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Analysing Impact of Economic Crises on Sector Profits with a New Approach

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Abstract

The manufacturing sector has been regarded as a key factor in the history of economic development and growth. However, economic fluctuations affect manufacturing seriously. This study examines the impact of the 2008 global economic crisis on Turkish manufacturing sector profitability. This paper uses micro-econometric difference in differences methods in conjunction with the macroeconomic forecasting method to investigate how profit levels in the Turkish manufacturing industry are affected by the crisis. The results indicate that the profit levels changed significantly after the crisis with a one-year lag and actual profits exceeded the estimated profits in the later years. Economic impacts of crises have long been investigated; however, this paper differs from the literature in using a new analytical framework for the issue. The suggested method can be expanded to other areas, which can spark new future studies.

Keywords: forecasting, difference in differences, 2008 economic crisis, manufacturing

JEL Codes: C53, C21, G01, L60

1. Introduction

A considerable body of literature has evolved around the theme of comparing the economic problems during the COVID-19 pandemic period with the effects of the 2008 crisis. Since the 2008 crisis was the biggest economic crisis that the world has experienced in the recent era, researchers have tried to explain the economic impact of the pandemic period by comparing it with said crisis. For this reason, studies on the 2008 crisis and its effects have been re-emphasised in recent years.

Studies that analyse the effects of crises, and even seek answers to how the economic outlook would have progressed if the crises had not occurred, are as important as those that examine crises historically or qualitatively (it is always debatable which is more important). The relevant literature shows that economic effects of the pandemic still continue (Choi et al., 2022; Das et al., 2022; United Nations, 2022) and affect economies at both micro and macro levels. For this reason, it may not be possible to measure the damage to the economies from beginning to end, or it may not be possible to get the full answer to how economic activity would have progressed if there was no pandemic. Answering such a normative question might be helpful to understanding the effects of any crisis and deducing a better way to navigate through crises. Lessons learned from former crises in terms of the expansion path of crises to the real economy can be valuable in current crises such as the Ukraine-Russia war and high inflation levels all around the world due to the prolonged effects of the pandemic. In this context, this study examines the 2008 crisis, which is considered to be the biggest economic crisis before the pandemic, and also seeks an answer to what the economic performance would have been like if the 2008 crisis had not occurred. With this evaluation, this paper will be able to answer whether the Turkish manufacturing sector has recovered from the 2008 crisis and, if it has, how long the recovery period was. While answering the question, this study also proposes a new method to the literature. The proposed method allows quantification of the economic impact of the pandemic across different time periods. Additionally, this method can be used to assess the effects of significant global events, such as the European debt crisis, Brexit, the Ukraine-Russia war, and high levels of inflation, on economies, even in the absence of a control group. This method provides means of evaluating the efficacy of policy interventions aimed at mitigating such impacts.

This paper focuses on the impact of the 2008 economic crisis on profitability of the Turkish manufacturing sector. The main reason for analysing the manufacturing sector in the study is that the manufacturing sector is one of the leading sectors that make a major contribution to the economic growth and development in developing economies such as Turkey.

In recent years, the manufacturing industry has undergone many structural innovations and changes, and it has a very important place in the sustainable growth and development of countries. For example, the manufacturing industry accounts for about a quarter of the GDP and 20 percent of employment in the European Union (Behun et al., 2018). In the USA, between 1960 and 2010, although the share of the manufacturing industry in employment decreased over the years, its contribution to real GDP remained at the same level, indicating important efficiency gains (Baily and Bosworth, 2014). In developing economies, there have been fundamental changes in the last two decades and the speed of industrialization and the importance of manufacturing industry have decreased compared to previous periods defined as pre-mature deindustrialization (Eichengreen and Gupta, 2009; Rodrik, 2016). On the other hand, Haraguchi et al. (2017) showed that there is no evidence indicating that the share of the manufacturing

industry in GDP has decreased significantly. However, the existing body of research generally shows that economic crises reduce production levels (Chalikias, 2017), investments (Martinez et al., 2019; Silva et al., 2022) and employment (Gennard, 2009) and cause deterioration of the sector in many other parameters. The 2008 crisis, which started in the US mortgage and financial sector, then turned into an economic crisis by affecting the entire economy and spread to the rest of the world, has also deeply affected the manufacturing industries of developed and developing economies.

The primary objective of this paper is to investigate the recovery of the Turkish manufacturing sector following the 2008 financial crisis. Specifically, we aim to address the following research questions: (1) To what extent has the Turkish manufacturing sector recovered from the 2008 crisis, and how rapid has this recovery been? (2) Can the 2008 crisis be characterized as an economic crisis with real sector effects, rather than simply a financial crisis? (3) If there are any discernible effects on the manufacturing sector, does the magnitude of these effects vary according to sector profitability shares?

This paper is divided into five sections. The following section gives a brief overview of the 2008 economic crisis, distinction between financial and economic crisis, and presents related literature. Section 3 begins by laying out the theoretical dimensions and introducing data. Section 4 presents the research findings. Section 5 deals with a discussion of the findings, significance, and limitations of the current study, and concludes.

2. Literature Review

The 2008 economic crisis, also referred to as the Great Recession, has been the subject of many studies in recent years. A considerable amount of related literature has tried to determine not only the foundations of the crisis from the microeconomic and macroeconomic perspectives but are aimed to observe its consequences. However, it is seen that the existing body of research has mostly identified the 2008 crisis as a financial or economic crisis; however, these terms refer to different types of crises.

