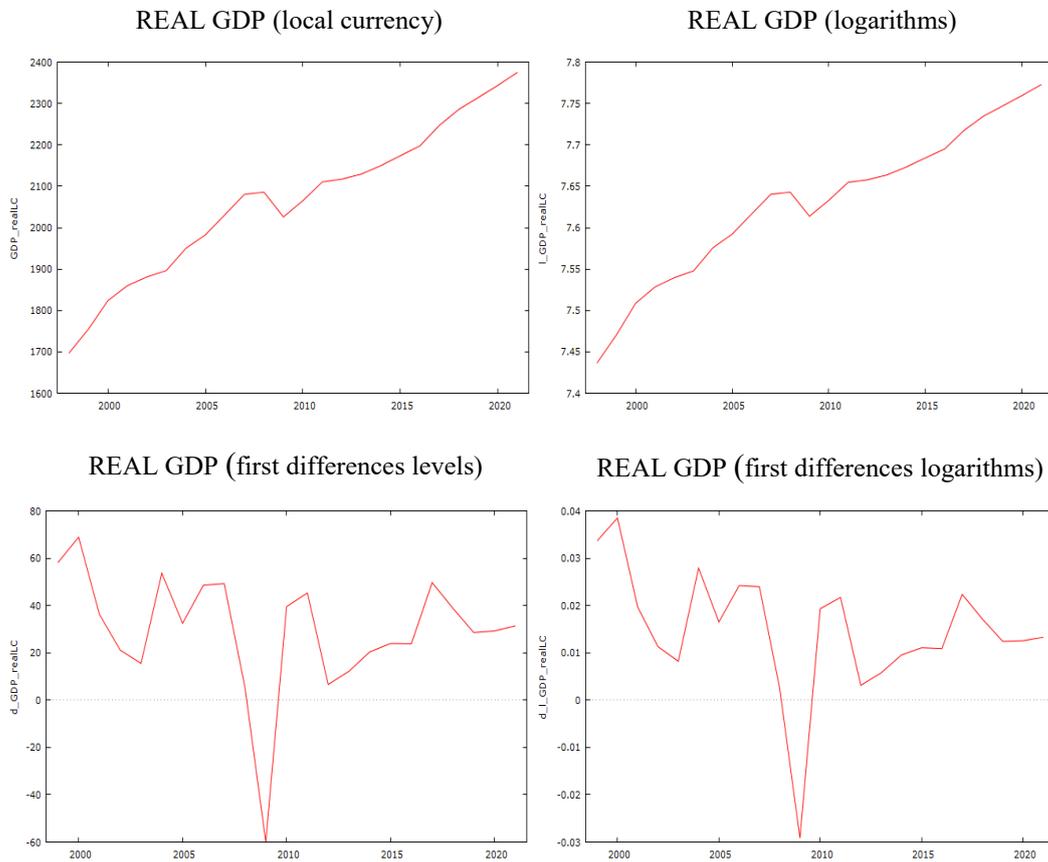


Figure II.21 - Real GDP in France. Period: 1998-2021



➤ *Step 2: Estimation of the VAR via OLS*

The Gretl output is the following:

```

VAR system, lag order 1
OLS estimates, observations 1999-2019 (T = 21)
Log-likelihood = 115.88493
Determinant of covariance matrix = 3.2315921e-009
AIC = -8.7509
BIC = -7.5572
HQc = -8.4919
Portmanteau test: LB(5) = 47.4869, df = 36 [0.0953]
    
```

Equation 3: l\_FurCons

	coefficient	std. error	t-ratio	p-value
const	1.82189	1.81274	1.005	0.3332
l_FurExp_1	0.0737131	0.0815580	0.9038	0.3825
l_FurImp_1	0.285576	0.267252	1.069	0.3047
l_FurCons_1	0.440365	0.352557	1.249	0.2337
ImpVGoodP	0.0109073	0.00273823	3.983	0.0016 ***
UNEMPLO_rate	-0.0101713	0.0199403	-0.5101	0.6185
gfcf_NresD1	0.00106450	0.00210010	0.5069	0.6207
time	-0.00773626	0.00858723	-0.9009	0.3840
Mean dependent var	7.003519	S.D. dependent var	0.153782	
Sum squared resid	0.018303	S.E. of regression	0.037523	
R-squared	0.961302	Adjusted R-squared	0.940464	
F(7, 13)	46.13341	P-value(F)	3.54e-08	
rho	-0.306644	Durbin-Watson	2.574572	

F-tests of zero restrictions:

All lags of l_FurExp	F(1, 13) = 0.81688 [0.3825]
All lags of l_FurImp	F(1, 13) = 1.1418 [0.3047]
All lags of l_FurCons	F(1, 13) = 1.5601 [0.2337]

As shown in the Gretl output for the equation “l\_FurCons”, among the exogenous variables, only the volume of imports of goods is highly significant.

The R-squared is 96.13%, meaning that the accuracy of the model is high.

Since the p-value for the F-test is 0.0012, the sample data provide sufficient evidence to conclude that the regression model fits the data better than the model with no independent variables.

➤ *Step 3: In-sample and out-of-sample forecast*

As follows the prediction values are expressed in logarithms.

For 95% confidence intervals,  $t(13, 0.025) = 2.160$

	l_FurCons	prediction	std. error	95% interval
2016	6.840598	6.809690	0.029523	6.745910 - 6.873470
2017	6.869502	6.859034	0.042890	6.766375 - 6.951693
2018	6.852166	6.870858	0.050491	6.761779 - 6.979937
2019	6.877954	6.894488	0.055200	6.775236 - 7.013740
2020		6.920077	0.058357	6.794005 - 7.046149
2021		6.943243	0.060499	6.812542 - 7.073944

In the following table logarithms are transformed into local currency, real values.

Moreover, the comparison between forecasted and observed office furniture consumption values is shown together with the year on year variation.

Table II.5 - Office furniture consumption in France: forecasted values vs observed values

	Forecast (log)	Forecast (real)	% change	FurCons (real) observed	% change
2016	6.8097	906.5897		935.0485	
2017	6.8590	952.4466	5.0582	962.4695	2.9326
2018	6.8709	963.7751	1.1894	945.9276	-1.7187
2019	6.8945	986.8203	2.3911	970.6382	2.6123
2020	6.9201	1012.3979	2.5919		
2021	6.9432	1036.1249	2.3436		

As a result of the forecast, it is possible to state that in the next two years office furniture consumption in France will increase by 2.6% in 2020 and 2.3% in 2021.

Growth rates largely vary between the countries. France is one of the best

performers and Brexit might increase the demand for office construction as corporations move across the Canal.<sup>24</sup>

Figure II.22 - Consumption forecast in France (in-sample and out-of-sample)

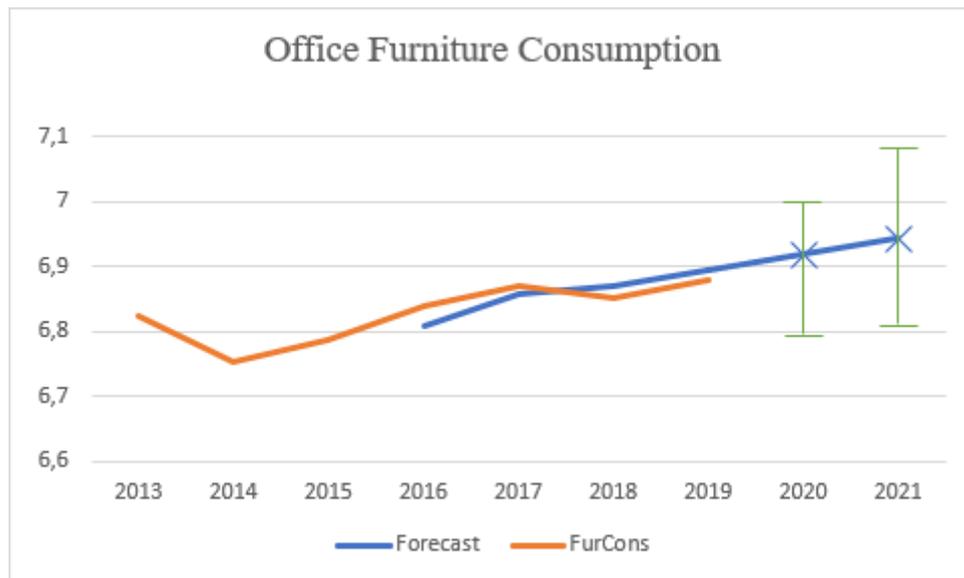


Figure II.23 - Forecast errors for France

Forecast evaluation statistics using 4 observations

Mean Error	0.0015376
Root Mean Squared Error	0.020541
Mean Absolute Error	0.019151
Mean Percentage Error	0.022761
<b>Mean Absolute Percentage Error</b>	<b>0.27935</b>
Theil's U	0.63684
Bias proportion, UM	0.0056038
Regression proportion, UR	0.83918
Disturbance proportion, UD	0.15522

Y	Residuals
2016	-0.0309
2017	-0.0105
2018	0.0187
2019	0.0165

<sup>24</sup> M. AMICO, M. SPINELLI, *The European market for office furniture*, CSIL, Milano, June 2019, p.21

## ***POLAND***

The variables used for the forecast analysis in Poland are:

- Three endogenous variables for which the forecast is required and available from 1999 to 2019 (“FurCons, FurExp and FurImp”).
- Three exogenous variables that could influence one or more of the three endogenous variables available between 1999 and 2021. In this case, they are:
  - Unemployment rate as a percentage of total labour force (“UNEMPLO\_rate”). According to the LFS (Polish Labour Force Survey), recent years have witnessed a gradual rise in the number of employed persons and, simultaneously, a decline in unemployment in Poland, which has had a beneficial effect on the employment and unemployment rates. The harmonised unemployment rate published by EUROSTAT for March 2019 in Poland stood at 3.7% (for the age group 15-74) compared with 6.4% in the EU (28).<sup>25</sup>
  - Real gross domestic product in local currency unit (“GDP\_realLC”). During the current global economic slow-down, Poland stands out as a European growth champion. With an uninterrupted pace of high growth averaging 4.2% per annum between 1992-2019, Poland is steadily

