

# Measuring the Economic Impacts of 2000 – 2001 Financial Crisis and Reforms in Turkish Banking Sector via Synthetic Control Method

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### **Abstract**

*A deep financial crisis, which is called the “2000 – 2001 Financial Crisis”, affected the whole economy and especially the banking sector in Turkey, during the 2000-2001 period. In order to overcome the negative effects of this crisis, banking restructuring process had been started in May 2001. In this framework, this paper aims to measure the economic impacts of this crisis and reforms afterwards via Synthetic Control Method (SCM). By using this method, we construct a synthetic counterpart of Turkey, in which there were no crisis, and no restructuring process, by using the same indicators of other countries’ banking sectors. Then, we compare this “synthetic Turkey” with “actual Turkey”, i.e. the actual values of the indicators, in order to estimate the effects of the crisis and reforms. Hence, we utilize SCM in banking and finance literature in order to measure the effects of crisis and reforms. Our results indicate that the crisis has negative impacts on both bank capital to total assets and ROE in Turkish banking sector during 2000 – 2001 period. On the other hand, our results also show that the reforms overwhelmed the negative effects of this crisis.*

*Keywords: mathematical and quantitative methods, synthetic control method, banking sector, impacts of financial crisis*

*JEL Codes: B40, C00, G01*

## **1. Introduction**

Starting from 2000 all of the indicators of the banking sector worsened and in 2001 a deep financial crisis affected all the economy and especially the banking sector in Turkey.

In order to overcome the direct impacts of the crisis, a restructuring process on the banking sector, so called “Banking Restructuring Program” had started, in May 2001. This program first coped with solving the financial problems and restructuring of problematic banks, by taking them under the Savings Deposit Insurance Fund’s (SDIF) control. Secondly, considerable public resources were transferred to state-owned banks in order to strengthen their capital and to make settlement of the “duty losses”, which had reached 50 percent of their balance sheets at the end of 2000. At the third stage, a program was adopted for reinforcement of the equity capital of private banks whose asset quality was deteriorated and equity capital rapidly melted down. In the restructuring period, the Banking Regulation and Supervision Authority (BRSA) was established as a regulatory and financial authority with administrative and financial autonomy in banking sector (TBA, 2009, p. 5). Because of the legislative measures implemented by BRSA, banking legislation was aligned with international regulations, particularly the EU directives, and works for incorporating the infrastructural elements of new Basel Capital Accord (Basel-II) was started. Besides, a program known as the “Istanbul Approach” was also

introduced in June 2002 for a period of three years, for restructuring the companies' debt to the financial sector (TBA, 2009, p. 6).

After overcoming the impacts of 2000–2001 crisis, i.e., between the years 2003 and 2008, not only by the favorable domestic and international macroeconomic situation, but also due to the positive reflections of these reforms, Turkish Banking Sector became healthier and showed a rapid growth performance.

In this framework, it became crucial to analyze and measure the overall (direct and indirect) impacts of the crisis and positive effects of the reforms, by excluding the effects of other environmental macroeconomic and/or global effects. This paper aims to measure the impact of 2000–2001 Financial Crisis and reforms afterwards in Turkish Banking Sector, over the period 2000–2008, in terms of bank healthiness measures. One approach to achieve this is to make a comparative analysis by using other countries or sectors' data, which have no crises or no structural changes in the same period. Therefore, we use a new and powerful tool for such kind of (above-mentioned) analysis, which is called as "Synthetic Control Method" (Abadie and Gardeazabal, 2003). In this way, the paper ensures a comparative study between the Turkish Banking Sector and the banking sectors of other countries, by constructing synthetic control indicators, which are estimated from the indicators of other countries' banking sectors. For this aim, we use the World Bank's Global Financial Development data set, which contains all the countries' comparative financial data.

