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CHARTING THE COURSE: TOTAL FACTOR PRODUCTIVITY TRENDS IN CROATIA POST-PRE-BANKRUPTCY ACT

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Abstract The synthetic control method (SCM) is a valuable tool for unbiased pre-bankruptcy reform analysis in economic policy evaluations. This study utilizes SCM to assess the impact of the Financial Operations and Pre-Bankruptcy Settlement Act (AFOPBS) on Croatia's total factor productivity (TFP). Control units and weights were meticulously chosen to construct a synthetic control for Croatia, creating a counterfactual scenario for the reform's absence. The policy's impact was quantified by comparing TFP growth post-policy between Croatia and its synthetic control. Placebo tests confirmed the results' significance, and further validation was achieved through panel difference-in-differences analysis (PDID). Our findings show that the pre-bankruptcy reform in late 2012 effectively reduced the gap between Croatia and its synthetic control throughout the post-treatment years. However, it had two short-term adverse impacts and a subsequent recovery-like phase. These effects were statistically significant and confirmed by cross-validation. In conclusion, Croatia's pre-bankruptcy reform significantly influenced TFP volatility, highlighting SCM's effectiveness in evaluating economic policies, especially those crucial for economic growth.

Keywords
total factor productivity,
pre-bankruptcy act,
synthetic control method,
placebo test,
Croatia

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1 Introduction

The AFOPBS was implemented in the fourth quartal of 2012 during a challenging period for the Croatian economy, which was grappling with high levels of illiquidity. The Act aimed to address this issue by reorganizing companies with economic potential and manageable debt, with the goal of preserving sustainable jobs in struggling firms and mitigating the decline in aggregate employment. The legislation drew inspiration from foreign models while taking into account Croatian specificities, notably its timing during a severe and prolonged recession from 2009 to 2014, which resulted in a cumulative decline in GDP of 12.5%. The reform was seen as a vital component of the economic revival policy.

The experiences of other countries facing stagnation have shown that unsuccessful reform of institutional rules surrounding bankruptcy laws can perpetuate economic crises. On the other hand, successful reform can lead to better reallocation and efficiency of labor and capital, contributing to improved productivity and reducing waste.

Objectives of the AFOPBS were to change the payment habits of business entities, reduce indebtedness, and increase liquidity. Additionally, the Act aimed to facilitate the restructuring of entrepreneurs (companies) to enhance their liquidity and solvency, offering more favourable conditions for creditors' settlements compared to traditional bankruptcy proceedings. By enabling the transformation of debtors into viable and competitive entities, the Act sought to benefit creditors, employees, owners, and the overall Croatian economy.

The reform was also driven by political goals, as the left-wing government sought to proactively prevent the spread of high unemployment and potential social unrest during the recessionary years. Offering failed companies or debtors a second chance through pre-bankruptcy settlements was seen as a means of sustaining their social mission while rehabilitating them with involvement from economic agents and various creditors.

While this paper primarily delves into the causal impact of the AFOPBS on TFP in Croatia within the economic domain, it also briefly acknowledges criticisms from legal professionals regarding the Act's influence on Croatian insolvency legislation.

Notably, Bodul and Vuković (2015, 191-193) raise concerns about the Croatian bankruptcy law, including extended processing times compared to other countries in the region, heightened costs, diminished creditor satisfaction, and a pressing need for improvements.

As this paper endeavours to chart the causal impact of a legislative act on economic outcomes in the post-adoption period, it is pertinent to provide a brief overview of these outcomes. TFP plays a pivotal role in shaping the economic landscape on a macro level. It represents the efficiency and effectiveness with which a country utilizes its inputs, such as labor and capital, to produce goods and services. TFP growth is a key driver of economic progress, as it reflects advancements in technology, innovation, and overall productivity. TFP is often considered a measure of economic health, as it directly impacts a nation's long-term economic growth potential. Higher TFP growth rates are associated with increased output per worker, which can lead to rising living standards and enhanced competitiveness in global markets. Moreover, TFP can be a critical factor in addressing economic challenges, such as mitigating the impact of labor force ageing or resource scarcity. It underscores the importance of fostering an environment conducive to innovation and efficiency gains, as these factors are fundamental to sustained economic development.