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<sup>25</sup> EUROPEAN COMMISSION, *Labour market information - Poland*, “<https://ec.europa.eu/eures/main.jsp?catId=2789&countryId=PL&acro=lmi>”

catching up with Western Europe and has become the seventh largest economy in the EU.<sup>26</sup>

- Annual urban population at mid-year (“Urb\_pop”). Currently, 60.3% of the population of Poland is urban (22,831,097 people in 2019). Rate of urbanization: -0.25% annual rate of change (2015-20 est.)<sup>27</sup>

➤ *Step 1: Graphic inspection and descriptive analysis*

Figure II.24 shows the time series of office furniture consumption in Poland (“FurCons”) in the upper left panel. In the lower left panel, the variable is expressed in first differences, while in the upper right panel it is expressed in logarithms. The first differences of the logarithms (growth rates proxy) are shown in the bottom right panel. From a first graphic inspection and looking at the levels, the series is characterized by a positive increasing trend. Especially if we look at the graphs at the bottom (first differences), it is possible to notice that there are five positive peaks, respectively in 2003 (+23%), 2007 (+12%), 2011 (+9%), 2014 (+17%) and 2016 (+12%). There are also three contractions, respectively in 2001 (-9%), 2005 (-7%) and 2010 (-8%), which reflect the effects of the crisis. However, compared to Italy, Germany and France, office furniture consumption in Poland has milder

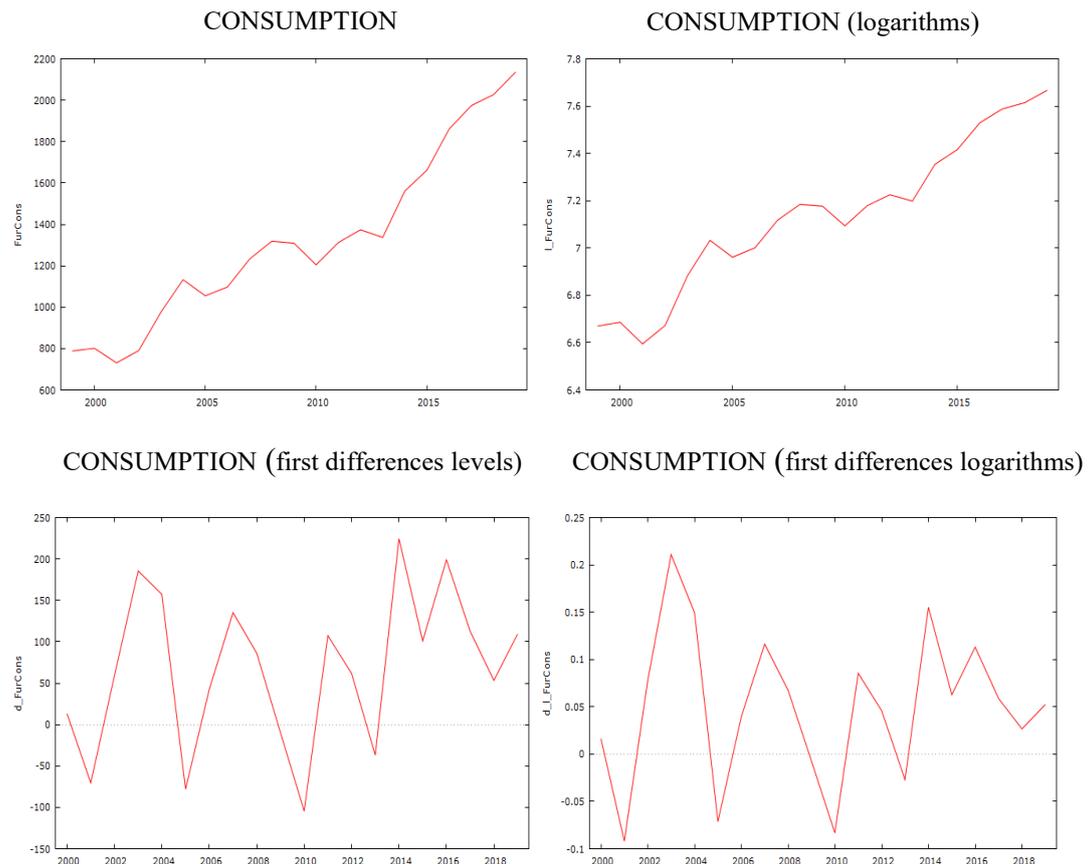
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<sup>26</sup> EURONEWS, *How Poland's 'golden age' of economic growth is going unreported*, “<https://www.euronews.com/2019/06/25/how-poland-s-golden-age-of-economic-growth-is-going-unreported-view>”

<sup>27</sup>WORLDOMETER, *Poland Demographics*, “<https://www.worldometers.info/demographics/poland-demographics/>”

negative peaks in correspondence of the periods of financial crisis. This results in a more stable and positive trend for polish office furniture consumption.

Figure II.24 - Office furniture consumption in Poland. Period: 1999-2019



Figures II.25, 26 and 27 show the trend of the exogenous variables chosen for the forecast. The unemployment rate has an overall decreasing trend, apart from the beginning (till 2002) and the period 2009-2013 in which it increased as a consequence of the crisis. Since 2018, the unemployment rate is stable around 3.8%. Real GDP has an increasing trend. As shown in the graph at the bottom right

(first differences logarithms), the series is always positive and registered a positive peak in 2007. As shown in the upper panels, the annual urban population at mid-year is characterized by a decreasing trend. As shown in the first differences graphs at the bottom, the values are always negative with a decreasing trend at the beginning (till 2003 negative peak) followed by a growth and a decline creating a parable. The trend reversed in 2015 when it started increasing again.