The existing literature mainly attributes financial crises to financial institutions such as banks (Park and Shin, 2020; Chen et al., 2021), stock markets (Dumontaux and Pop, 2013) and therefore examines financial crises using monetarist concepts (Taylor, 2009; Machaj, 2016). Kindleberger (2008) and Schwartz (1987) argue that banking panic has been the biggest reason for the emergence of financial crises. Krugman (1999) stated that banking system problems are among the main reasons underlying financial crises. Mishkin (1992) argued that a financial crisis ensues from the deterioration in one or more of five financial conditions, namely increases in interest rates, declines in stock markets, increases in uncertainty, bank panic, and unanticipated declines in the aggregate price level. Radelet and Sachs (1998) grouped financial crises into five categories examining the previous literature on financial crises. These are macroeconomic

policy-induced crisis, financial panic, bubble collapse, moral hazard crisis, and disorderly workout/debt overhang. In contrast, the International Monetary Fund (IMF, 1998) classified financial crises into four main groups: currency crisis, banking crisis, systemic financial crisis, and foreign debt crisis.

Real sector crises, on the other hand, can be defined as disruptions in goods and services and/or labour markets. Crises in goods and services markets can be attributed mainly to inflation pressure (Kibritcioglu, 2002). However, it is not possible to link inflation to a single cause. Inflation may be caused either by an increase in total demand, by an excessive decline in the total supply or by political reasons (Kibritcioglu, 2002). Alternatively, the inflationary pressure may have been caused by an excessive increase in production costs due to an input price boost. In such case, the industrial sector may experience serious contraction, layoffs may start, and as a result, the output level may fall, and the crisis may spread further. The oil and food crisis can be given as an example for this definition.

The studies presented thus far provide evidence that financial crises and economic crises are different concepts. While financial instruments such as money, foreign exchange and banking cause financial crises, fluctuations in goods, services and labour markets cause real sector crises. However, what can start as a financial crisis can spread to the real sector and the effects of the crisis may be observed in households and firms, i.e., in the whole economic system. In such case, the financial crisis is said to evolve into an economic crisis. Within this context, the 2008 crisis can be classified as an economic crisis. As is well known, the 2008 crisis was caused by deterioration of the US mortgage sector. Due to loans which were not paid in time by house owners, a mortgage crisis transpired, and it expanded towards financial institutions and affected the real sector. More precisely, the housing market (especially the subprime/secondary market) was directly affected by the decline in housing prices, rise in delinquencies and foreclosures and the lack of low-interest loans from banks. After 2007, banks such as IKB, BNP Paribas, UBS, Merrill Lynch and Citigroup, which had a considerable share in the mortgage market, were directly affected by this situation. Some of these banks had experienced funding problems and some of them had also disclosed losses. This panic spread rapidly to other financial institutions (Claessens et al., 2010).

Various countries have used various measures to respond to the 2008 crisis. According to the OECD Report (2009), the USA took various measures to minimize the impacts of the crisis. Similarly, the UK also used all available instruments in the face of the crisis. Furthermore, it was also observed that almost all the countries covered by the report either transferred capital to banks and/or guaranteed or bought their debts. It may also be seen that Turkey and Czechia preferred not to use any selected instruments from mid-2008 to 2009. Based on the OECD Report (2009), Table 1 presents countries' precautions against the crisis.

Table 1: Crisis precautions of selected countries

	Increase deposit insurance	Guarantee or buy bank debt	Inject capital	Nationalise	Fund commercial papers	Fund asset-backed securities	Ban or restrict short selling
United States	✓	✓	✓	✓	✓	✓	✓
Germany	✓	✓	✓				✓
France	✓	✓	✓				✓
Italy	✓		✓				✓
United Kingdom	✓	✓	✓	✓	✓	✓	✓
Canada		✓			✓	✓	✓
Austria	✓	✓	✓				✓
Belgium	✓	✓	✓				✓
Czechia							
Greece	✓	✓	✓				
Hungary	✓	✓	✓				
Iceland	✓		✓	✓			✓
Ireland	✓	✓	✓	✓			
Korea		✓					
Spain	✓	✓				✓	✓
Turkey							
Mexico		✓					
Japan		✓	✓		✓	✓	✓

Source: OECD (2009)

Despite these precautions and packages, the 2008 global economic crisis had several microeconomic and macroeconomic results. For instance, almost all countries' growth trends turned negative, and the unemployment levels increased significantly in 2008–2009. Moreover, a sharp decline was observed after 2008 in total and manufacturing production values.

Differently from existing studies, which mainly aim to highlight the key points of the 2008 crisis, this study aims to contribute to this growing literature by providing a new perspective

on the issue. This new perspective aims to better understand the microeconomic effects of macroeconomic crises. For this aim, the effects of the crisis on the profitability of firms are measured using DID and forecasting analysis. Combining these two methods is the first in the literature and one of the most important contributions of this paper.

The forecasting technique is employed by many studies in the existing literature to identify not only the effects of the 2008 crisis but also other economic crises and disruptions such as the COVID-19 pandemic, the European debt crisis and Brexit. In the relevant literature that analyses COVID-19 pandemic using the forecasting method, studies have tried to estimate the effects of the pandemic on various sectors (Suanpang et al., 2021; Zhang et. al. 2021; Vena-Oya et al., 2022) and the poverty it creates (Parolin and Wimer, 2020), and aimed to measure macroeconomic parameters such as growth, investment, and employment (Foroni et al., 2022). Similarly, there are important studies that analyse the effects of the European debt crisis (Liu et al., 2021) and try to predict the direction the UK economy if there was no Brexit (Bento and Duarte, 2020).