More precisely, the main goal of this paper is to measure the economic impact of the financial crisis in Turkey during 2000–2001 period. In particular, first we construct a synthetic counterpart of Turkey, in which there were no crisis, and no restructuring process, by using the efficiency, stability and other indicators of other countries' banking sectors according to the World Bank's classification of the measures (for a two years period before the crisis). Then we focus on bank healthiness in order to measure the effects of this financial crisis on Turkish banking sector. Specifically to capture the bank healthiness, we use the bank capital to total asset ratio stands for a stability measure and return on equity (ROE) for an efficiency measure (for a period after the crisis). Moreover, Turkey adopted a stabilization program after this crisis, and the second goal of the paper is to measure the impact of this stabilization program on Turkish banking sector again in terms these healthiness indicators. Briefly, the objective of this paper is to measure both negative effects of 2000–2001 Turkish banking sector crisis and the positive effects of the stabilization program, which was adopted after this crisis. Hence, this paper contributes to the literature by providing the estimates of the effects of financial crisis and the stabilization program during 2000–2008.

Our results indicate that the crisis has negative impacts on both bank capital to total assets and ROE in Turkish banking sector during 2000–2001 period. On the other hand, our results also show that the reforms overwhelmed the negative effects of this crisis.

The rest of this paper is organized as follows. In Chapter 2 introduces the Synthetic Control methodology. In Chapter 3, the data, variables and model results are presented. Chapter 4 concludes the paper.

## **2. Model: The Synthetic Control Method**

In this study we use a mathematical model called "Synthetic Control Method (SCM)" developed by Abadie and Gardeazabal (2003). They first introduced the method and measured the economic impacts of the terror in the Bask region in Spain, i.e. they calculated the growth and prosperity losses in this region by using their model, SCM.

This was a valuable contribution to the economic impact literature; hence this model was accepted as a useful tool and a powerful alternative to the classical econometric and statistical models. The main question, which the model is trying to answer, can be expressed as follows: "if an external shock (e.g. terror) or policy (e.g. controls, reforms) had not been experienced or not implemented, then what would the economic situation had been?"

In comparative case studies, researchers estimate the evolution of aggregate outcomes for a unit affected by a particular occurrence of the event or intervention of interest and compare it to the evolution of the same aggregates estimated for some control group of unaffected units. For this type of estimation, one of the most widely used tool is differences-in-differences methodology which is mainly developed by Card and Krueger (1994). However, in a more recent study Abadie and Gardeazabal (2003) propose

a synthetic control methodology in order to estimate effects of an event or intervention of interest and compare it with unaffected group. In some cases, treatment and potential control groups do not follow parallel trends. Due to this reason, standard differences-in-differences methodology method would lead to biased estimates. Moreover, Abadie and Gardeazabal (2003) motivate the synthetic control method with a model that generalizes the difference-in-differences model by allowing the effect of unobserved confounding characteristics to vary over time. Hence, synthetic control method is an increasingly popular tool for estimating the effect of an event or intervention.

The advantage of SCM methodology has been accepted by most researches and widely used in empirical studies, as well. Some recent studies which use this methodology in different fields can be listed as; measuring the economic impacts of natural disasters (Noy, 2009; Cavallo, et.al., 2013); hurricanes (Coffman & Noy, 2011); government policies such as tobacco control program (Abadie et. al., 2010); capital controls (Jinjarak et. al., 2013), among others.

In this study, we will modify and calibrate the synthetic model in order to measure the effects of the 2000-2001 banking crisis in Turkey and the reforms made afterwards.<sup>1</sup>

The detailed explanation of the model is provided below:

In order to construct Turkey (Turkish banking sector) synthetically, we use  $J$  control countries (other countries' banking sectors), which have not received a crisis in those years.

$X_1$  vector (with  $K \times 1$  dimension) denotes  $K$  economic and banking sector indicators in Turkey.

$X_0$  matrix (with  $K \times J$  dimension) denotes economic and banking sector indicators for  $J$  control countries.

$W = (w_1 \dots w_J)$  vector (with  $J \times 1$  dimension) denotes the weights assigned to each control country.

$V$  diagonal matrix (with  $K \times K$  dimension) includes non-negative values and represents the relative importance of each economic indicator.

Values in  $V$  matrix are determined so that it replicates the economic and banking sector conditions before the crisis. As  $V$  diagonal matrix changes, the optimal weights will also change. We can write the optimal weights as  $W^*(V)$ .

For a given  $V$  matrix, to determine the weights of control regions to construct the synthetic Turkey, we will solve the following minimization problem:

$$\text{minimize}_{(w \in \omega)} (X_1 - X_0 W)' V (X_1 - X_0 W) \quad (1)$$

where  $\{(w_1, \dots, w_J) \mid s.t. w_1 + \dots + w_J = 1, w_j \geq 0 (\forall j = 1 \dots J)\}$ .