To study the impact of the AFOPBS on TFP, the paper will use a quasi-experimental procedure to analyze the Croatian case. The SCM will be employed to compare the TFP growth rate some years before and after the reform while controlling for certain co-predictors of aggregate TFP. The analysis will involve selecting a pool of countries with similar characteristics that did not implement the pre-bankruptcy reform during the analysis period to serve as the control group. The robustness of the SCM results shall be confirmed through a placebo test and cross-validation, employing the PDID method.

The remainder of this paper is structured as follows: the next section provides a summary of the literature on our topic and introduces the methodology. Following that, we delve into the data sources and variables utilized. Subsequently, the empirical analysis, along with the final results, is presented in the ensuing section, leading to the conclusion of this study.

2 Literature preview

The reviewed literature comprises a blend of theoretical and empirical approaches, each contributing distinct insights into the relationship between bankruptcy laws and TFP growth. While some papers delve into theoretical frameworks to establish foundational principles, others employ empirical methodologies to quantify the effects in real-world scenarios.

The intersection of bankruptcy laws, legal protection, and their impact on TFP constitutes a pivotal area of the following investigation. This research domain is characterized by a spectrum of methodologies aimed at uncovering the intricate relationships between legal frameworks, economic policies, and growth outcomes. Studies have delved into these dimensions using diverse analytical approaches. To study fluctuations in TFP, Tomura (2007: 1-10) presents a dynamic general equilibrium model that considers the interactions between credit market frictions, firm entry and exit, and TFP fluctuations in response to various shocks. In Jensen's seminal work (1986: 3-5), he presents a theoretical model that highlights how debt levels can incentivize managers to enhance firm performance, thus influencing TFP growth. His paper establishes a crucial link between financial decisions and productivity. Furthermore, in Lim and Hahn's research (2004: 10-12), the wider landscape of research on bankruptcy laws offers insights into the multifaceted connections between legal protection, economic policies, and growth in East Asia.

In essence, the exploration of bankruptcy laws, legal protection, and their impact on TFP is a multidisciplinary endeavour that leverages various methodologies to deepen our understanding of the mechanisms underlying economic dynamics. Additionally, other works in the field have explored the impact of bankruptcy laws and legal protection on economic dynamics. For example, in the context of bankruptcy laws and firm performance, Bodul and Vuković (2015: 181-193) explore the effects of multiple reforms in the Croatian Bankruptcy Act. Using indicative methods, the study evaluates the changes in bankruptcy and preliminary bankruptcy procedures adopted in 2012 and their relative efficiency in comparison to other countries in the region. The authors highlight the need for further improvement in the Croatian regulatory framework, considering the challenges posed by external institutional factors. The empirical study by Misra (2019: 1-10) utilizes quantitative analysis to compute TFP growth for Indian states in distinct time periods. By examining actual

TFP data, the research provides empirical evidence of the impact of post-crisis periods on TFP growth. Employing an empirical approach, Köke's study (2001, 1-10) investigates the relationship between financial pressure and productivity growth in German manufacturing firms. The research employs econometric techniques to analyze real-world data, offering insights into the impact of financial factors on productivity. The authors Gonçalves and Martins (2016: 1-10) used empirical analysis in their study, exploring determinants of TFP growth in the Portuguese manufacturing sector. The authors employ quantitative methods to identify factors affecting TFP and suggest policy implications. The paper by Yamaguchi (2022: 11-20) adopted a Regression Discontinuity (RD) design; this study evaluates the impact of government interventions on the productivity of airlines. The empirical approach helps quantify the effects of interventions in a real-world context.

The paper by Dvouletý, Srhoj, and Pantea (2021: 1-10) employs a systematic review of empirical evidence to assess the impact of public grants in the intervention context on SME performance. The authors critically evaluate various empirical studies, identifying patterns and heterogeneity in the effects of grants on different outcomes, including TFP. The research by Miao *et al.* (2022: 11-20) combines firm-level accounting data with data on state aid for restructuring. It uses treatment effects estimators to analyze the impact of aid on static and dynamic efficiency, contributing empirical insights into the consequences of state aid.