Using the forecasting technique, researchers have been able to analyse the 2008 crisis as well as other economic crises and turmoils. Chatzis et al. (2018), for example, tried to predict stock market crises by analysing a 20-year period, including the 2008 economic crisis years, and showed that a very high probability of reoccurrence of a crisis in very near future. Junttila and Vataja (2018), on the other hand, used policy uncertainty data for the UK and the Eurozone for 1997–2016 and found a significant relationship between policy uncertainty and market variables. It is also stated that policy uncertainty is an instrument that should be followed in order to predict future crises. Chinese manufacturers were analysed by Hu (2012) and a decreasing trend was reported in the manufacturing industry growth due to the 2008 crisis.

3. Data and Methodology

3.1 Data

Data covering the period 2006–2014 obtained from TURKSTAT (Turkish Statistical Institute) and EIS (Entrepreneur Information System) are used in this study to examine the effects of the 2008 economic crisis on the Turkish manufacturing industry. Information regarding the number of enterprises, persons employed, paid employees, hours work by employees, wages and salaries, total purchases of goods and services, turnover, production value and value-added at factor cost were obtained from TURKSTAT Industry and Service Statistics. Information regarding net profit, exports, domestic sales, and net foreign exchange profit/loss were taken from the EIS. All these data have a two-digit structure according to NACE Rev. 2 classification. This classification organizes the manufacturing industry into 24 sub-sectors. Table 2 offers a description of the variables used in the model.

Table 2: Description of variables

Variables	Detail	Source
Profit	Actual net profit levels in the given year	EIS
Value added	Natural logarithm of value added at factor costs	TURKSTAT
Export	Natural logarithm of export value	EIS
Number of employees	Natural logarithm of number of paid employees	TURKSTAT
Wages	Natural logarithm of wages and salaries	TURKSTAT
Total purchases	Natural logarithm of total purchases of goods and services	TURKSTAT
Turnover	Natural logarithm of turnover	TURKSTAT
Domestic sales	Natural logarithm of domestic sales	EIS
Net foreign exchange profits	Actual values of net foreign exchange profit / loss	EIS
Number of enterprises	Natural logarithm of the number of enterprises (exogenous)	TURKSTAT
Number of persons employed	Natural logarithm of all persons employed (exogenous)	TURKSTAT
Number of hours worked	Natural logarithm of the number of hours worked by employees (exogenous)	TURKSTAT
Production value	Natural logarithm of production value (exogenous)	TURKSTAT

Profit in Table 2 was selected as a dependent variable while others as the independent variables for the forecasting analysis. Furthermore, natural logarithmic values of the number of enterprises, number of persons employed, number of hours work by employees, production value and years were used as exogenous variables.

3.2 Method

To analyse the effects of the crisis on the Turkish manufacturing industry, the difference in differences methodology (DID) was employed and profit values were selected as the dependent variable. Since profitability tends to decline in periods of recession, depression or crises in economies, profit levels can be used as an important indicator in terms of determining the

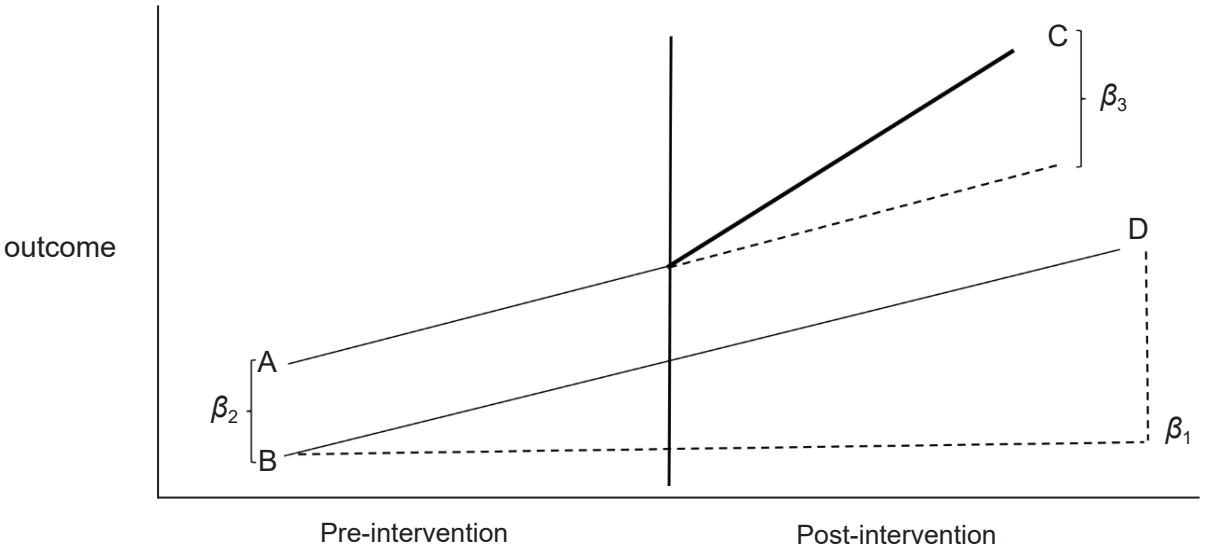
effects of such economic events. It is also possible to use several other indicators such as liquidity or indebtedness; however, this study uses profitability mainly to focus on microeconomic foundations of macroeconomic events and for data availability reasons.

The DID setup requires two different groups to be observed over two different periods, namely treatment and control groups. The control group should not be subject to any policy changes or, in this case, any shocks in either period. The treatment group, on the other hand, should not be subject to a shock in the first period but is in the second. The DID methodology, therefore, allows us to estimate the differences among times and groups due to the group-level shock. The basic setting for DID is as follows:

$$Y = \beta_0 + \beta_1 \times [time] + \beta_2 \times [intervention] + \beta_3 \times [time \times intervention] + e \quad (1)$$

Where Y is the outcome variable (profit). β_0, β_1, β_2 and β_3 represent baseline average (B), time trend in the control group. (D−B) is the difference between the two groups before an intervention (pre-shock) (A−B) and difference in changes over time (C−A) – (D−B), respectively. Figure 1 shows the implementation of the DID technique.