That is, we choose the optimal weights in order to replicate Turkey (Turkey's banking sector) synthetically. In other words, we determine an optimal convex combination of control countries to be able to represent Turkey in the best possible way.

After the determination of the optimal weights of control counties, we calculate values of earning (ROE) and capital indicators (outcome variables) for the synthetically created Turkey. We calculate the values of those indicators counterfactually in case the crisis had not been occurred by the following formula:

$$\sum_{j=1}^J w_j^* x h_j \quad (2)$$

where  $w_j^*$  denotes the optimal weights and  $h_j$  denotes the actual values of the indicators.

Finally, we calculate the difference between the actual and synthetically created values of the indicators for Turkey by the following formula:

$$\sum_{j=1}^J w_j^* x h_j - h_1 \quad (3)$$

where  $h_1$  denotes the actual values of the economic indicators in Turkey.

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<sup>1</sup> In calculations of the model, we write and run the codes in MATLAB.

### 3. Application: Data and Model Results

Synthetic control provides a systematic way to estimate the counterfactual. By using this methodology, first we construct a synthetic counterpart of Turkey in which there were no crisis, and no restructuring process in Turkish Banking Sector in 2000–2008. We use other countries as a control group, and then we calculate an optimal convex combination of these control countries where the constructed synthetic Turkey represents the actual Turkey in a best way. Then, we compare the synthetic Turkey and actual Turkey after 2000-2008 period in order to estimate the effects of the banking crisis and restructuring process.

#### 3.1 Data

As mentioned above, the paper ensures a comparative study between the Turkish Banking Sector and the banking sectors of other countries, by constructing synthetic control indicators, which are estimated from the other countries' banking sectors. For this aim, the sample is first constructed by the OECD and BRICs countries and we use the banking sector indicators and some economic indicators, which are taken from the World Bank's Global Financial Development data set. This is an extensive dataset of financial system characteristics for 203 economies. The database includes measures of size of financial institutions and markets (financial depth), degree to which individuals can and do use financial services (access), efficiency of financial intermediaries and markets in intermediating resources and facilitating financial transactions (efficiency), and stability of financial institutions and markets (stability). (For the description of this dataset and a discussion of the underlying literature, see: Čihák et. al., 2012).

First, there had been 39 countries including Turkey in the sample. However, because of lack of data, five countries had been excluded from the initial sample (34 are remained). In Table 1, we present these 34 countries. Among them 31 countries are finally included in the analysis sample since Slovak Republic, Japan and Czech Republic experienced a financial (bank) crisis in one or both of the years 2000 and 2001 (similar to Turkey), according to the 'banking crisis dummy' variable data which is also given in the dataset we use.

Table 1: The Countries in the Analysis Sample with Adequate Data

Australia	Italy
Austria	Japan
Belgium	Luxembourg
Brazil	Mexico
Canada	Netherlands
Chile	Norway
China	Poland
Czech Republic	Portugal
Denmark	Russian Federation
Estonia	Slovak Republic
Finland	Slovenia
France	South Africa
Germany	Spain
Hungary	Switzerland
India	United States
Ireland	Korea, Rep.
Israel	Turkey

Source: World Bank's Global Financial Development data set

From the World Bank's dataset we used the "efficiency" and "stability" measures, as well as "other" indicators, which show the other aspects of the economies to construct the counterfactual, i.e.

synthetic Turkey. In other words, “other” class stands for showing economic or structural characteristics.<sup>2</sup> In Table 2, the variables, which are used, are listed.

Table 2: The Variables Used in the Analysis

Indicator	World Bank’s Classification / Topic
GDP per Capita	Other
Bank capital to total assets (%)	Stability
Bank concentration (%)	Other
Bank cost to income ratio (%)	Efficiency
Bank credit to bank deposits (%)	Stability
Bank deposits to GDP (%)	Other
Bank nonperforming loans to gross loans (%)	Stability
Bank regulatory capital to risk-weighted assets (%)	Stability
Bank net interest margin (%)	Efficiency
Liquid assets to deposits and short term funding (%)	Stability
Bank return on equity (% , before tax)	Efficiency
Bank return on equity (% , after tax)	Efficiency

Source: World Bank’s Global Financial Development data set

### 3.2 Model Results

We utilize the synthetic control model by using the data described in Section 3. The model results are presented in Table 3. In the model “Synthetic Turkey” resembles the Turkey in which there is no crisis and reforms. In other words, synthetic Turkey is a convex combination of control countries, which represents the Turkey in a best way for the years 1998–1999.