Figure II.25 - Unemployment rate in Poland. Period: 1999-2021

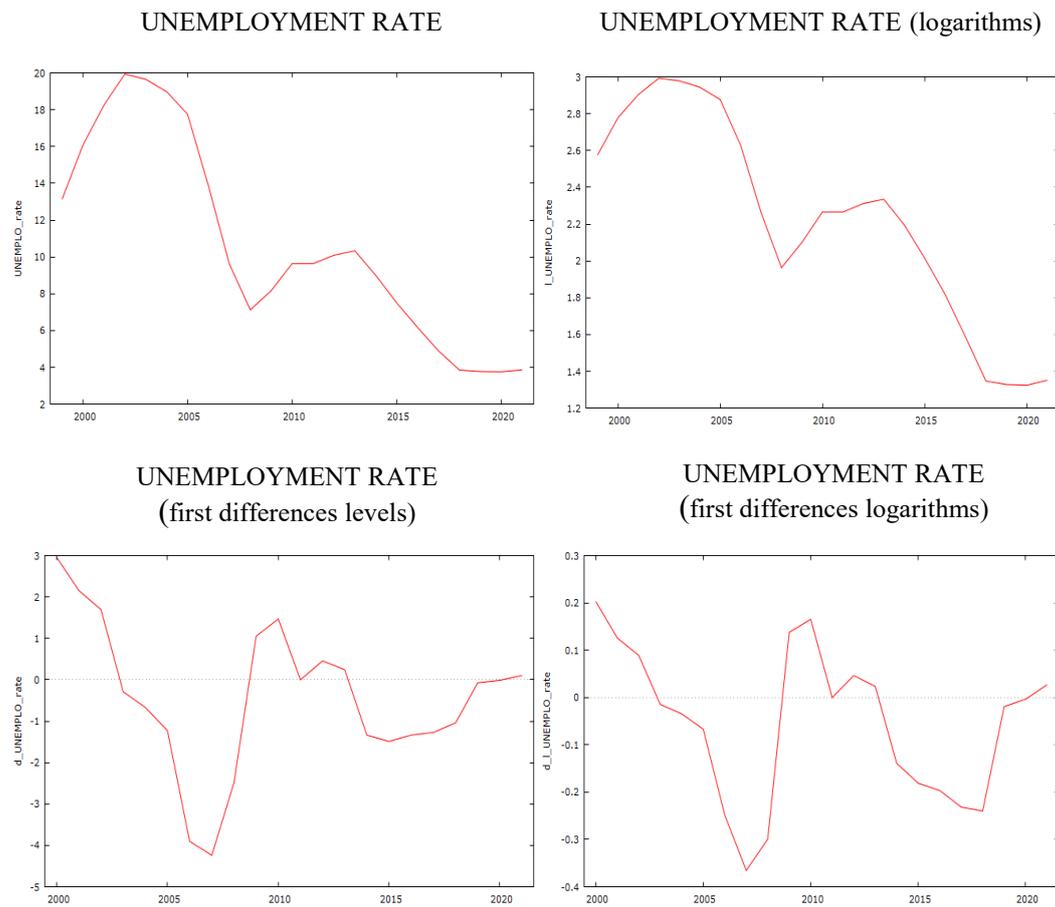


Figure II.26 - Real GDP in Poland. Period: 1999-2021

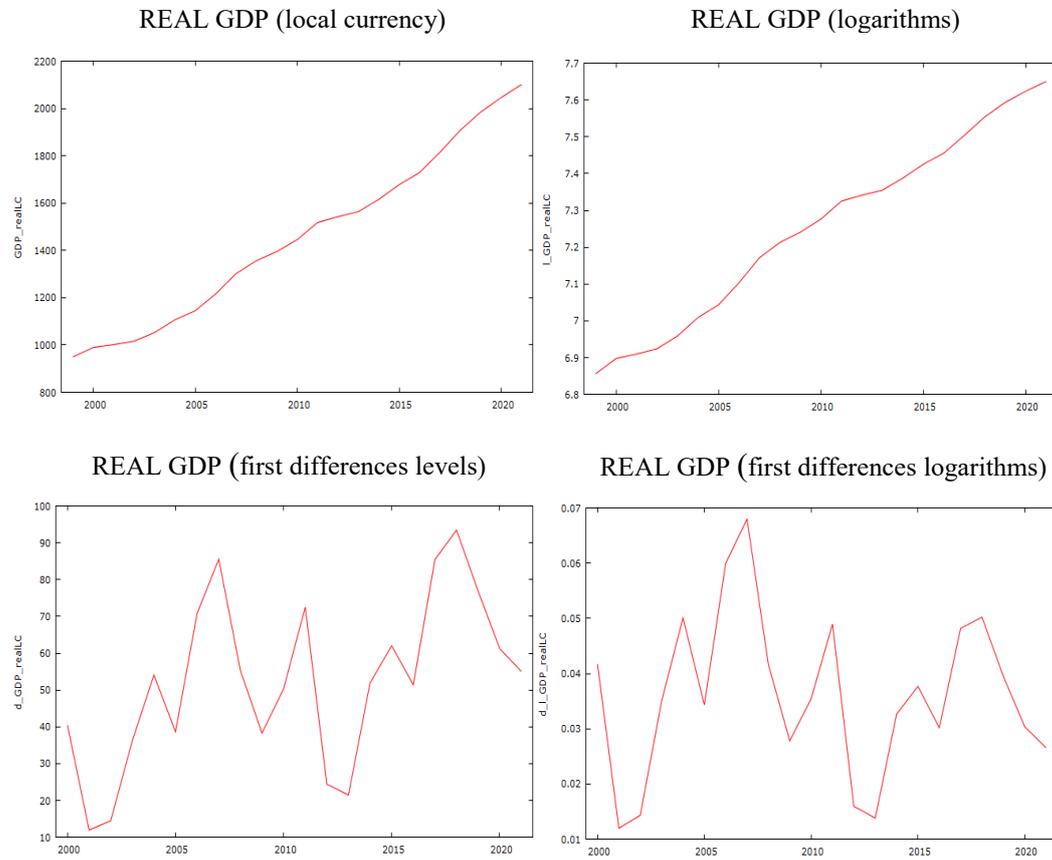
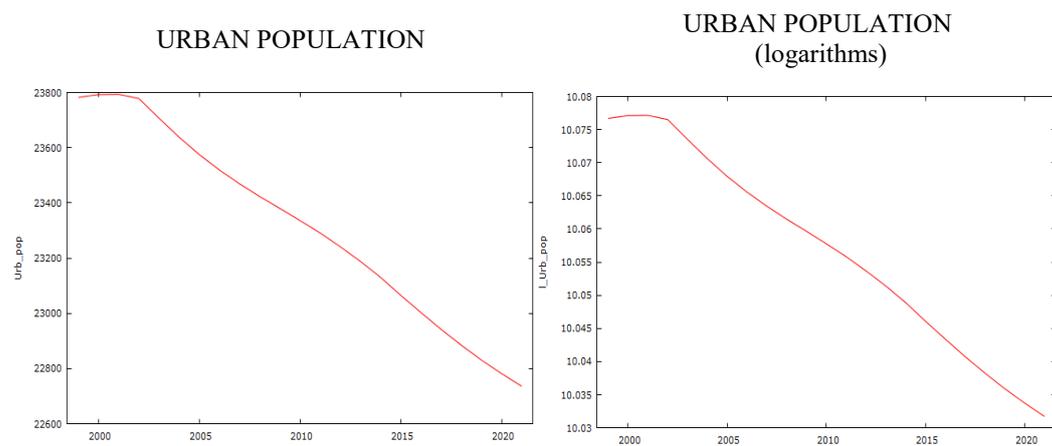
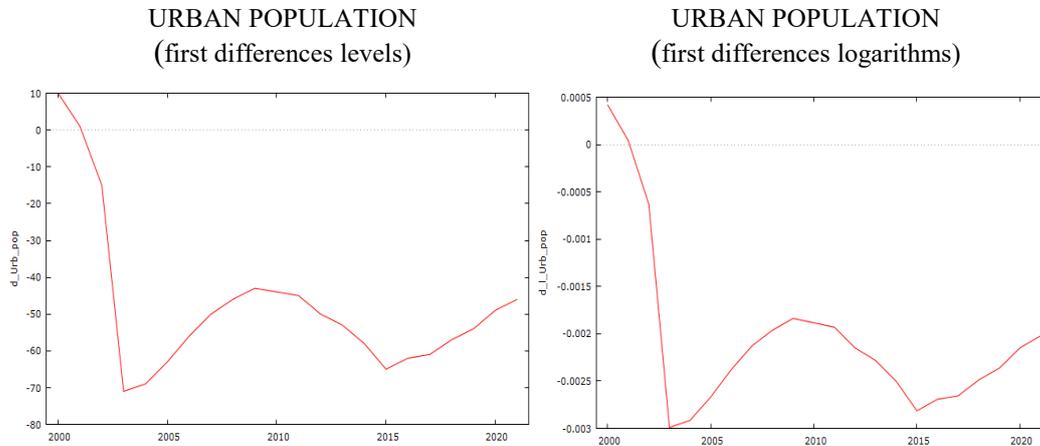


Figure II.27 - Annual Urban Population at Mid-Year in Poland. Period: 1999-2021





➤ *Step 2: Estimation of the VAR via OLS*

The Gretl output is the following:

VAR system, lag order 1  
 OLS estimates, observations 2000-2019 (T = 20)  
 Log-likelihood = 101.05915  
 Determinant of covariance matrix = 8.1966001e-009  
 AIC = -7.7059  
 BIC = -6.5110  
 HQC = -7.4727  
 Portmanteau test: LB(5) = 64.922, df = 36 [0.0022]

Equation 3: l\_FurCons

	coefficient	std. error	t-ratio	p-value	
const	81.8953	26.8336	3.052	0.0100	**
l_FurExp_1	0.429087	0.185195	2.317	0.0390	**
l_FurImp_1	-0.236204	0.0808625	-2.921	0.0128	**
l_FurCons_1	-0.156460	0.255759	-0.6117	0.5521	
UNEMPLO_rate	-0.00880496	0.00719786	-1.223	0.2447	
GDP_reallC	-0.000801255	0.000691400	-1.159	0.2690	
Urb_pop	-0.00312963	0.00107103	-2.922	0.0128	**
time	-0.0780763	0.0432813	-1.804	0.0964	*

Mean dependent var 7.158601 S.D. dependent var 0.310961  
 Sum squared resid 0.039339 S.E. of regression 0.057256  
 R-squared 0.978588 Adjusted R-squared 0.966097  
 F(7, 12) 78.34655 P-value(F) 4.59e-09  
 rho 0.266930 Durbin-Watson 1.463868

F-tests of zero restrictions:

All lags of l\_FurExp F(1, 12) = 5.3682 [0.0390]  
 All lags of l\_FurImp F(1, 12) = 8.5326 [0.0128]  
 All lags of l\_FurCons F(1, 12) = 0.37423 [0.5521]

As shown in the Gretl output for the equation “l\_FurCons”, among the coefficients associated with the lags of the endogenous variables, the ones of exports and imports of office furniture are statistically significant, whereas among the exogenous variables, only the annual urban population at mid-year is highly significant. Both the two deterministic components (the constant and the trend) are statistically significant too.

The R-squared is 97.86%, meaning that the accuracy of the model is high.

Since the p-value for the F-test is 0.00057, the sample data provide sufficient evidence to conclude that the regression model fits the data better than the model with no independent variables.

➤ *Step 3: In-sample and out-of-sample forecast*

As follows the prediction values are expressed in logarithms.

For 95% confidence intervals,  $t(12, 0.025) = 2.179$

	l_FurCons	prediction	std. error	95% interval
2016	7.528830	7.496264	0.044351	7.399633 - 7.592896
2017	7.587588	7.547447	0.049358	7.439904 - 7.654989
2018	7.614211	7.599207	0.050204	7.489823 - 7.708591
2019	7.666683	7.657691	0.051349	7.545812 - 7.769570
2020		7.698224	0.051635	7.585721 - 7.810728
2021		7.724150	0.051661	7.611590 - 7.836710

In the following table logarithms are transformed into local currency, real values.

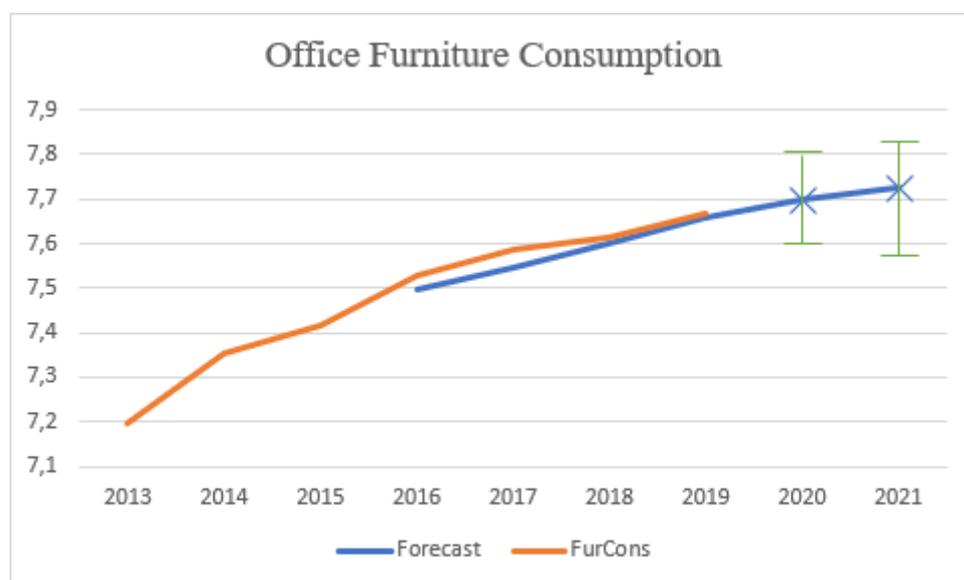
Moreover, the comparison between forecasted and observed office furniture consumption values is shown together with the year on year variation.