In addition to the mentioned studies, the work by Sadeghi and Kibler (2022: 1-10) provides an empirical investigation into the relationship between bankruptcy legislation and entrepreneurship. Employing the Synthetic Control Method (SCM), the authors explore the effect of entrepreneur-friendly bankruptcy reform on entrepreneurial activity in Finland. The study contributes to the empirical understanding of how legal reforms impact entrepreneurial decisions and growth ambitions.
The author, Neira (2017: 1-47), proposes that variations in bankruptcy procedures explain a positive relationship between aggregate productivity and the proportion of large firms; he uses a model to demonstrate that worsening bankruptcy procedures lead to lending shifts towards smaller firms, impacting TFP. The study by Aleksanyan and Huiban (2016: 89-108) shows that firm productivity predicts bankruptcy risk, with credit cost and productivity playing significant roles in determining the probability of bankruptcy. The study by Acemoglu and Guerrieri

(2008: 467-498) analyzes a model with formal and informal sectors, indicating that countries with low debt enforcement and high formality costs have low allocative efficiency and reduced TFP. Other authors, Hiroki, Iwatsubo, and Watkins (2022: 1-36), find that Japanese manufacturers' firm-level TFP positively predicts their future stock returns, with intangible expenditure risks explaining much of the predictive power. The study by Tamayo (2017: 225-242) highlights that poorly designed bankruptcy arrangements can substantially increase financial constraints, negatively impacting aggregate output and TFP. On the other hand, Cosci and Meliciani (2002: 37-54) in their work investigate bankruptcy determinants, finding that firm inefficiency and qualitative factors such as customer concentration and competitors' strength predict bankruptcy, reflecting the importance of monitoring beyond balance sheet variables.

The research by Albalate, Bel, and Mazaira-Font (2022: 549–584) identifies and examines the inhibitory impact of zombie enterprises on TFP growth of non-zombie enterprises, using comprehensive identification methods. The study by Xia and Wu (2021: 592–600) models the impact of credit market shocks, explaining the unusual increase in aggregate TFP during the 2008 financial crisis. The paper by Cespedes, Thakor, and Yang (2022: 1-30) explores the link between competition, non-financial enterprise financialization, and TFP, finding that financialization decreases TFP but is mitigated by strong competition.

By exploiting a chapter of Bankruptcy Law eligibility using a regression discontinuity design, the research by authors reveals that enhanced bankruptcy protection improves ex ante outcomes, including investments and productivity.

The seminal study by Di Martino, Latham, and Vasta (2020: 936-990) employs a comprehensive data set to investigate the evolution of bankruptcy law features in European economies from 1850 to 2015, revealing that while macroeconomic changes influenced the introduction of alternative procedures, national-level differences in change and bankruptcy features challenge the idea of legal system affiliation or economic development as sole determinants, indicating a complex interplay with state formation processes.

These studies, in summary collectively demonstrate the diverse range of methods employed to dissect the intricate connection between bankruptcy laws, economic policies, and their subsequent impacts on TFP growth.

3 Methodology and Data

3.1 Synthetic Control Method

The SCM has been widely employed in academia for policy evaluation in work by Abadie and Gardeazabal (2003: 113-132), Abadie, Diamond, and Hainmueller (2010: 493-505), Abadie, Diamond, and Hainmueller (2015: 495-510), Sampaio (2014: 1-14), Lin and Chen (2018: 734-750), Albalate, Bel, and Mazaira-Font (2021: 549-584), Xia and Wu (2021: 592-600), and Qi and Han (2021: 52431-52458), offering advantages over the Difference-in-Differences (DID) method by utilizing data-driven selection to construct a virtual control group most similar to the treated group. This method reduces subjective bias, addresses endogeneity concerns to some extent, and ensures evaluation reliability (Abadie, 2021: 391-425). In this study, SCM was applied to assess the impact of the AFOPBS intervention on TFP trajectory in Croatia, utilizing a single treatment group and timing (AFOPBS implementation at the end of 2012) and constructing a control group using economic counterparts from other countries. This research centres on a single treatment nation, specifically the Croatian economy, during a particular treatment period, which corresponds to the year 2013. This period is chosen as it aligns with the initiation of the first financial settlements, occurring with a relatively short time lag among debtors and creditors in our analysis.

The SCM enables the estimation of the impact of a specific event, referred to as the "treatment" even when a counterfactual scenario for the treated country is unobservable. The focal point of our study is the enactment of the pre-bankruptcy legislation, which we aim to analyze. To achieve this, counterfactual TFP values are simulated for Croatia (central to our research) using the SCM, illustrating potential deviations in the TFP trajectory if the country had not implemented the pre-bankruptcy act. By comparing the actual and counterfactual series, we assess the measurable causal effect of implementing the AFOPBS on TFP.