Table 3: The Convex Optimization Results (Actual vs. Synthetic Turkey)

Indicator (Control Variables or Predictors)	Synthetic	Actual
GDP per Capita	4417.30	4200.97
Bank capital to total assets (%)	7.05	6.95
Bank concentration (%)	56.64	57.42
Bank cost to income ratio (%)	67.26	53.81
Bank credit to bank deposits (%)	71.00	53.91
Bank deposits to GDP (%)	30.79	23.54
Bank nonperforming loans to gross loans (%)	11.90	8.60
Bank regulatory capital to risk-weighted assets (%)	12.45	8.20
Bank net interest margin (%)	4.68	10.82
Liquid assets to deposits and short term funding (%)	38.48	21.13
Bank return on equity (% , before tax)	19.84	34.61
Bank return on equity (% , after tax)	12.92	26.16

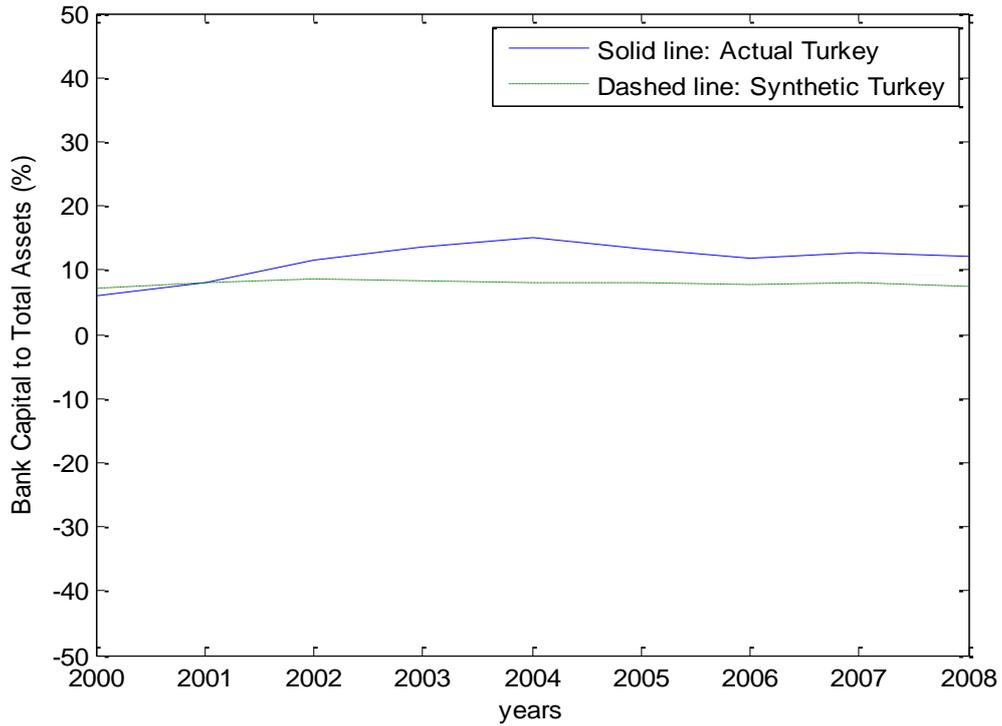
Source: authors’ calculations

The convex optimization results (best approximation) of the indicators for actual Turkey are given by the full weight (of 1.00) of one country-Poland.

Figure 1 and Figure 2 compare the actual and synthetic Turkey between the years 2000-2008 in terms of bank healthiness measures, i.e. bank capital to total assets and ROE, respectively. Since we know that synthetic Turkey, which is the convex combination of control countries resembles Turkey very well for 1998 and 1999, Turkey without 2000-2001 crisis and reforms should follow the dashed line in Figure 1 and Figure 2.