Table II.6 - Office furniture consumption in Poland: forecasted values vs observed values

	Forecast (log)	Forecast (real)	% change	FurCons (real) observed	% change
2016	7.4963	1801.3002		1860.9266	
2017	7.5474	1895.8963	5.2515	1973.5466	6.0518
2018	7.5992	1996.6120	5.3123	2026.7955	2.6981
2019	7.6577	2116.8639	6.0228	2135.9851	5.3873
2020	7.6982	2204.4294	4.1366		
2021	7.7241	2262.3288	2.6265		

As a result of the forecast, it is possible to state that in the next two years office furniture consumption in Poland will increase by 4% in 2020 and 2.6% in 2021. Among new European Member countries, Poland is one of the largest markets performing well.<sup>28</sup>

Figure II.28 - Consumption forecast in Poland (in-sample and out-of-sample)



<sup>28</sup> M. AMICO, M. SPINELLI, *The European market for office furniture*, CSIL, Milano, June 2019, p.15

Figure II.29 - Forecast errors for Poland

Forecast evaluation statistics using 4 observations

Mean Error	0.024176
Root Mean Squared Error	0.027285
Mean Absolute Error	0.024176
Mean Percentage Error	0.31898
<b>Mean Absolute Percentage Error</b>	<b>0.31898</b>
Theil's U	0.52862
Bias proportion, UM	0.7851
Regression proportion, UR	0.15519
Disturbance proportion, UD	0.059714

Y	Residuals
2016	-0.0326
2017	-0.0401
2018	-0.0150
2019	-0.0090

### **EUROPEAN UNION (28)**

The variables used for the forecast analysis in the EU (28)<sup>29</sup> are:

- Three endogenous variables for which the forecast is required and available from 2000 to 2019 (“FurCons, FurExp and FurImp”).
- Two exogenous variables that could influence one or more of the three endogenous variables available between 2000 and 2021. In this case, they are:
  - Real total investment in constant euros (“InvT\_real”). Investment in the European Union is up 18% of the European Union’s GDP<sup>30</sup>. The EU is the world’s main provider and the top global destination of foreign investment. Foreign direct investment stocks held in the rest of the world by investors resident in the EU amounted to EUR 8,75 billion at the end

<sup>29</sup> The UK is still considered as a member of the European Union because historical data cover periods prior to December 31, 2019.

<sup>30</sup> EUROPEAN INVESTMENT BANK, *Investment report 2019/2020, accelerating Europe’s transformation*, “[https://www.eib.org/attachments/efs/economic\\_investment\\_report\\_2019\\_en.pdf](https://www.eib.org/attachments/efs/economic_investment_report_2019_en.pdf)”

of 2018. Meanwhile, foreign direct investment stocks held by third country investors in the EU amounted to EUR 7,2 billion at the end of 2018.<sup>31</sup>

- Population, total (“POP\_tot”). The EU has 446 million inhabitants being the world’s third largest population after China and India. Europe’s population is increasing through a combination of natural growth (more people are born each year than die) and net migration (more people settle in the EU than leave it). At the same time, the population of Europe is ageing as life expectancy increases and fewer children are born.<sup>32</sup>

➤ *Step 1: Graphic inspection and descriptive analysis*

Figure II.30 shows the time series of office furniture consumption in the EU (28) (“FurCons”) in the upper left panel. In the lower left panel, the variable is expressed in first differences, while in the upper right panel it is expressed in logarithms. The first differences of the logarithms (growth rates proxy) are shown in the bottom right panel. From a first graphic inspection and looking at the levels, the series is characterized by a decreasing trend with some ups and downs. In general, after a decreasing trend at the beginning (till 2004), the series shows a positive trend till 2008, four years of growth (2005-2008) and then it decreases again as a

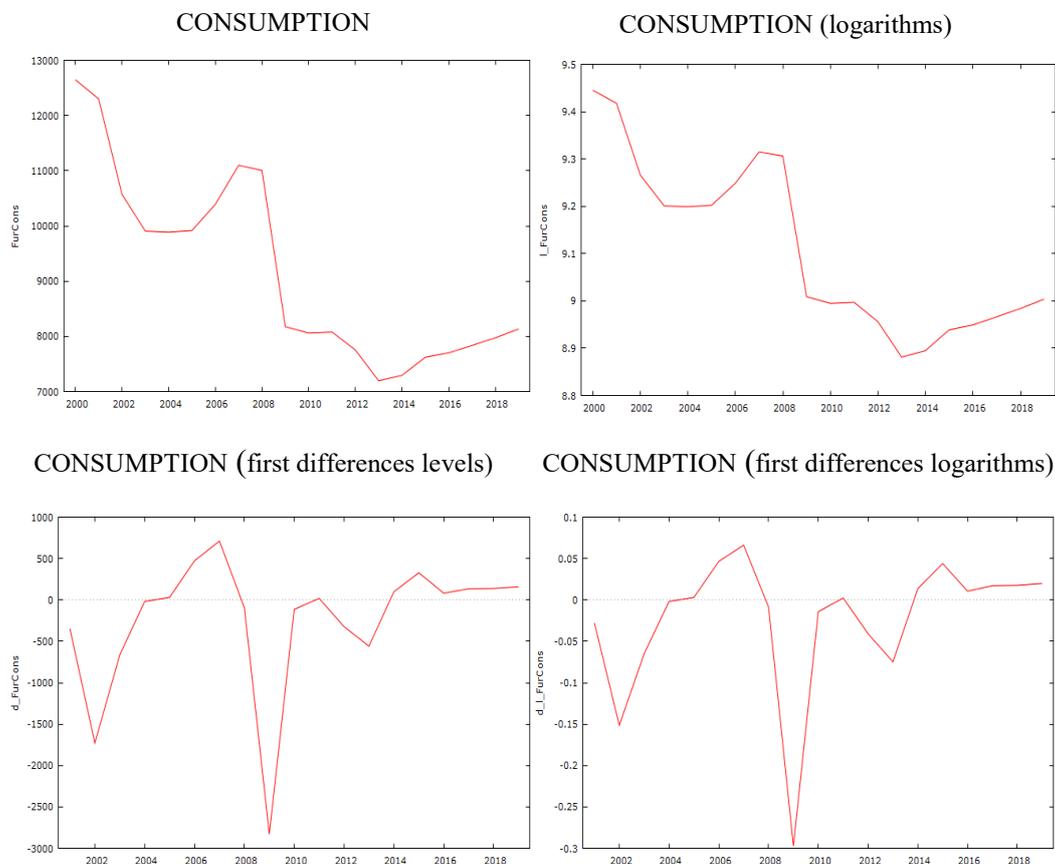
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<sup>31</sup> EUROPEAN COMMISSION, *Investment*, “<https://ec.europa.eu/trade/policy/accessing-markets/investment/>”

<sup>32</sup> EUROPA.EU, *Living in the EU*, “[https://europa.eu/european-union/about-eu/figures/living\\_en](https://europa.eu/european-union/about-eu/figures/living_en)”

consequence of the crisis. In the last years (2014-2019) the series shows an increasing trend. Especially if we look at the graphs at the bottom (first differences), it is possible to notice that there are three negative peaks, respectively in 2002 (-15%), 2009 (-30%) and 2013 (-7.5%), which clearly reflect the effects of the crisis.

Figure II.17 - Office furniture consumption in the EU (28). Period: 2000-2019



Figures II.31, 32 and 33 show the trend of some exogenous variables (the ones chosen for the forecast and the real GDP). Real total investment has an overall positive increasing trend, apart from the period 2008-20013 in which it increased.

In fact, as shown in the graphs with the first differences at the bottom, there was a negative peak in 2009 as a consequence of the financial crisis and a slight decrease also in 2012. Two positive peaks were registered in 2007 and 2015.

Population, total has an increasing trend with slight variations.

Real GDP has an increasing trend apart from the negative peak registered in 2009 as a consequence of the financial crisis. As shown in the first differences graphs at the bottom, a second negative variation was registered in 2012 due to the crisis.