Figure 1: Illustration of DID setup



Source: Columbia University Mailman School of Public Health

This study treats the 2008 economic crisis as a group-level shock and, therefore, aims to analyse the effects of such a shock on manufacturing industry profits. However, since an economic crisis by definition affects the economy as a whole, the control group for this study is

missing. It is possible to argue that all companies and sectors are affected by crises to different extents. However, it is nearly impossible to find a specific sector which is not at all affected by a large-scale economic crisis. Therefore, in order to forge the control group for the DID estimation, this study employs a forecasting methodology. In this scenario, a forecast of the profit levels in the Turkish manufacturing industry was estimated as if there was no economic crisis in 2008. The existence of the actual and estimated profits for all years and sub-sectors also allowed us to predict how the profitability levels would change in the Turkish manufacturing sector if the 2008 crisis did not exist.

The random effects GLS estimation, which forms the basis of forecasting analysis, can be written as follows.

$$y_{it} = \beta' X_{it} + a_i + \lambda_t + \mu_{it} \tag{2}$$

Where λ_t is the unobservable time effect and μ_{it} is the remainder stochastic disturbance term. While for the random case,

$$a_i \sim i.i.d\left(0,\sigma_a^2\right) and\ \lambda_t\ i.i.d\left(0,\sigma_a^2\right) \tag{3}$$

X_{it} is independent of α_i, λ_t and μ_{it} and they are independent of each other.

Thus, $Ea_i = E\lambda_t = E\mu_{it} = 0$

$$Ea_i\lambda_t = Ea_i\mu_{it} = E\lambda_t\mu_{it} = 0$$

$$Ea_iaj = \sigma_a^2 \quad if\ i = j\ or\ 0\ otherwise,$$

$$E\lambda_t\lambda_s = \sigma_\lambda^2 \quad if\ t = s\ or\ 0\ otherwise,$$

$$E\mu_{it}\mu_{js} = \sigma \quad if\ i = j,\ \ t = s\ or\ 0\ otherwise,$$

$$\text{Variance } y_{it} = \sigma_\alpha^2 + \sigma_\lambda^2 + \sigma_\mu^2 \tag{4}$$

In the random effects setting, changes to units or units and time are included in the model as a component of the error term. The reason is to prevent the loss of degrees of freedom in fixed-acting models. Furthermore, it also considers the differences in cross sections, units, and time not only in sample but also out of sample (Gujarati, 2003).

The OLS estimator is BLUE in the fixed effects model but not in the random effects model. In the random effects model, the OLS estimator is consistent and unbiased, but not efficient. In order to solve this problem, Baltagi (2008) used the GLS estimator and showed that it is BLUE. For this reason, this study employs a random effects GLS estimation.

$$\hat{\beta}_{GLS} = \left[\frac{1}{T}\sum_{i=1}^{N} X_i' Q X_i + \varphi + \sum_{i=1}^{N}\left(\bar{X}_i - \bar{X}\right)\left(\bar{X}_i - \bar{X}\right)'\right]^{-1}\left[\frac{1}{T}\sum_{i=1}^{N} X_i' Q y_i + \varphi + \sum_{i=1}^{N}\left(\bar{X}_i - \bar{X}\right)\left(\bar{y}_i - \bar{y}\right)'\right]$$

$$= \Delta\hat{\beta}_b + (I_K - \Delta)\hat{\beta}_{CV}$$

$$= \hat{\mu}_{GLS} = \bar{y} - \hat{\beta}'_{GLS}\,\bar{X}$$

where:

$$\Delta = \varphi T\left[\sum_{i=1}^{N} X_i' Q X_i + \varphi T + \sum_{i=1}^{N}\left(\bar{X}_i - \bar{X}\right)\left(\bar{X}_i - \bar{X}\right)'\right]^{-1} \times \left[\sum_{i=1}^{N}\left(\bar{X}_i - \bar{X}\right)\left(\bar{X}_i - \bar{X}\right)'\right]$$

$$\hat{\beta}_b = \left[\sum_{i=1}^{N}\left(\bar{X}_i - \bar{X}\right)\left(\bar{X}_i - \bar{X}\right)'\right]^{-1}\left[\sum_{i=1}^{N}\left(\bar{X}_i - \bar{X}\right)\left(\bar{y}_i - \bar{y}\right)\right],$$

$$\varphi = \frac{\sigma_\mu^2}{\sigma_\mu^2 + T\sigma_\mu^2} \tag{6}$$

In this study, the random effects GLS estimator is basically run to begin the forecasting analysis. All the analyses were made using Stata 14 software. In addition to this, forecasting analysis after the GLS estimator is based on Stata commands and algorithms such as forecast, forecast predict, and forecast solve.

4. Results

In this study, the profitability of the Turkish manufacturing industry after the 2008 crisis is analysed at the two-digit sub-sectoral level. Table 3 presents the descriptive statistics of the dependent and independent variables.