In this study, the treatments are represented by pre-bankruptcy settlements that trigger a distinct transition toward business restructuring. By leveraging a weighted average of TFP data from diverse economies across Europe, characterized by transparent bankruptcy regulations that underwent gradual reform, this approach facilitates comparison of TFP before and after bankruptcy reform in the treated country (Sadeghi and Kibler, 2022: 5). We have categorized the years from 2008 to 2012 as the pre-policy period, while the years spanning from 2013 to 2019 constitute the post-policy period. This distinction is rooted in the fact that the AFOPBS reform was formally announced in Croatia on October 10, 2012, and subsequently implemented across the entire nation after a short time lag.

The weights assigned to the control countries (referred to as "donors") are selected to ensure that the synthetic control exhibits characteristics that closely resemble the TFP patterns of the treated country before the modification in bankruptcy laws. Through the SCM, the disparity between the feature vectors related to outcome predictors of the treated nation and those of the synthetic control is minimized prior to the implementation of the treatment. Indeed, the weight calculations were derived by minimizing a distance matrix to ensure that the synthetic control closely mirrored Croatia's attributes in the pre-intervention timeframe. Subsequently, the impact of the policy for each time point in the post-intervention period was estimated by contrasting Croatia's observed outcomes with those generated by the constructed "synthetic control".

The timeline of SCM implementation, along with clarification steps, proceeded as follows: The assumption was made that pertinent TFP data for $K + 1$ countries were gathered statistically during the period $t \in [1, T]$, with country i (Croatia) being the subject of the AFOPBS intervention at $T_0\left(1 \leq T_0 \leq T\right)$, forming the experimental group. The remaining K countries constituted the control pool, encompassing nations that did not implement the pre-bankruptcy settlement. At time t, P_{it}^{Y} signifies the TFP values influenced by the intervention for country i, whereas $P_{it}N$ represents the TFP values for country i that remain unaffected by the pertinent mechanism. Let $a_{it} = P_{it}^{Y} - P_{it}^{N}$ denote the alteration in TFP values for country i, which is subject to the intervention policy, at time t. D_{it} is a binary variable indicating whether the country is implementing the "new legislation that addresses bankruptcy issues" at time t. This variable takes the value of 1 if country

i adopts the legislation at time t, and 0 otherwise. The TFP growth rate of country i at time t is represented as $P_{it} = P_{it}^{N} + D_{it}a_{it}$. For the control group throughout this period, P_{it} remains as P_{it}^{N}. However, for the experimental group, $a_{it} = P_{it}^{Y} - P_{it}^{N} = P_{it} - P_{it}^{N}$. In this study, the change in TFP values influenced by the policy intervention is denoted as a_{it}. Here, P_{it}^{Y} represents the observable TFP values influenced by the "pre-bankruptcy law" (AFOPBS). While P_{it}^{N} is not directly available, it can be estimated using the factor model proposed by (Xia and Wu, 2021: 1-10). The specific calculation formula is as follows:

$$P_{it}^{N} = \delta_t + \theta_t Z_i + \lambda_t \mu_i + \varepsilon_{it} \tag{1}$$

where δ_t is the time fixed effect and Z_i is the observed r × 1 dimension control variable, which is not influenced by the implemented policy. In this study, the various data are selected as control variables. The rationale for selecting those variables will be clarified later on. θ_t is the 1 × r dimension unknown parameter vector, λ_t is the common factor vector of the 1 × F dimension that cannot be observed, μ_i is the country fixed effect of the F × 1 dimension, and ε_{it} is the short-term shock that cannot be predicted and has an average value of 0. Under general conditions, $\sum_{k=2}^{K+1} w_k P_{kt}$ can be used as an unbiased estimate of P_{it}^{N} if the period before the policy intervention is longer than the period after policy implementation. Here, w_k represents the country specific weight in the SCM. Finally, the estimated a_{1t} of the policy influence effect is calculated as follows:

$$a_{it}^{\wedge} = P_{1t} - \sum_{k=2}^{K+1} w_k P_{kt}, t \in [T_0 + 1, \dots T] \tag{2}$$

Let Z_1 represent a k × 1 vector containing the pretreatment characteristics' values of the treated unit, while Z_0 is a k × J matrix comprising the values of the same characteristics for the donor units. The optimal weights W^* minimize the following expression:

$$\| Z_1 - Z_0 W \| = \sqrt{(Z_1 - Z_0 W)' V (Z_1 - Z_0 W)} \tag{3}$$

where V is a k × k symmetric and positive semi-definite matrix, and it reflects the relative significance of each predictor.