Figure II.31 - Real total investment in the EU (28). Period: 2000-2021

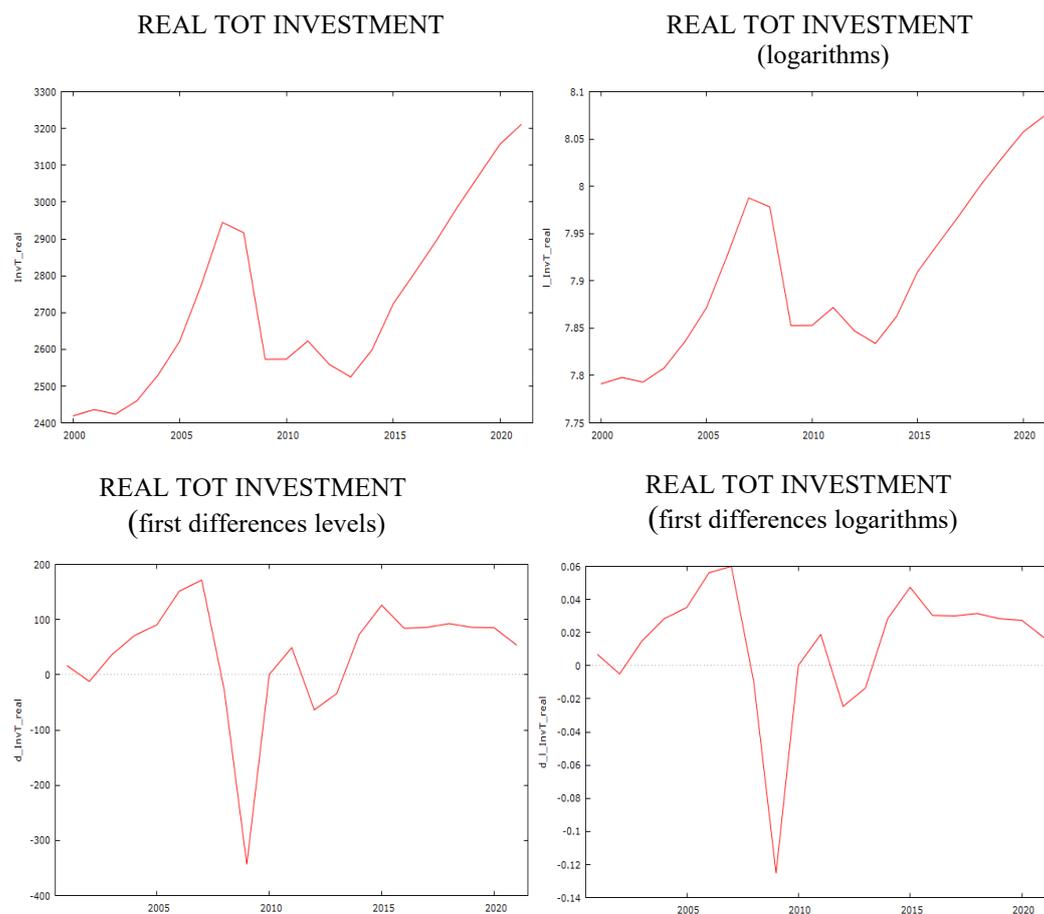


Figure II.182 - Population, total in the EU (28). Period: 2000-2021

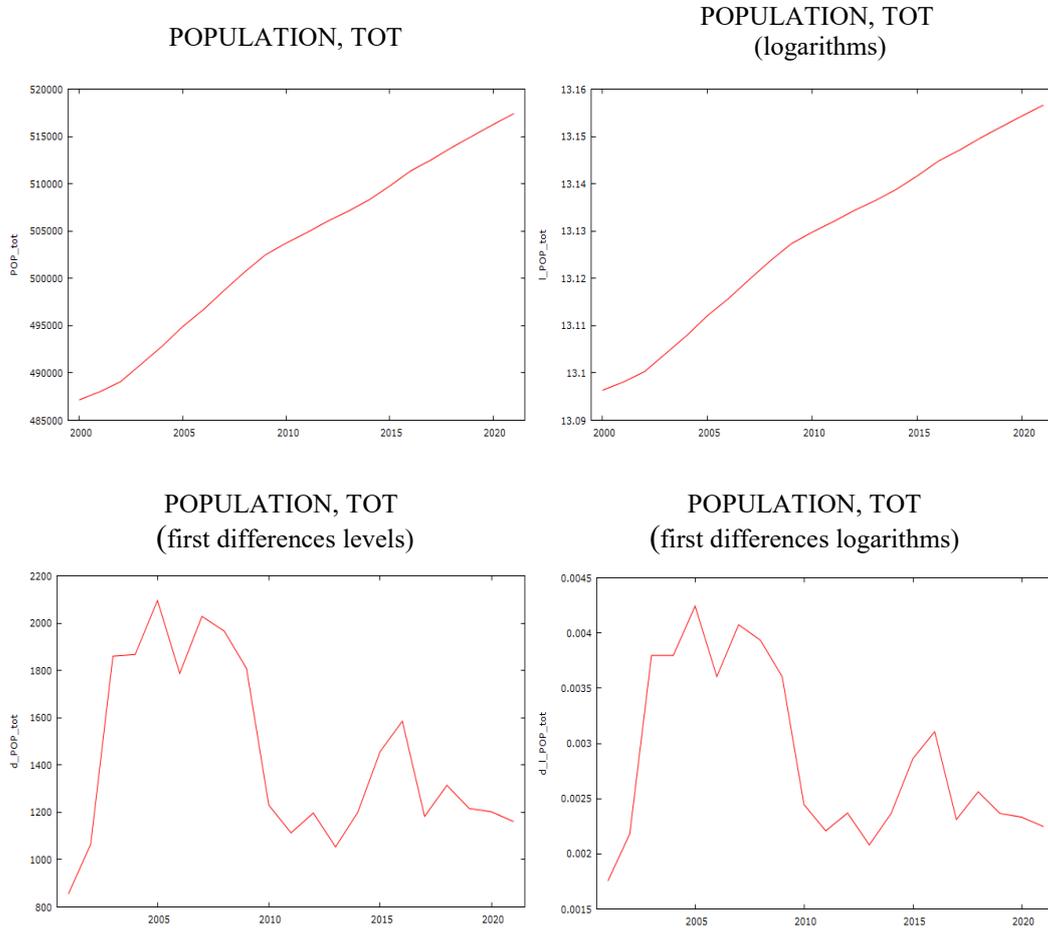
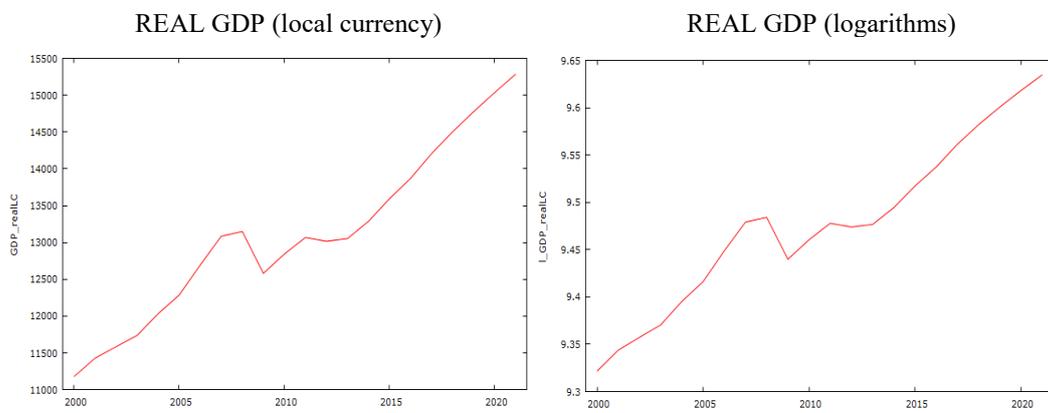
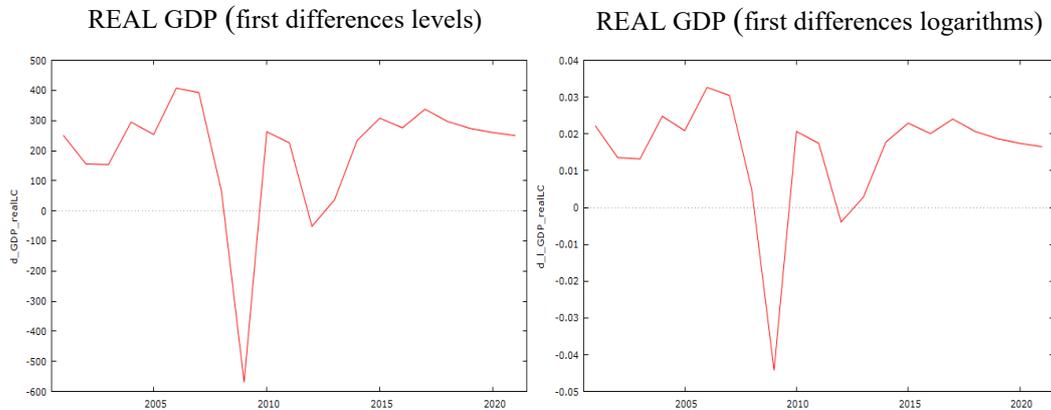


Figure II.33 - Real GDP in the EU (28). Period: 2000-2021





➤ *Step 2: Estimation of the VAR via OLS*

The Gretl output is the following:

```
VAR system, lag order 1
OLS estimates, observations 2001-2019 (T = 19)
Log-likelihood = 144.41288
Determinant of covariance matrix = 5.0200983e-011
AIC = -12.9908
BIC = -11.9470
HQIC = -12.8142
Portmanteau test: LB(4) = 32.0483, df = 27 [0.2303]
```

Equation 3: `l_FurCons`

	coefficient	std. error	t-ratio	p-value	
const	33.2880	7.95231	4.186	0.0013	***
<code>l_FurExp_1</code>	0.0806160	0.292279	0.2758	0.7874	
<code>l_FurImp_1</code>	1.59777	0.689963	2.316	0.0391	**
<code>l_FurCons_1</code>	-1.71482	0.675585	-2.538	0.0260	**
<code>InvT_real</code>	0.000325949	8.68172e-05	3.754	0.0027	***
<code>POP_tot</code>	-4.49347e-05	1.39130e-05	-3.230	0.0072	***
<code>time</code>	-0.00979496	0.0178010	-0.5502	0.5922	

Mean dependent var	9.091042	S.D. dependent var	0.166269
Sum squared resid	0.010844	S.E. of regression	0.030061
R-squared	0.978209	Adjusted R-squared	0.967313
F(6, 12)	89.77921	P-value(F)	2.89e-09
rho	-0.398568	Durbin-Watson	2.538276

F-tests of zero restrictions:

All lags of <code>l_FurExp</code>	F(1, 12) = 0.076076 [0.7874]
All lags of <code>l_FurImp</code>	F(1, 12) = 5.3626 [0.0391]
All lags of <code>l_FurCons</code>	F(1, 12) = 6.4429 [0.0260]

As shown in the Gretl output for the equation “l\_FurCons”, among the coefficients associated with the lags of the endogenous variables, the ones of imports and consumption of office furniture are statistically significant, whereas among the exogenous variables, both of them are highly significant. Among the two deterministic components, the constant is highly significant.

The R-squared is 97.82%, meaning that the accuracy of the model is high.

Since the p-value for the F-test is 0.00036, the sample data provide sufficient evidence to conclude that the regression model fits the data better than the model with no independent variables.

➤ *Step 3: In-sample and out-of-sample forecast*

As follows the prediction values are expressed in logarithms.

For 95% confidence intervals,  $t(12, 0.025) = 2.179$

	l_FurCons	prediction	std. error	95% interval
2016	8.949244	8.962638	0.023890	8.910587 - 9.014690
2017	8.966445	8.967505	0.032729	8.896195 - 9.038815
2018	8.983977	8.990249	0.033313	8.917666 - 9.062832
2019	9.003780	9.015151	0.033325	8.942542 - 9.087760
2020		9.035260	0.033333	8.962633 - 9.107886
2021		9.047585	0.033334	8.974955 - 9.120214

In the following table logarithms are transformed into local currency, real values.