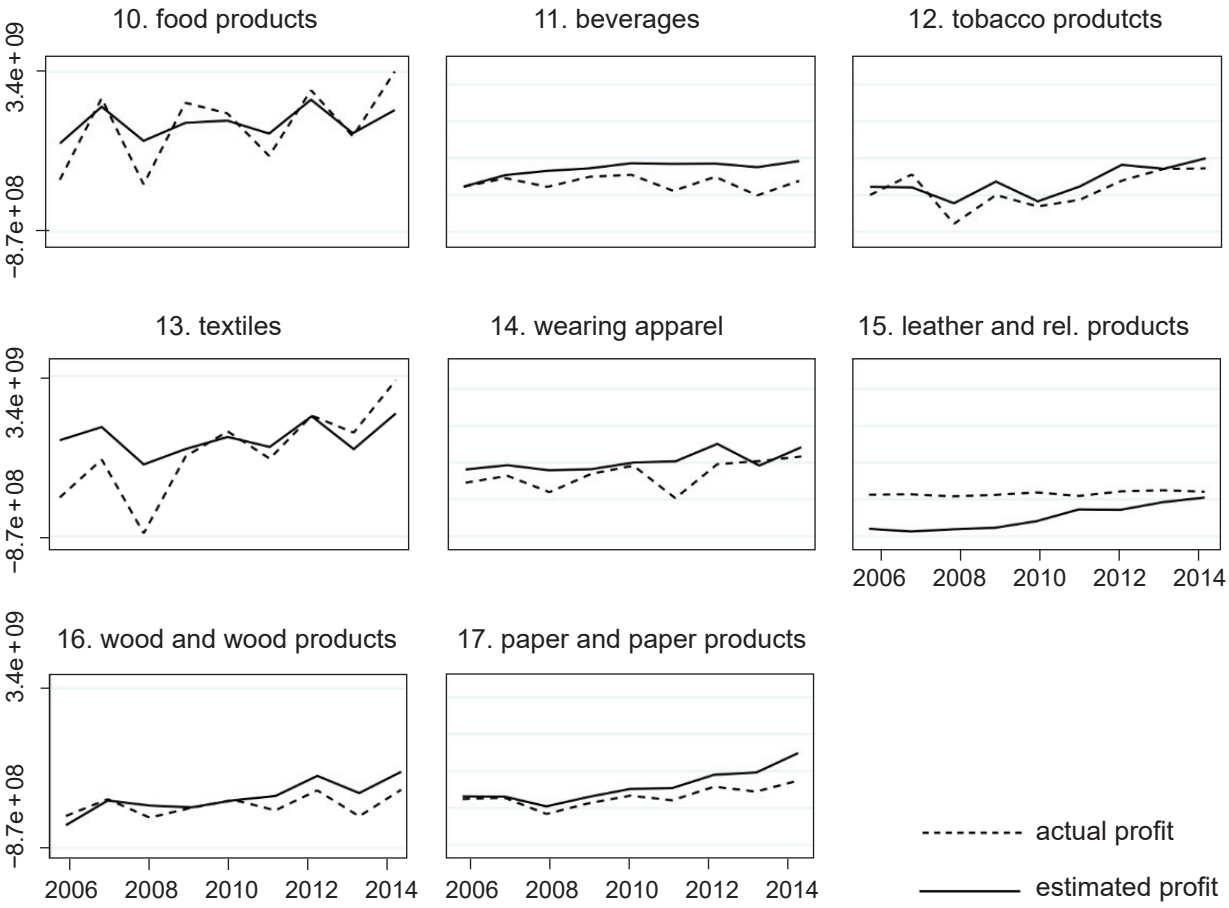
As discussed above, a forecasting analysis was conducted in order to obtain the control group for the DID methodology. Figures 2, 3 and 4 present the results of the forecasting analysis for the Turkish manufacturing industry at the sub-sectoral level. The results indicate a good match between estimated and actual profit values before 2008, showing goodness of fit for the forecasting estimation. When the results were examined, the most noteworthy outcome was that the actual profit values of almost all the sub-sectors were falling dramatically in 2008. Besides, the greatest difference between actual and estimated profit values was observed in 2008–2009, when the impacts of the crisis were the worst at both macro and micro levels. The results showed that the sectors whose profitability decreased the most due to the crisis were food and textiles in Figure 2, and basic metals in Figure 3. However, recovery in sector profitability was observed starting as early as 2010 and the gap between actual and estimated profit values decreased correspondingly. Furthermore, it was determined that profit values of the manufacturing sector bounced back, and actual profits even exceeded the estimated profits in the later years.

Table 3: Descriptive statistics

Variables	Mean	SD	Min	Max
Wages	21.02	0.938	19.22	23.00
Total purchases	23.33	1.065	20.65	25.64
Turnover	23.53	1.020	21.04	25.76
Value added	21.91	0.901	20.04	23.80
Export	21.97	1.313	18.79	24.32
Domestic sales	23.44	0.907	21.17	25.64
Number of employees	11.12	1.119	8.285	13.11
Net foreign exchange profits	6.492e+07	2.633e+08	−7.067e+08	1.495e+09
Profit	8.527e+08	9.557e+08	−8.906e+08	4.517e+09