In our analysis, we employed the Root Mean Square Prediction Error (RMSPE) as a measure to quantify the disparity between the actual outcome of a country and the outcome predicted by its synthetic control counterpart. The RMSPE calculation is as follows:

$$RMSPE = \sqrt{\frac{1}{T}\sum_{t=1}^{T}\left(P_{1t} - \sum_{k=2}^{K+1} w_k \, P_{kt}\right)^2} \tag{4}$$

Where P_{1t} represents the actual value of the experimental group, w_k stands for the weight, P_{kt} signifies the value of the control group, and T denotes the number of time periods within a specific year. The early fit of the SCM, we emphasize, is crucial. An effective early fit (if occurs) indicates that the constructed synthetic control closely mirrors the pre-policy outcomes of the treated unit (or country). When the early fit is good, the difference in RMSPE values measured after and before the implementation of the policy serves as a reliable measure of the extent of influence exerted by the AFOPBS intervention. This difference in RMSPE provides valuable insights into the accuracy of the synthetic control model in replicating the actual post-policy outcomes of the treated unit, thereby shedding light on the effectiveness of the AFOPBS policy intervention. Conversely, if the RMSPE indicates suboptimal performance, we will initiate a restructuring process by forming a new control pool consisting of countries that exhibit relatively high weights assigned to the previously set of donors.

As of our last knowledge update in September 2021, there isn't a specific R package that directly provides an automated method for composing optimal donor weights to minimize the MSPE in the context of synthetic control methods. The process of finding optimal donor weights involves a try and error procedure. The "Synth" package in R provides a comprehensive set of tools for implementing synthetic control methods, but it might not directly offer a pre-built function for automatically composing optimal donor weights. The optimization process is often part of the synthesis step itself. Hence, we create the code that will loop through the different permutations of control sets, create dataprep objects for each scenario, perform synthesis, and store the MSPE values for each scenario. Finally, we will get MPSE values for all scenarios and within it one with optimal performance.

3.2 Placebo Tests

To assess the statistical significance of the AFOPBS intervention effect on TFP, we conducted placebo experiments through an iterative process of reassigning the treatment status to individual control units. For each of these "placebo-treated" units, we recalculated the treatment effect using the synthetic control method and then compared the resulting estimated treatment effect to a distribution of placebo effects (Kreif *et al.*, 2016: 1519). Specifically, we analyzed the proportion of placebo effects that exhibited at least as extreme absolute values as the estimated treatment effect for the country under investigation, such as Croatia. This examination allowed us to determine whether the impact of financial reform in Croatia exceeded what would be expected if the reform had been "randomly assigned" to another country.

3.3 Data Source

The data utilized in this study were sourced from publicly available country-level datasets, specifically the latest version 10.0 of the Penn World Table (GGDC, 2021) and the World Bank (World Bank, 2023). As a result, data were retrieved from two distinct online platforms. Pertaining to the outcome variable growth rate (real TFP - RTFPNA), information from the first source was employed spanning the years 2000 to 2019. For the covariates linked to each country and deemed relevant to the outcomes, we relied on data extracted from the World Development Indicators dataset.

3.4 Control Variables

To construct the synthetic controls, we included variables known from prior research to encapsulate the confounding factors that are likely to affect TFP. Table 1 presents these variables, which encompass a wide range of economic and demographic factors recognized for their influence on TFP.

3.4 Control Pool

In configuring the donor pool, our selection targeted countries sharing Croatia's level of development, predominantly encompassing several former socialists as well as other nations within the European Union (EU).

The set of 10 potential control countries, a noteworthy highlight, represents a sampling of economies that did not adopt the Pre-Bankruptcy Settlement Act during the analyzed time window. The donor countries include Austria, Bulgaria, Estonia, Spain, Greece, Hungary, Lithuania, Latvia, Poland, and Slovenia. Additionally, the one country subjected to intervention was treated as the focal point of the investigation, resulting in a final sample of 11 countries.

Our intention was to assemble a highly varied assortment of nations within the donor pool, aiming to comprehensively explore the mediated influence on TFP brought about by the AFOPBS in this analysis. This perspective is closely aligned with the "convergence theory" (Barro, 1998: 10), which posits that less developed countries are likely to experience faster growth rates during transition dynamics, contributing to a catching-up process with advanced economies. It is well recognized that long-term growth is substantially spurred by TFP advancements.