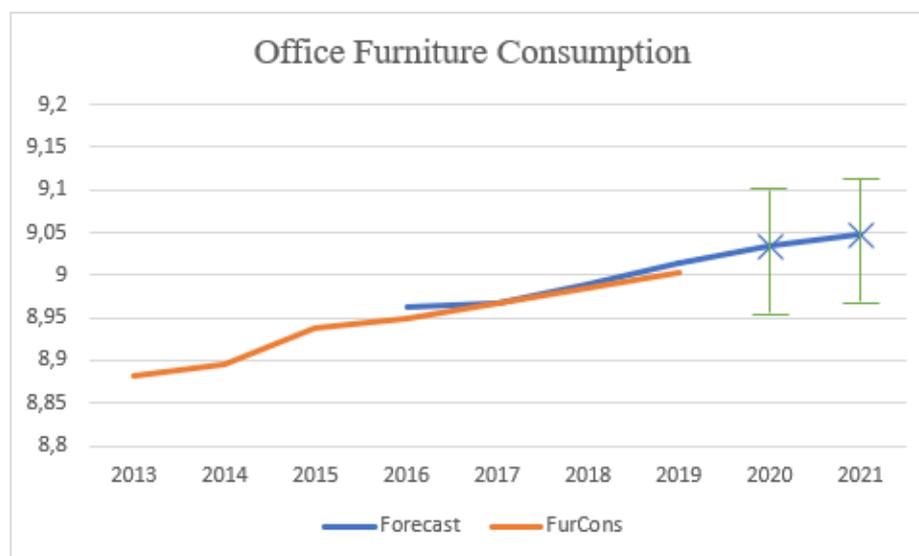
Moreover, the comparison between forecasted and observed office furniture consumption values is shown together with the year on year variation.

Table II.7 - Office furniture consumption in the EU (28): forecasted values vs observed values

	Forecast (log)	Forecast (real)	% change	FurCons (real) observed	% change
2016	8.9626	7805.9223		7702.0681	
2017	8.9675	7844.0064	0.4879	7835.6976	1.7350
2018	8.9902	8024.4547	2.3005	7974.2862	1.7687
2019	9.0152	8226.7885	2.5215	8133.7701	1.9999
2020	9.0353	8393.8955	2.0313		
2021	9.0476	8497.9905	1.2401		

As a result of the forecast, it is possible to state that in the next two years office furniture consumption in the EU (28) will increase by 2% in 2020 and 1.2% in 2021, continuing its positive evolution. The total office furniture consumption in Europe reached EUR 9,061 million in 2019. The growth of +3.5% if compared to 2018 represented the second best performance registered since 2014.<sup>33</sup>

Figure II.34 - Consumption forecast in the EU28 (in-sample and out-of-sample)



<sup>33</sup> M. SPINELLI, M. AMICO, S. PELIZZARI, *The European market for office furniture*, CSIL, Milano, June 2020, p.16

Figure II.35 - Forecast errors for EU28

Forecast evaluation statistics using 4 observations

Mean Error	-0.0080243
Root Mean Squared Error	0.0093429
Mean Absolute Error	0.0080243
Mean Percentage Error	-0.089398
<b>Mean Absolute Percentage Error</b>	<b>0.089398</b>
Theil's U	0.41245
Bias proportion, UM	0.73764
Regression proportion, UR	0.014398
Disturbance proportion, UD	0.24796

Y	Residuals
2016	0.0134
2017	0.0011
2018	0.0063
2019	0.0114

This second chapter has described how to make predictions for sector variables using a VAR approach. After having introduced forecast analysis in a business context, the dataset and the basics of VAR models, the focus was on a statistical model, in line with professional standards, to obtain a two-years forecast for the consumption of Office Furniture in four countries (Italy, Germany, France and Poland) and in Europe (28) by using Gretl. However, the results of the five forecasts require subsequent analysis and discussion because, as said about forecast errors and their cause, there could be unpredictable future events that can invalidate them. In fact, possible future shocks, that are not foreseeable to date, are not included in the dataset and cannot be taken into consideration by the model itself. Among these exceptional events that may affect the trend of office furniture consumption in the future, Covid-19 has a crucial role this year. As a consequence, the next chapter will try to analyse and predict the Covid-19 impact on the European market for office furniture.

### CHAPTER III. QUALITATIVE INSIGHT POST-COVID 19

As shown in the second chapter, companies can rely on research institutes to mathematically predict the values of sector variables over the coming years. Anyway, the final results of forecasting models need to be cross checked with the results of further analysis over the country. It is crucial to collect as many information as possible to be informed over factors that might affect consumption trends because the performed Gretl analysis is based only on the trend of the chosen variables.

This year, in particular, needs an in-depth study in order to try to anticipate the impact of Covid-19 over the European industries. In fact, with almost 28 million confirmed coronavirus cases, more than 905 thousand confirmed deaths and 216 countries, areas or territories involved in the world<sup>34</sup>, this disease has been classified as an unexpected pandemic with three essential characteristics. First of all, it has become a global phenomenon since the virus showed unprecedented magnitude, scope and speed that went around the world in just a few months. This differentiates the recent pandemic from other more or less recent pandemics whose health effects have been localized and limited. Second, the effects were multidimensional as it

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<sup>34</sup> WORLD HEALTH ORGANIZATION, *Coronavirus disease (COVID-19) pandemic*, “<https://www.who.int/emergencies/diseases/novel-coronavirus-2019>”

had negative impacts on both public health and economic activity in most national economies. In addition, policy responses designed to address any negative impact through containment measures have actually caused a downside with consequent damage to the economy. Lastly, the impact on the global economy has been really severe and this is due to the highly interconnected nature with which the Global Value Chains (CGV) involve people, capital, goods and services.<sup>35</sup>

In this case, the office furniture sector is among the most affected ones, not only for the economic losses and the office furniture consumption reduction that will be recorded in the 2020 financial year but also for the more or less radical changes that this situation brought to the observed sector.

This last chapter therefore focuses on the post-Covid 19 analysis starting from the Covid-19 impact on real GDP and unemployment rate in Europe and providing an overview of the current trends and forecasts for 2020 and 2021 for Italy, Germany, France, Poland and EU28 (as in the previous chapter). To conclude, an insight into the major offices' changes and the introduction of new technologies and ways of working will be provided.

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<sup>35</sup> D. BEVERE, *Le catene globali del valore post-virus*, "<https://www.ispionline.it/it/pubblicazione/le-catene-globali-del-valore-post-virus-27269>"

### **3.1 THE IMPACT OF COVID-19 ON REAL GDP AND UNEMPLOYMENT RATE IN EUROPE**

The European Union will be one of the most affected regions by Covid-19, with a forecasted real GDP of about -7% in 2020. Specifically, Italy (-12.8%), France (-12.5%), Germany (-7.8%) and Poland (-4.6%) will face a downturn as well, even if of varying entity.<sup>36</sup> (Table III.1) This is due to the fact that every European country is dealing with a different evolution of the Covid-19 pandemic. So, although the EU Member States are dependent on each other, their reactions to this crisis differ. In fact, their economic recovery will rely on their ability to react by issuing the right policies according to the structure of their economies.<sup>37</sup>

The economic shock caused by the Covid-19 pandemic can also be compared to the global financial crisis of 2008-2009 in order to show which are the elements that these two important events have in common and which are not. Ten years ago, in fact, the outbreak of the crisis originated from finance (starting from the crisis related to subprime mortgages), while today the nature of the shock is real (starting from activities interruptions and lockdowns). Compared to the 2008-2009 financial crisis, the actions put in practice to prevent the spread of Covid-19, such as lockdowns and social distancing, had a negative impact on the labour market and

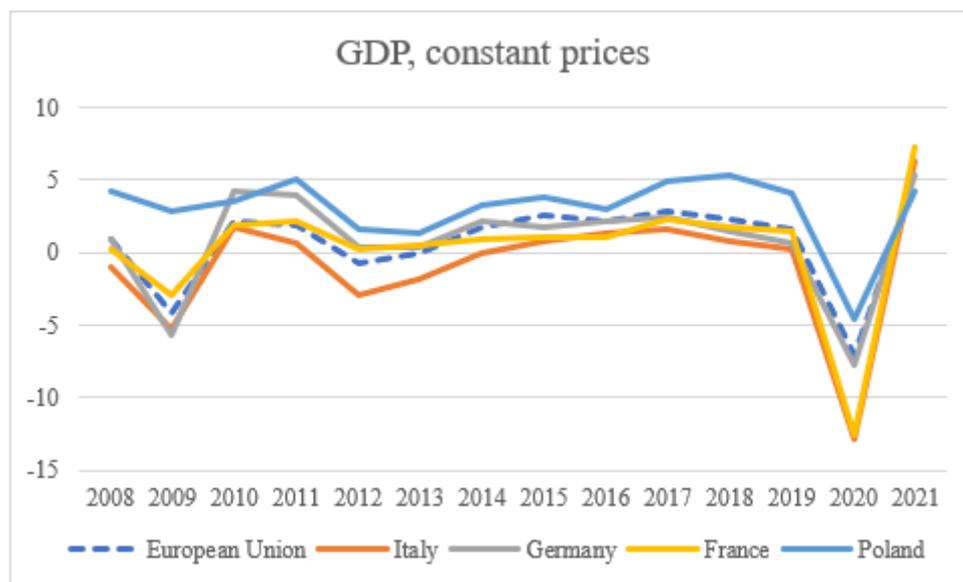
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<sup>36</sup> THE ECONOMIST, Intelligence Unit, *Covid-19 to send almost all G20 countries into a recession*, “<https://www.eiu.com/n/covid-19-to-send-almost-all-g20-countries-into-a-recession/>”

<sup>37</sup> EUROPEAN COMMISSION, *Spring 2020 Economic Forecast: A deep and uneven recession, an uncertain recovery*, “[https://ec.europa.eu/commission/presscorner/detail/en/ip\\_20\\_799](https://ec.europa.eu/commission/presscorner/detail/en/ip_20_799)”

on some sectors such as transport and travel. Given that services represent the largest share of value added in advanced countries and have a higher employment rate than manufacturing, lost sales can hardly be recovered. So, although governments implemented in both cases relevant policies to fight the recession and ensure temporary income support to companies and families, the Covid-19 pandemic will have a more severe impact on EU Member States' GDP than 2008-2009 financial crisis as shown in the figure III.6 and table III.1 below.<sup>38</sup>

Figure III.1 - Real GDP, 2008-2021 updated in 2020 (annual percent change)



SOURCE: IMF, World Economic Outlook Update, June 2020, “<https://www.imf.org>”

EU data updated in April 2020; Italy, Germany, France and Poland data updated in June 2020

<sup>38</sup> WTO, *Trade set to plunge as COVID-19 pandemic upends global economy*, “[86](https://www.wto.org/english/news_e/pres20_e/pr855_e.htm#:~:text=World%20merchandise%20trade%20is%20set,to%20the%20COVID%2D19%20pandemic.&text=Services%20trade%20may%20be%20most,tensions%20and%20slowing%20economic%20growth.”</a>”</p>
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Table III.1 - Real GDP (annual percent change), 2008 financial crisis vs Covid-19 pandemic consequences

	Financial crisis			Pre Covid-19			Post Covid-19		
	2008	2009	2010	2019	2020*	2021*	2019	2020*	2021*
European Union	0.93	-4.21	2.13	1.53	1.64	1.66	1.66	-7.11	4.77
Italy	-0.96	-5.28	1.71	0.01	0.54	0.77	0.30	-12.80	6.30
Germany	0.97	-5.69	4.19	0.54	1.25	1.44	0.60	-7.80	5.40
France	0.26	-2.87	1.95	1.25	1.26	1.34	1.50	-12.50	7.30
Poland	4.25	2.82	3.61	4.03	3.08	2.69	4.10	-4.60	4.20

\*projections; pre Covid-19 data dates back to December 2020; post Covid-19 EU data were updated in April 2020; while post Covid-19 Italy, Germany, France and Poland data were updated in June 2020

SOURCE: IMF, World Economic Outlook Update, June 2020, “<https://www.imf.org>”

In addition, table III.2 below shows the impact of Covid-19 pandemic on the unemployment rate of the countries analysed in the previous chapter through Gretl: Italy, Germany, France and Poland. It is possible to note that this crisis will cause different increase in the unemployment rate of the four countries.