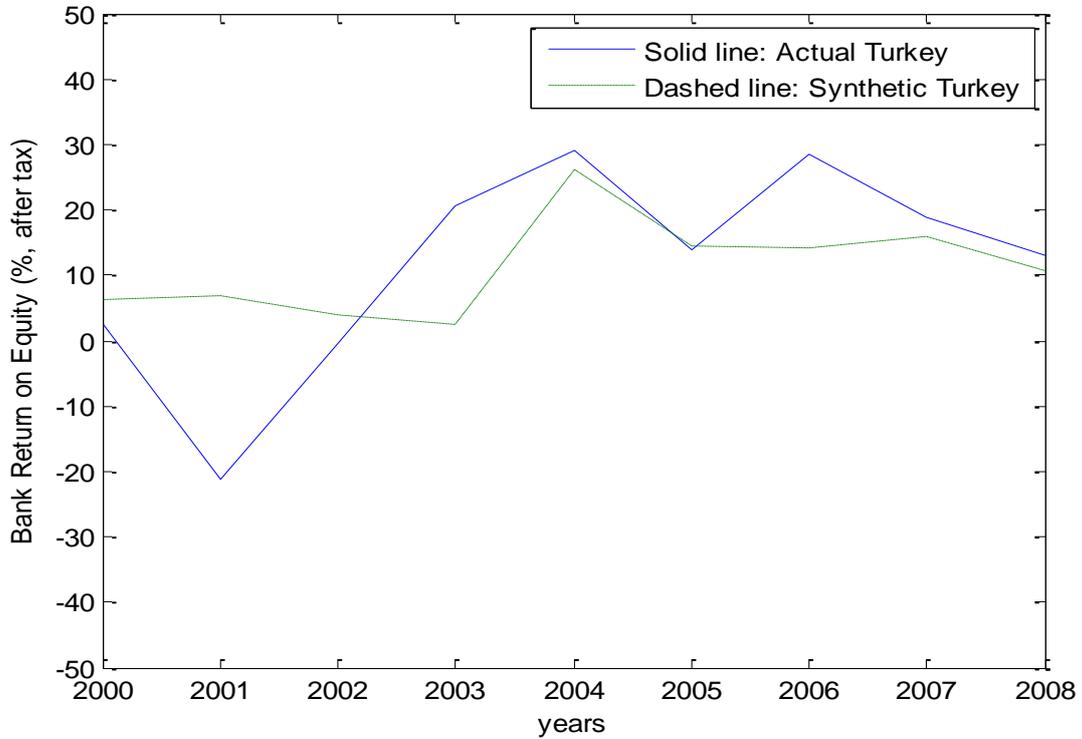
<sup>2</sup> In SCM, both economic and social variables are used in order to construct the synthetic counterpart of an actual region (country in our case). The basic idea behind this is to find a region or a country most closely resembles the actual in more than one aspect.

Figure 1: Bank Capital to Total Assets (Actual vs. Synthetic Turkey)



Source: authors' calculations

Figure 2: Return on Equity (Actual vs. Synthetic Turkey)



Source: Authors' calculations

As we see in Figure 1, 2000-2001 crisis has a negative impact on Bank Capital to Total assets in Turkey, since the value for synthetic Turkey (i.e. Turkey without 2000-2001 crisis) is above the actual

Turkey (i.e. Turkey with 2000-2001 crisis) for 2000 and 2001. But the reforms (after 2002) on Banking sector had a positive effect on this indicator, since the Bank capital to total assets ratio of actual Turkey's banking sector after the reforms (after 2002) is constantly higher than the synthetic Turkey's, i.e. without any reforms.

More specifically, we find that the bank capital to total asset ratio would be 7.1% and 8% for 2000 and 2001, respectively in Turkey in the absence of 2000–2001 Turkish banking sector crisis. However, we observe that the actual bank capital to total asset ratio is 6.1% and 7.9%, for 2000 and 2001 respectively in Turkey. These results imply that especially in 2000 the bank capital to total asset ratio dramatically declined due to the 2000–2001 crisis. The average of bank capital to total asset ratio of 2002–2008 period is 7% in the absence of stabilization program. However, the actual average of the bank capital to total asset ratio of 2002–2008 period is 13%. This result shows that Turkish banking sector benefited from the stabilization program a lot.