The selected "control pool" is consistent with the proposed co-predictors of TFP in the SCM, particularly in light of the hypothesis suggesting that the proliferation of the service economy may have contributed to weaker productivity growth compared to growth driven by manufacturing. Within the neoclassical growth framework, the equation for growth underscores technological progress translating into TFP advancements, acting as a pivotal driver of long-term economic expansion. The Solow residual, characterized by Solow as the "manna from heaven," is far from being a mere accounting artefact; rather, it plays a fundamentally important role in explaining the trajectory of real GDP per capita growth (Vollrath, 2019: 39).

Recognizing the significance as well as the challenges inherent in measuring it accurately, and acknowledging the plethora of potential contextual variables that can be drawn from endogenous growth empirics, we focus on variables (such as production, capital formation, employment distribution between service and manufacturing sectors, human capital, openness, labor economy issues) that might contribute to the volatile nature of TFP growth.

These factors collectively constitute a balanced selection of potential variables that could serve as co-predictors for TFP. Our approach is underpinned by the notion put forth by Ferranti (2012: 132-135), asserting that the demographic transition toward a services sector, along with the contemporary TFP growth observed in our dataset, were predominantly influenced by the following factors: the process of deindustrialization coupled with the expansion of the service industry, the role of physical infrastructure and employment as fundamental components in the production function, and the concept of output per capita as a catalyst for perpetuating technological change and enhancing productivity through the principle of "learning by doing."

3.6 Cross-Validation

For the purpose of cross-validating the estimates of the pre-bankruptcy reform effect derived from the SCM, an additional analysis was conducted the PDID method. The specific steps of the PDID analysis are outlined as follows:

$$Y_{it} = \beta_0 + \beta_1 Treat_{it} Post_{it} + \sum_{k=1}^{10} \gamma_k Z_{itk} + u_i + \tau_t + \varepsilon_{it} \quad (5)$$

Here, Y_{it} represents the TFP outcome variable for Croatia at time *t*, and both $Treat_{it}$ and $Post_{it}$ are dummy variables specific to country *i* and time *t*. The coefficient β_1 of the interaction term $Treat_{it} \times Post_{it}$ captures the effect of the pre-bankruptcy act on TFP. Additionally, Z_{itk} (where *k*=1,2,...,10) represents the control variables, u_i is the individual fixed effect term, and τ_t is the time-fixed effect term. For our analysis, we continue to consider Croatia as the treatment unit, with the remaining countries serving as the reference group.

4 Results

4.1 Baseline Results

In the initial phase, adhering to a "general to specific" approach, we embarked on the task of optimizing the composition of the control pool, which consists of 10 countries with features outlined in the control pool section within the methodology chapter. In order to capture the diverse array of economic, social, and policy factors that may influence the trajectory of our treated unit, we set a minimum threshold of 10 countries in our control pool. This approach was motivated by the need to provide a rich set of potential matches for our treated unit, contributing to the credibility of our results. We systematically generated permutations by iteratively excluding one donor country at a time from the sorted dataset.

We then proceeded to evaluate the various simulating scenarios, each corresponding to one of the permutations we generated. For each scenario, we created a dataset using the treatment unit (Croatia) and one of the control sets from the permutations. Subsequently, we conducted the synthesis and calculated the RMSPE for each scenario. Our goal was to identify the scenario that resulted in the lowest MSPE, indicating the most appropriate set of control units for the synthesis.

Our calculations, reveal that one of the simulating scenarios, with a specific set of donor countries, produced the minimum RMSPE (0.006475). The control set was meticulously curated to include the following countries: Austria, Bulgaria, Estonia, Spain, Greece, Hungary, Lithuania, Latvia, Poland, and Slovenia.

Utilizing the SCM, we estimate what the TFP in Croatia would have been if the AFOPBS had not been approved. This estimation is based on a carefully designed set of donor countries that represents the best-case scenario.

In this analysis, we consider TFP growth rate and incorporate the control factors discussed in the earlier data section to approximate the outcome variable. We explore all possible combinations of control countries to achieve the closest match to Croatia's actual TFP and its characteristic variables before the treatment period, specifically, pre-2013, preceding the adoption of the pre-bankruptcy reform.

The optimal match for Croatia's TFP (the outcome variable) and other characteristic variables, such as the minimum distance between synthetic and actual outcome and characteristic variables, is achieved using the corresponding weights of control countries, as detailed in Table 2.