Italy is one of the most affected EU countries with a loss of 500,000 jobs in just three months (March, April, May 2020). Actually, the forecast for the 2020 unemployment rate in Italy is 12.7%. The relevant job loss was also accompanied by a decline in the number of hiring: the number of daily advertisements published online by companies between February and June 2020 collapsed in Italy by 30%. Moreover, a large percentage of the workers who remained employed was actually not at work. If in April 2019 about 5% of people did not work for holidays or sickness, in April 2020 a third of the “employed” workers were on unemployment

benefit (“Cassa Integrazione”), recording an increase of 33% compared to the same month of the previous year. Youth unemployment in Italy increased from 11.2% in February 2020 to 17.6% in May 2020.<sup>39</sup>

France follows Italy with an unemployment rate that is forecast to rise to 10.4%.

Poland, as well, will face an important raise in the unemployment rate in 2020 as it will increase from 3.8% to 9.9%, while Germany is the least affected country with a forecast unemployment rate of 3.9% in 2020. (Table III.2)

*Table III.2 - Unemployment rate in Italy, Germany, France and Poland pre and post Covid-19 Pandemic (percentage of total labour force)*

	Pre Covid-19			Post Covid-19		
	2019	2020*	2021*	2019	2020*	2021*
Italy	10.32	10.28	10.16	9.95	12.70	10.50
Germany	3.21	3.27	3.38	3.16	3.89	3.45
France	8.62	8.43	8.29	8.45	10.40	10.40
Poland	3.77	3.76	3.86	3.28	9.92	8.03

\*projections; pre Covid-19 data dates back to December 2020; post Covid-19 data were updated in April 2020

SOURCE: IMF, “<https://www.imf.org>”

### **3.2 OFFICE FURNITURE SECTOR FORECASTS POST COVID-19**

After having shown that the Coronavirus pandemic caused relevant differences in the EU 2020-2021 projections of some macroeconomic variables, such as real GDP and unemployment rate, it is possible to state that the forecasts implemented with Gretl and reported in the second chapter of this thesis will not be consistent with

<sup>39</sup> ADNKRONOS, *Covid, in Italia persi in tre mesi 500mila posti di lavoro*, “[https://www.adnkronos.com/soldi/economia/2020/07/23/covid-italia-persi-tre-mesi-mila-posti-lavoro\\_DUyZw4BogLLRAQNZNUS1PP.html?refresh\\_ce](https://www.adnkronos.com/soldi/economia/2020/07/23/covid-italia-persi-tre-mesi-mila-posti-lavoro_DUyZw4BogLLRAQNZNUS1PP.html?refresh_ce)”

what is actually going on. This is due to the fact that the 2019-2021 data collected for the forecast analysis date back to December 2019, while the spread of Covid-19 requires a continuous data update in order to consider the impact of the pandemic on the years 2020-2021. For example, EU non-residential construction is expected to fall somewhat more than 12% in 2020<sup>40</sup>, reducing office furniture consumption. So, table III.3 below shows tentative and provisional projections of office furniture consumption in Italy, Germany, France, Poland and the European Union based on the already mentioned updated macroeconomic forecasts issued until June 2020 by international organizations (particularly the International Monetary Fund, European Commission and the Organization for Economic Co-operation and Development) adapted to the specific features and prospects of the office furniture sector.

With its trade fairs cancelled, showrooms shuttered and deliveries of larger items significantly reduced due to social distancing, the office furniture industry in Europe has been particularly badly hit by current restrictions on trade and travel.

The post-Covid 19 forecast for Europe shows an important reduction of office furniture consumption in real terms of -29% in 2020 and a rebound in 2021 of about +1%. Office furniture retailers with a large and highly evolved online presence have been better placed to respond to the crises, launching above all online campaigns.

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<sup>40</sup> M. SPINELLI, M. AMICO, S. PELIZZARI, *The European market for office furniture*, CSIL, Milano, June 2020, p.23

For example, Ikea has refocused on its e-commerce platform and reports an increase in demand for many products, particularly in the home office category.

Table III.3 - Office furniture consumption in Europe (Germany, France, Italy and Poland). 2020-2021 forecasts (percentages changes in real terms)

	2020	2021
<b>Central Europe (DACH)</b>		
Germany	-28%	2%
<b>Western Europe</b>		
France	-36%	3%
<b>Southern Europe</b>		
Italy	-33%	1%
<b>Central-Eastern Europe</b>		
Poland	-24%	3%
<b>EUROPE</b>	<b>-29%</b>	<b>1%</b>

SOURCE: M. SPINELLI, M. AMICO, S. PELIZZARI, The European market for office furniture, CSIL, Milano, June 2020, p.24

Among the four analysed countries, France and Italy will experience the strongest reduction compared to the EU average. In fact, with an estimated reduction of office furniture consumption in real terms of -33% in 2020, Italy is one of the most affected countries by the pandemic. The postponement of the Milan based “Salone del Mobile” to April 2021 has left a gap in the Italian furniture-design companies as it represents a great aggregative moment with almost 400,000 visitors a year and the ability to catalyse the interest and attention of the whole world in the design sector. For this reason, furniture producers must invent new ways and new means to present the new collections to buyers, architects, designers and journalists from

all over the world. They have chosen to create virtual presentations for professional platforms, websites and social media, hoping for the possibility of visiting showrooms or companies in the autumn 2020 or even assuming participation in minor fairs in the second half of the year.<sup>41</sup> However, given the weakness of the Italian market, companies fear to lose access also to the international office furniture market without the participation to the Italian “Salone del Mobile”.

From their side, french companies attribute the decline in office furniture consumption to the lockdown and interruptions in the supply chain. Although an increase in online orders, office furniture consumption in France is expected to decline significantly with a reduction in real terms of -36% in 2020.

As expected, the mood in the German furniture industry deteriorated significantly in April 2020. The German furniture industry has suffered massively from the effects of the corona pandemic. As a result of the temporary closure of furniture stores, manufacturers saw a drastic decline in orders from the retail sector and manufacturers are also pessimistic about business expectations for the next six months. In addition to an office furniture consumption decline in real terms of -28% in 2020, German furniture exports to China suffered the consequences of corona virus with a - at least temporary - significant decline.

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<sup>41</sup> G. MANCINI, *Design, le aziende orfane del Salone mettono online le collezioni 2020*, Il Sole 24 Ore, April 2020, “[https://www.ilsole24ore.com/art/design-aziende-orfane-salone-mettono-online-collezioni-2020-ADU0U8J?refresh\\_ce=1](https://www.ilsole24ore.com/art/design-aziende-orfane-salone-mettono-online-collezioni-2020-ADU0U8J?refresh_ce=1)”

On the other hand, Poland is the country with the most “optimistic” forecast compared to the ones taken into consideration. Office furniture consumption will face a reduction in real terms of -24% in 2020 and a rebound in 2021 of about +3%, even better than the European average.

### **3.3 HOW OFFICES CHANGE WITH THE CORONAVIRUS EMERGENCY**

The exit from the Covid-19 health emergency means also being able to return to work, but it is not so immediate. The unexpected shift caused by the coronavirus in workplace operations may have a lasting impact on workplace design, thinking and use. With the lockdown, started in March 2020, the majority of office-occupying industries have been working from home, while sheltering in place. This resulted in relevant behavioural changes that may have a lasting impact on workplace design and use, while simultaneously altering the demand for commercial office space for the next years. In fact, companies must equip themselves to make work environments safe and adhere to anticontagion protocols.

The situation is constantly changing due to the adoption of emergency solutions, medium term solutions and long term (structural) changes in office and public spaces. The European Agency for Safety and Health at Work (EU-OSHA) published the EU guidance on how to adapt workplaces in order to ensure the health and safety of workers. So, they provided indications for risk assessment and collective security measures despite the restrictions’ differences among the

members of the European Union.<sup>42</sup> The key principle to be followed for the various adaptations is that of maintaining safety distances. Social distancing is the rule around which, depending on the type of office, the company has to manage meetings, work shifts, lunch breaks and so on.

In the last years, offices have increasingly favoured shared workstations, with work tables with 4, 6 or 8 workstations. Today, it is essential to separate the desks, for a greater distance between the operators. Thinking just about the 1.5 meters distance among workers means that half of the workplaces must remain empty. This decreases even more because workplaces can no longer be shared on the same day. As a consequence, recent research and papers published by office manufacturers shows that around six in ten workplaces will be temporarily unusable till the necessary adjustments.<sup>43</sup> Below, the ones that will have a greater impact on the office furniture sector showing the first new sector trends.