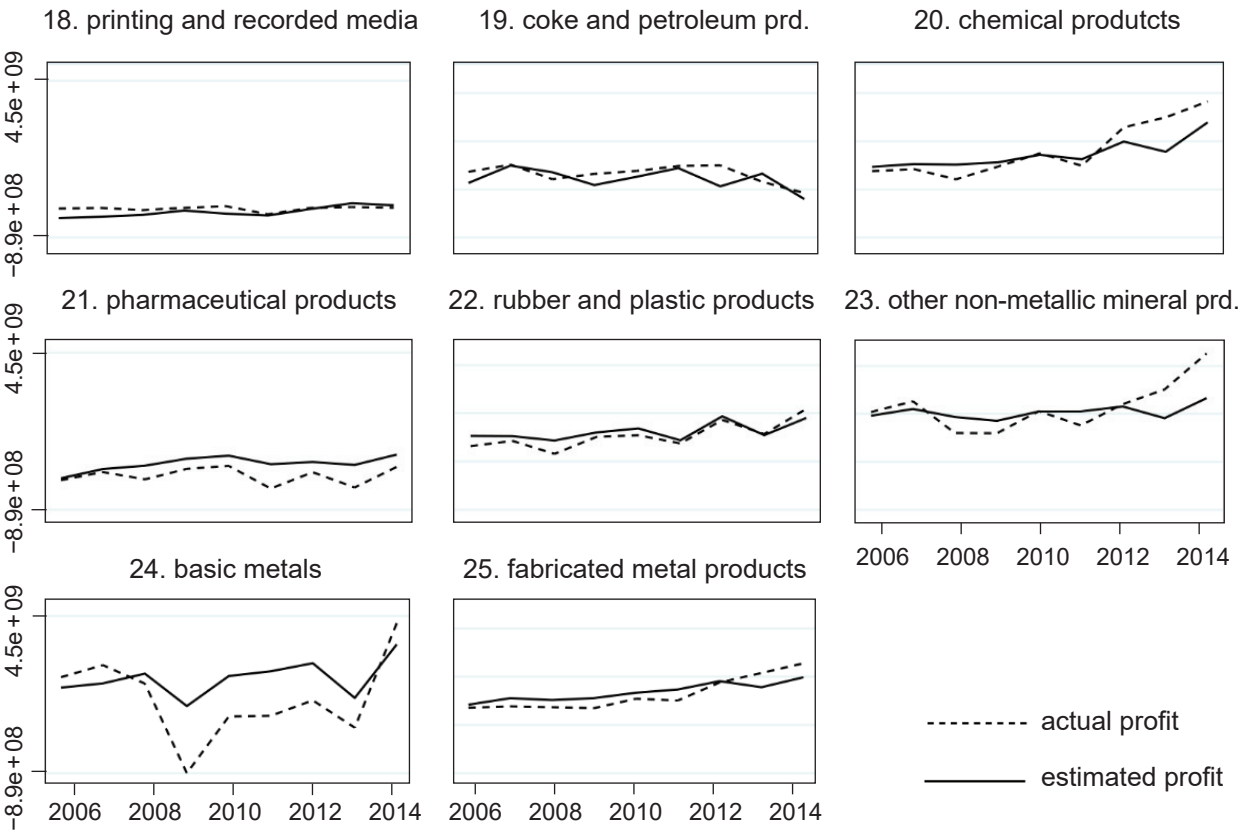
Source: authors' own calculations

Figure 2: Forecasting analysis results (sub-sectors 10–17)



Source: EIS and authors' own calculations

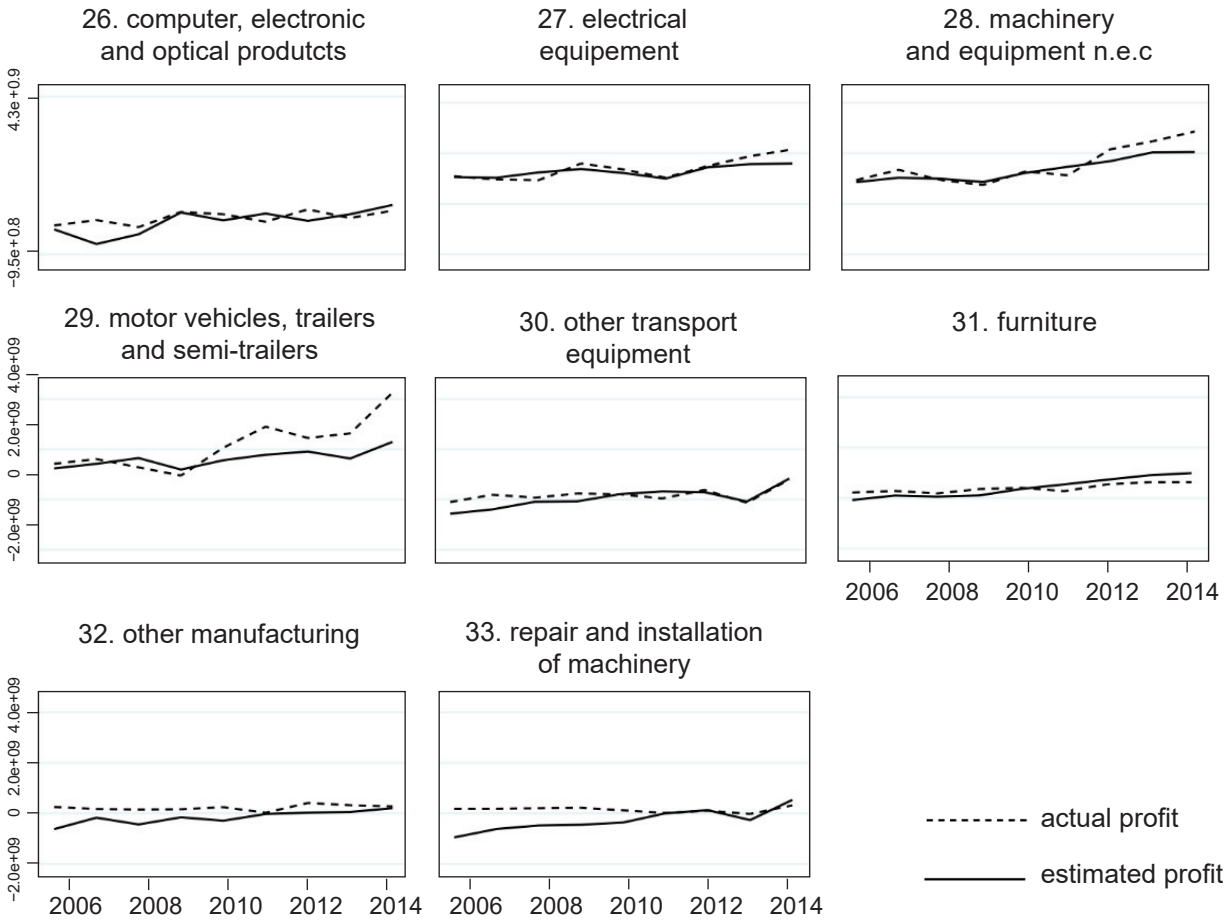
Figure 3: Forecasting analysis results (sub-sectors 18–25)