These weights for the control countries are determined through the minimization problem outlined in Equation 5. To synthesize the counterfactual results, we assign weights to each country in the control group, and these weights are displayed in Table 2. Notably, Table 2 reveals that TFP in Lithuania, Greece, and Hungary carries the highest weight, each at 99.998%, while Bulgaria and Poland contribute with minimal weights of approximately 0.001% each.

In Table 3, we compare the mean values of the outcome variable and covariates in Croatia and the synthetic control created through the minimization process, along with the averages of all countries in the donor pool during the pre-policy period. As depicted in Table 3, the disparities between actual and synthetic outcomes, as well as characteristic variables, are notably small.

Both realized and synthetic TFP growth is depicted in Figure 1. As illustrated in the graph, a close alignment exists before the treatment period (2008–2013), indicating our effective preliminary work in selecting the optimal donor pool and control variables. Following the treatment period, the series labelled 'synthetic Croatia' illustrates the estimated TFP growth Croatia would have experienced if the pre-bankruptcy act had not been adopted. The figure reveals a distinctive pattern with two sinusoidal curves intersecting three times during the post-intervention period.

The impact of the AFOPBS, as observed in Figure 1, was not immediate and varied over time. In the short term, spanning from 2013 to 2015, the policy change led to instantaneous disruptions and adjustments that temporarily lowered TFP growth. This could be attributed to businesses struggling to adapt to new regulations and other transitional challenges. However, a noteworthy shift occurred after 2015, where realized TFP growth outperformed its synthetic counterpart for the following two years until 2017.

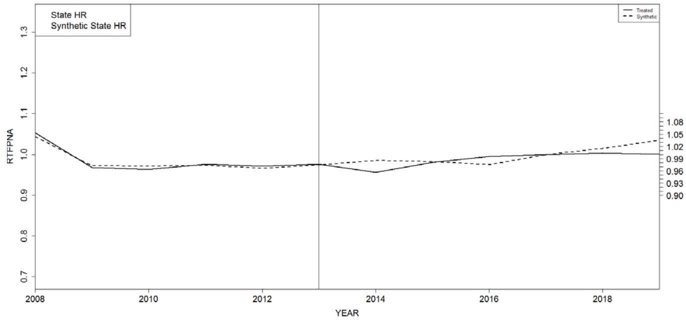

Figure 1: The TFP growth in real and synthetic Croatia
Source: Authors' calculation.

Despite these marked positive signs, we also acknowledge that policies like those under AFOPBS, even when well-intentioned, can sometimes yield unintended consequences. In light of this, the negative impact observed in the short term (2017-2019) warrants further investigation to comprehend the underlying factors contributing to it. This exploration will help determine whether these effects were solely due to the treatment itself or influenced by external factors.

Importantly, it is encouraging to highlight that the gap in TFP growth is gradually narrowing over time, with an average reduction of -0.055% during the post-treatment period. This suggests that the treatment may indeed be having a positive, albeit gradual, effect. This perspective is particularly relevant given our belief that the treatment's objectives were, or should have been, oriented toward long-term outcomes.

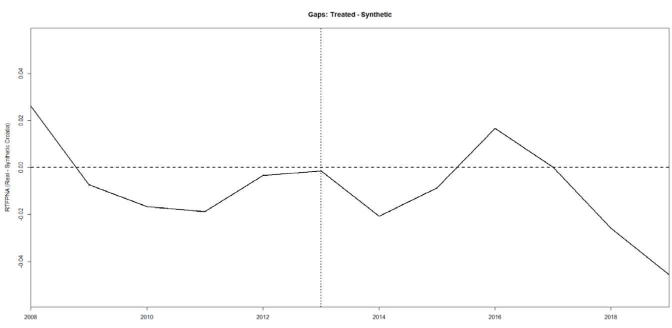

Figure 2: The TFP growth gap between real Croatia and synthetic Croatia
Source: Authors' calculation.

Figure 2 above illustrates the evolution of the TFP growth gap, providing a comparative view of Croatia and the synthetic control group. Notably, this visual comparison highlights two distinct short-term negative effects resulting from the implementation of the AFOPBS on Croatia's TFP growth.