- 1) The new offices will have a greater presence of contactless technologies and voice assistants to avoid contact with surfaces. Furthermore, the organization of work shifts, with some remote workers and others in the office, requires dedicated platforms and staggered entrances. Within the office, apps and

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<sup>42</sup> T. MENDUTO, *Rivedere la valutazione dei rischi se i processi lavorativi sono cambiati?*, “<https://www.puntosicuro.it/sicurezza-sul-lavoro-C-1/coronavirus-covid19-C-131/rivedere-la-valutazione-dei-rischi-se-i-processi-lavorativi-sono-cambiati-AR-20054/>”

<sup>43</sup> M. SPINELLI, M. AMICO, S. PELIZZARI, *The European market for office furniture*, CSIL, Milano, June 2020, pag. 92

sensors will monitor the air quality, the health of the employees and the respect of distance and flows (for example, anti-crowd apps). Some companies have already developed their own application internally. The Generali Group, for example, will equip its workers with an app that will allow them to order lunch at their desks and monitor their movements.<sup>44</sup> Another example of technological revolution is the project of the Egyptian architect Moahmed Radwan who won the "Responsible Design" award at the recent DNA Paris Design Awards in 2020. The Qwokntnine are capsules that provide employees with the right amount of space they need to comfortably do their work, while keeping them at a distance from colleagues. The units are accessible via facial recognition to eliminate the need for a door handle and are equipped with ventilators and air purifiers to maintain fresh and healthy air.<sup>45</sup>

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<sup>44</sup> Morning FUTURE, *Coworking, ingressi scaglionati e app anti assembramento: come cambiano gli uffici dopo il Coronavirus*, "<https://www.morningfuture.com/it/article/2020/06/12/come-cambiano-uffici-coronavirus/927/>"

<sup>45</sup> TGC24, *Coronavirus, ecco l'ufficio post-pandemia: dipendenti al lavoro nelle capsule "spaziali"*, "[https://www.tgcom24.mediaset.it/magazine/foto/coronavirus-ecco-lufficio-post-pandemia-dipendenti-al-lavoro-nelle-capsule-spaziali\\_18587144-2020.shtml](https://www.tgcom24.mediaset.it/magazine/foto/coronavirus-ecco-lufficio-post-pandemia-dipendenti-al-lavoro-nelle-capsule-spaziali_18587144-2020.shtml)"

Figure III.2- *Qworkntine*, the office capsules to work in safety after Coronavirus emergency



SOURCE: C. SALZANO, *Qworkntine*, le capsule da ufficio per lavorare in sicurezza post Coronavirus, “<https://design.fanpage.it/qworkntine-le-capsule-da-ufficio-per-lavorare-in-sicurezza-post-coronavirus/>”

2) Workstations will be equipped with moveable partitioning and flexible screens/dividers between workstations, so that each operator has his own space and is safe. Open spaces have to be divided into smaller spaces, too. It is possible to use the classic wooden screens, or the brand-new plexiglass panels, which, thanks to their transparency, do not “close” and maintain the visual depth of the spaces. It is important to keep in mind the acoustics: thanks to the sound-absorbing panels, in fact, it is possible to divide the workstations, for greater safety of the workers, but also to create a more comfortable environment, reducing the reverberation of the open rooms. A fluid work environment allows

employees to quickly re-configure their workspace. So, true mobility is offered via demountable walls, furniture on wheels, mobile writable surfaces, and a well-integrated and distributed electrical and audio-visual infrastructure.

- 3) In the first half of 2020, meetings were held in video-conferences. With the return to the office, meeting rooms will have lower maximum capacity. The number of seats is reduced to allow for more distance between attendees. Meeting rooms that are too small to enable physical distancing will be transformed for single-use activities such as focus work, phone calls or other virtual interactions. Training areas will be reduced in favour of virtual areas.
- 4) Wardrobe furniture, lockers and drawer units will increase in the offices, so that everyone has closed available compartments to store their personal items (jacket, gloves, bag, helmet, water) separated from those of others and from the ones used for working activities.
- 5) Companies will prefer offices equipped with:  
surfaces, furnishings, dividers and accessories that are easily washable, linear, without discontinuity; seats in washable material (such as eco-leather) and waiting sessions in PVC or plastic material so that they can be easily disinfected with an alcohol-based solution.<sup>46</sup>

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<sup>46</sup> FORBES, *Come predisporre gli uffici post Covid-19, dieci consigli pratici*, “<https://forbes.it/2020/06/03/lavoro-in-sicurezza-come-predisporre-gli-uffici-post-covid-19-consigli/>”

- 6) Major change in space and geographical locations is possible. Meaning that companies may decentralize their physical presence and open regional hubs wherever their workers are located, whether that's in the suburbs, mid-sized cities or provinces.

### 3.3.1 The diffusion of remote working

Even if a remote working revolution had been sporadically forecasted for over forty years, it never really happened. Indeed, figures from representative labour force surveys show that until the advent of the Covid-19 crisis, only around one in twenty people employed in the EU27 usually worked from home in 2019, a share that had remained rather constant since 2009. With the Covid-19 outbreak and above all during the lockdown phase in the first semester of 2020, working from home has definitely increased becoming the norm for millions of workers in the EU and around the world.<sup>47</sup> Early estimates from Eurofound (2020) suggest that close to 40% of those currently working in the EU began to telework fulltime as a result of the pandemic.<sup>48</sup> In fact, thanks to new technologies it is possible to perform tasks that until a few years ago were done just from the office: to work, send emails, write projects and reports, participate to meetings and more just through mobile devices.

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<sup>47</sup> S. MILASI, M. BISELLO, J. HURLEY, M. SOSTERO, E. FERNÁNDEZ-MACÍAS, *The potential for teleworking in Europe and the risk of a new digital divide*, "<https://voxeu.org/article/potential-teleworking-europe-and-risk-new-digital-divide>"

<sup>48</sup> EUROPEAN COMMISSION, *Coronavirus pandemic reveals large differences in the prevalence of telework across the EU*, "<https://ec.europa.eu/jrc/en/news/coronavirus-pandemic-reveals-large-differences-prevalence-telework-across-eu>"

In this way workers will save time and money, improve the quality of life, health and personal well-being. In addition, companies rationalize the use of office spaces that become more collaborative and cut costs related to the workers' presence.<sup>49</sup>

On the other side, many workers didn't have a dedicated separate room at home, "co-working" with family members or roommates. Working all the day in a space created for a different use, reflects on a general dissatisfaction for some of the furniture and other tools. The problems start from a key element, the seat, as the vast majority of the new teleworkers use a standard chair with no ergonomic properties. Generally speaking, ergonomic is an issue for teleworkers, together with technological limits, and this include a vast array of aspects: lighting, desk regulation and other posture supports.

For companies operating in the office furniture sector this means that home spaces will change accordingly, providing a "studio" where it is possible to isolate oneself to work, make video calls, study. As a consequence, firms operating in this sector will find themselves dealing directly with individuals, and no more only with companies. B2C office furniture will face a sales increase due to Covid-19 changes; moreover, because many companies have preferred to maintain remote working even after the offices reopening, experimenting a sort of "widespread office": no

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<sup>49</sup> Morning FUTURE, *Coworking, ingressi scaglionati e app anti assembramento: come cambiano gli uffici dopo il Coronavirus*, "<https://www.morningfuture.com/it/article/2020/06/12/come-cambiano-uffici-coronavirus/927/>"

longer a centralized work environment, but a network which includes those who remain in the office, those who operate from home and those who connect from spaces made available by coworking facilities<sup>50</sup>.

This chapter showed how forecasts change with severe unpredictable future events. The latter invalidate the forecast analysis made with Gretl because of the impact over the economy and the macroeconomic variables of the countries taken into consideration. Moreover, given the constantly changing framework conditions, a reliable annual forecast is currently not possible, but a post-Covid 19 scenario has been depicted. Nowadays, forecasts for office furniture consumption in Europe are for a huge reduction in 2020, impacting on all top markets even if with different consequences. A feeble rebound is expected in 2021. Apart from the direct impact of the pandemic over the sector, Covid-19 caused also some important changes to offices' organization, introducing new technologies and ways of working.

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<sup>50</sup> A sort of coworking Airbnb: houses that are normally rented to tourists for short stays are now transformed into offices ready to welcome workers from different companies.

## CONCLUSIONS

The work of this thesis relies on the execution of a forecasting analysis. Nowadays this method is particularly employed to anticipate current market trends by building, with reliable statistics, forecasts of the variables that are relevant for the firms' decision-making processes. The ability to assume a proactive behaviour towards the market in which they operate is a key factor to companies' success but the use of forecasting tools and techniques requires specific knowledge and arrangements; reason why this kind of analysis is usually performed by professional researchers. In this case, the object of study was the office furniture sector in Europe. As shown in the first chapter, it has been continuously growing in the last years and office furniture consumption in Europe registered in 2019 its second-best performance since 2014. Moreover, some European producers are among the best performing companies in the world and some EU countries such as Germany, Italy and Poland are by far the largest office furniture and seating European exporters.

Starting from the creation of a dataset, the achieved objective of this analysis was obtaining a two-years forecast for the consumption of office furniture in Italy, Germany, France, Poland and European Union (28). After a first step characterised by a graphic inspection and descriptive analysis, the Vector Autoregressive model was estimated via OLS in Gretl providing an in-sample and out-of-sample forecast. Each of the five analysis gave a different office furniture consumption growth for

the years 2020-2021 according to the significant structural differences of these economies and availability of data. However, predicting the future values of a variable is subject to the presence of errors. Some of them can be identified and corrected reducing their impact on the uncertainty of the forecast itself; others are unknown and unpredictable. The spread of Covid-19 is among the latter and it invalidates the performed forecasts. Beyond the negative effect that the pandemic produced over some sectors, this emergency caused also a negative impact on some macroeconomic variables, such as real GDP and unemployment rate, that is more severe than the one of the 2008 financial crisis. For these reasons, the post-Covid 19 forecasts for Italy, Germany, France, Poland and Europe show important reductions of office furniture consumption in 2020 and slight rebounds in 2021. In particular, the Covid-19 containment measures (lockdown and social distancing) brought radical changes to the observed sector as people started working from home and public and private workplaces had to be adapted to anticontagion protocols.

In conclusion, it is possible to mathematically predict the values of sector variables over the coming years but the forecast is based on the information that are available today. So, every quantitative analysis needs to be cross checked with the results of further qualitative analysis over the country and the sector of study.

Only collecting as many information as possible, we will be informed over factors that might affect consumption trends in the future.

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