Source: EIS and authors' own calculations

Before the DID analysis, the share of each sub-sector's profit values in the manufacturing sector was examined. The purpose of this was to prevent any deviation that may occur when all sectors with large shares and small shares are analysed together. With this aim, first, total profit values were calculated for each year. Then the manufacturing sector's total profit value was obtained by summing annual profit values. Afterwards, the total profit values of each sub-sector in the examined period were calculated. A ratio was obtained by dividing the sub-sector's total profit value by the sector's profit value, and this step was repeated for each sub-sector separately. This ratio showed the ratio of that sector's share within the total sector profit value in the examined period. As a result of this calculation, three sub-sectors with the highest shares in the total profit value of the manufacturing industry were identified: other non-metallic mineral products; motor vehicles, trailers and semi-trailers; and food products with 11.1%, 10.6% and 9.4% profit shares, respectively. In addition, the average of the obtained ratios of the sub-sectors was found to be 4.16%. In this context, the sub-sectors above average were pooled together, forming a large sample since they have a larger share in the sector's total profit. The other sub-sectors were pooled under the name of "small sample".

Figure 4: Forecasting analysis results (sub-sectors 26–33)



Source: EIS and authors' own calculations

The large-share sample had 10 sub-sectors, including the manufacture of other non-metallic mineral products (23), motor vehicles (29), food products (10), basic metals (24), chemicals and chemical products (20), machinery and equipment n.e.c. (28), electrical equipment (27), textiles (13), fabricated metal products except for machinery and equipment (25), rubber and plastic products (22), respectively. The results of the DID analysis are presented in Table 4.

As shown in Table 4, the results indicate that the difference between the actual and estimated profit values in the small-share sample was statistically significant at the 5% significance level. Furthermore, there is a significant difference between actual and estimated profits ($p < 0.1$) in the large-share sample. Taken together, these results suggest that the 2008 crisis had a significant and negative impact on profit levels of the Turkish manufacturing sector.

Table 4: DID analysis results for large and small samples

Variables	Large share	Small share
Time	3.547e+08** (1.709e+08)	4.150e+08*** (7.801e+07)
Treated	–2.850e+08 (1.974e+08)	1.917e+08** (9.008e+07)
_diff	4.058e+08* (2.417e+08)	–2.721e+08** (1.103e+08)
Constant	1.414e+09*** (1.396e+08)	6.281e+06 (6.369e+07)
Observations	180	252
R^2	0.121	0.113

Note: Standard errors in parentheses *** p<.01, ** p<.05, * p<.1

Source: authors' own calculations

5. Discussion and Conclusion

This paper aimed to examine the effects of the 2008 global crisis on the profit levels in the Turkish manufacturing sector. For this purpose, a DID analysis was employed. In the DID setting, control and treatment data groups were necessary. In this context, the actual profit levels of each sub-sector served as a treatment group; however, since the crisis affected all the firms in the manufacturing industry, the control group was absent. For this reason, the forecasting estimation method was employed to create the control group. The estimated profits obtained by this method provided information about the profitability of the manufacturing sector in the scenario for the absence of a 2008 crisis. In this context, this study offers a test to identify to what extent the Turkish manufacturing sector has recovered from the 2008 crisis, and how rapid this recovery has been.

In this study, the period 2006–2014 was analysed to observe the effects of the crisis on the Turkish manufacturing industry. It is very important to explain why this period was chosen for the study. First of all, the Turkish economy has struggled with other economic crises and fluctuations after 2008. For example, a failed coup d'état was attempted against Turkey's state institutions in 2016 and economic stress rose in the following period. A currency crisis occurred in 2018 (Bedirhanoglu, 2022; Gergely and Obrycki, 2022) and finally, the COVID-19 pandemic started in 2020. All these created deep problems in the Turkish economy at both micro and macro levels. As explained in the previous sections, this study aimed to focus on the effects of the 2008

crisis. If the examined period of this study were extended, it would have become controversial whether the positive or negative changes in the profitability of the manufacturing industry might have resulted from the 2008 crisis or other mentioned economic turmoil. If this study had been carried out for an economy that did not experience major economic fluctuations from the 2008 crisis to the pandemic period, perhaps the examined time interval could have been extended to investigate whether the crisis had an impact until the pre-pandemic years. Apart from all these, some of the recent studies focusing on the effects of the 2008 crisis did not need to extend the time interval to observe the effects of the crisis. For example, Dinçer et al. (2022) analysed the effects of the 2008 crisis on the Turkish service sector in the period 2003–2015. Similarly, Jermias and Yigit (2019) analysed the effects of the crisis on the Turkish economy by extending the period until 2012. It is also observed that similar time intervals are preserved in recent studies examining the effects of the 2008 crisis on other countries or country groups (see, for example, Afonso and Blanco-Arana, 2022; Milanovic, 2022). In light of all this information, it is thought that the period examined in the study is consistent with the recent literature.