We can see in Figure 2 that 2000–2001 crisis has a negative impact on bank return on equity (after tax) in Turkish Banking sector, since the value for synthetic Turkey (i.e. Turkey without 2000–2001 crisis) is above the actual Turkey (i.e. Turkey with 2000–2001 crisis) for 2000 and 2001. But the reforms (after 2002) on Banking sector had a positive effect on this indicator, since the ROE of actual Turkey's banking sector after the reforms (after 2002) is constantly higher than the synthetic Turkey's, i.e. without any reforms.

We also estimate that the bank return on equity after tax would be 6.2% and 7% for 2000 and 2001, respectively in Turkey in the absence of 2000–2001 Turkish banking sector crisis. However, we observe that the actual bank return on equity after tax is 2.5% and - 21.1%, for 2000 and 2001, respectively in Turkey. These results imply that especially in 2001 the bank return on equity is dramatically negatively affected from the 2000–2001 banking crisis. The average of bank return on equity after tax of 2002–2008 period is 12.5% in the absence of stabilization program. However, the actual average of bank return on equity after tax 2002–2008 is 17.64%. This result also shows that Turkish banking sector benefited from the stabilization program.

#### 4. Conclusion

This paper aims to measure the economic impact of 2000–2001 Financial Crisis and reforms afterwards, in Turkish Banking Sector via “Synthetic Control Method” (Abadie and Gardeazabal, 2003), over the period 2000–2008, in terms of bank healthiness measures. In this way, the paper ensures a comparative study between the Turkish Banking Sector and the banking sectors of other countries, by constructing synthetic control indicators, which are estimated from the other countries' banking sectors. For this aim, we use the World Bank's Global Financial Development data set.

The results show that Synthetic Control Method is a useful tool to measure impacts of shocks such as crises and reforms, in banking and financial field as well.

Results also show that, the 2000–2001 crisis has a negative impact on Bank Capital to Total assets and ROE in Turkey, since the value for synthetic Turkey (i.e. Turkey without 2000–2001 crisis) is above the actual Turkey (i.e. Turkey with 2000–2001 crisis) for 2000 and 2001. But the reforms (after 2002) on Banking sector had a positive effect on these indicators, since both ratios of actual Turkey's banking sector after the reforms (after 2002) is constantly higher than the synthetic Turkey's, i.e. without any reforms. On the other hand, our results also show that these reforms overwhelmed the negative effects of 2000-2001 crisis.

#### References

- ABADIE, A., GARDEAZABAL, J. (2003). The Economic Costs of Conflict: A Case Study of the Basque Country. *American Economic Review*, vol. 93, no. 1, pp. 112–132.
- ABADIE, A., DIAMOND, A., HAINMUELLER, J. (2010). Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program. *Journal of the American Statistical Association*, vol. 105, no. 490, pp. 493–505.
- BANKS ASSOCIATION of TURKEY, TBA (2009). *The Financial System and Banking Sector in Turkey*. Istanbul: TBA.

CARD, D., KRUEGER, A.B. (1994), Minimum Wages and Employment: A Case Study of the Fast-Food Industry in New Jersey and Pennsylvania. *American Economic Review*, vol. 84, pp. 772–793.

CAVALLO, E., GALIANI, S., NOY, I., PANTANO, J. (2013). Catastrophic natural disasters and economic growth. *Review of Economics and Statistics*, vol. 95, no. 5, pp. 1549–1561.

COFFMAN, N., NOY I. (2011). Hurricane Iniki: measuring the long-term economic impact of a natural disaster using synthetic control. *Environment and Development Economics*, vol. 17, pp. 187–205.

ČIHÁK, M., DEMIRGÜÇ-KUNT, A., FEYEN, E., LEVINE, R. (2012). *Benchmarking Financial Systems around the World*. World Bank Policy Research Working Paper 6175. Washington: World Bank.

JINJARAK, Y., NOY, I., ZHENG, H. (2013). Capital Controls in Brazil. *Journal of Banking and Finance*, vol. 37, pp. 2938–2952.

NOY, I., (2009). The macroeconomic consequences of disasters. *Journal of Development Economics*, vol. 88, no. 2, pp. 221–231.

World Bank’s Global Financial Development data set.