In order to predict manufacturing sector profits with the forecasting method, the variables that were thought to have an effect on profitability were regarded as independent variables in this study. The related literature also supports this hypothesis. For example, studies have shown that firm size (Arocena et al., 2021; Alarussi and Alhaderi, 2018), turnover (Alarussi and Alhaderi, 2018; Paul and Rahman, 2021), wages (Bamberger et al., 2021), sales (Sensini and Vazquez, 2021), export (Tyagi and Mahajan, 2022), and foreign exchange gain (Soni, 2018) directly affect profitability. Thus, it can be clearly stated that the independent variables in this study are consistent with the literature. In addition, the results of the forecasting analysis support this idea, since the estimated and actual profit values were almost the same in the years before the 2008 crisis.

As stated in the introduction, one of the main research questions of this study is whether the 2008 crisis can be characterized as an economic crisis with real sector effects, rather than simply a financial crisis. The results indicate that almost all sub-sectors in the manufacturing industry were affected by the crisis. Especially, the biggest gap between actual and estimated profit values was seen in food, textiles, wearing apparel, chemical products, mineral products, and basic metals. In this context, it can be stated that the impact of the crisis on the aforementioned sub-sectors' profitability is greater. To reduce the effects of the crisis, stimulate domestic demand and increase competitive power, the government announced various stimulus packages in early 2009. For instance, the rates of special consumption tax (SCT) and value added tax (VAT) were reduced and/or postponed for selected product groups such as food, textiles, durable household appliances, furniture, wood products, and electrical equipment. In the same period, some tax exemptions and deductions for SMEs were applied (Karaca, 2014). The difference between actual and estimated profits was quite apparent for almost all sub-sectors in 2009; however, these gaps started to close after 2010. The aforementioned incentives might have had an impact on the increase in profitability.

As can be seen from Table 1, policy makers in Turkey struggled with the crisis through various sectors instead of adopting precautionary packages protecting the financial system and banking system against this major crisis that started in the financial circles. In other words, tools of fiscal policy rather than monetary policy were used as a method of struggle in the early stages of the crisis. The Turkish banking and financial system experienced a major crisis in 2000–2001, and more than 20 banks went bankrupt during this period (Polat, 2019). In the later years, important and strict regulations regarding the banking sector in Turkey were introduced and its fragility was reduced. For this reason, the banking and finance sector in Turkey was more prepared than before for the devastating effects of the 2008 crisis, and the effects of the crisis were limited to these sectors. On the contrary, the real sector became quite fragile with decreasing demand at the beginning of the crisis. Steps were taken to revive the market by taking the above-mentioned precautions, and as a matter of fact, this positive effect was immediately felt in sub-sectors such as textiles, metals, motor vehicles, food and chemical products, which lead the manufacturing industry. With the results of the forecasting analysis in this study, it was determined that the recovery in the sub-sectors was fast and actual profits in some of them even exceeded the estimated profits in the later years.

After this step, in order to evaluate whether there are any discernible effects on the manufacturing sector, and the magnitude of these effects across sector profitability shares, a DID analysis was conducted on sub-sector profit values. Results of the DID analysis indicate that sectors with both high and small shares in total manufacturing sector profitability were affected significantly by the 2008 crisis.

This study revealed that despite the measures and incentives, the Turkish manufacturing industry was significantly affected by the 2008 crisis. Moreover, it was proved that the crisis affected not only the financial markets but also the real sector significantly, showing that the crisis should be called an economic crisis.

This study makes an important contribution to the existing literature by using a new analytical framework, combining DID with forecasting methodology. Even though DID and forecasting methods are used widely in the current literature, this study is the first attempt to combine the two methodologies in order to forge the control group needed for the DID setting. One other important advantage of using a forecasting analysis is that it allows us to observe how different sectors' profitability would progress if the crisis had not occurred by looking at the estimated profits.

There are several policy implications that can be drawn from the study:

1. Governments and policymakers should prioritize the manufacturing sector in their economic policies, as it has a significant impact on economic development and growth.
2. In times of economic fluctuations or crises, policymakers should consider implementing measures to support the manufacturing sector and mitigate negative effects on profitability.

These could include measures such as providing financial assistance to businesses, implementing fiscal policies to stimulate demand, or implementing trade policies to protect domestic manufacturers.

3. The use of micro-econometric difference in differences methods and macroeconomic forecasting can provide valuable insights into the impacts of economic crises on the manufacturing sector, and policymakers should consider using these analytical frameworks in their decision-making processes.

4. Further research should be conducted using the suggested method to investigate the impacts of economic crises on other sectors, which could provide further insights and inform policy decisions.

Even though this study is the first attempt to examine the crisis effects with the aforementioned techniques, it is not without limitations. Profit was selected to measure the effect of the 2008 crisis on the manufacturing sector. To obtain estimated profit values, the aforementioned independent and exogenous variables were used; however, one might argue that the analysis could be run by adding new variables that are thought to affect profitability. Besides, forecasting analysis can be transformed into a dynamic structure by expanding the examined time series if data are available. Despite these limitations, this study differs from other literature due to the use of forecasting and micro-econometric DID methods together for determining the impacts of crisis. In this way, the impacts of the crisis on the profits and thereby on the sector could be analysed statistically by creating treatment and control groups. This method can be used in future studies to analyse the effects of the European debt crisis, Brexit, trade wars, the COVID-19 pandemic and the Ukraine-Russia war, which have recently created a global economic crisis. Furthermore, it is also possible to extend the scope of the research by using different sectors/countries and other dependent variables.

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