The two distinct phases of convergence and divergence, as depicted by the cumulative gap values, reflect the dynamic impact of the AFOPBS policy on Croatia's TFP evolution. While the early years post-treatment witnessed a rapid convergence, the subsequent years demonstrated a concerning decline in Croatia's TFP growth, underscoring the need for a comprehensive analysis of these shifts. Our results contradict those of authors (Sadeghi and Kibler, 2022: 5), who utilized the same method as we did and found no effect whatsoever on the outputted economic indicator. Additionally, their robustness tests indicate a zero-effect impact of bankruptcy reform in 2004 on the overall level of entrepreneurial activity in Finland.

4.2 Robustness Tests

In this analysis, we employ in-space placebo tests to compare the estimated treatment effect for treated Croatia with all the (simulated) treatment effects of the control countries. These simulated effects are derived from experiments where each control country is hypothetically affected by the same event (the pre-bankruptcy reform) in the same year (2013) as treated Croatia. If the estimated effect in treated Croatia is larger than the majority of the effects obtained from these simulated experiments, it allows us to conclude that the observed findings are not attributable to chance. In such a scenario, we can confidently attribute the effect to the adoption of AFOPBS.

The p-value derived from the post/pre-treatment MSPE ratio for treated Croatia and the placebo tests is relatively high (0.18). This p-value is often used to assess the validity of the synthetic control approach. In general, a higher p-value suggests that the synthetic control approach is performing well because it indicates that the actual treated Croatia is not an extreme outlier in terms of prediction error. None of the placebo effects were found to be as significant as the estimated effect in Croatia regarding TFP outcomes (as shown in Fig. 3). Only one country, Spain, exhibited a placebo effect greater than that of Croatia in the TFP movement scenario, indicating a substantial policy effect stemming from the pre-bankruptcy settlement or financial reform.

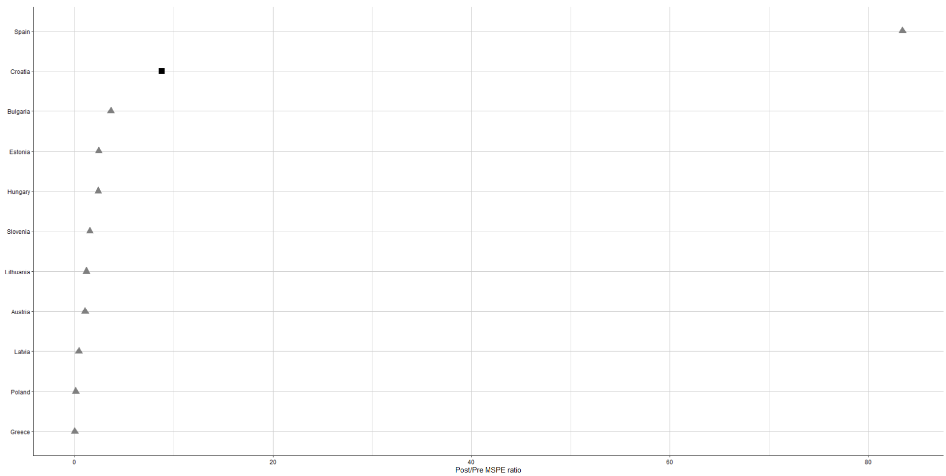

Figure 3. The Ratio of post-intervention MSPE and pre-intervention MSPE: Croatia and donor pool
Source: Authors' calculation.

It's worth noting that, following the standard practice of Abadie, Diamond, and Hainmueller (2010), we may choose to exclude Spain due to pre-policy MSPE values of TFP that were more than five times greater than the MSPE observed in Croatia during the placebo test analysis. We interpret these seemingly substantial placebo effects in the excluded country, Spain, as a result of a lack of fit rather than the effect of the assumed reform.

The placebo testing suggests that our synthetic control approach provides a good match for Croatia's post-treatment outcomes, and there is no strong evidence to suggest that Croatia's outcomes significantly deviate from what would be expected based on the control group. In other words, we can conclude that we are observing a treatment effect that exceeds what would typically occur by chance.

In the context of placebo testing, we constructed Table 4 Post/Prior RMSPE ratio. The provided data offers valuable insights into the effectiveness of the intervention in Croatia, serving as a focal point for understanding its impact on neighbouring countries. The data encompasses a diverse set of countries, each subjected to a hypothetical intervention akin to Croatia's pre-bankruptcy reform. These countries serve as a control group, enabling a comparative assessment of the treatment's outcomes.

The Prior-Intervention RMSPE values quantify the predictive accuracy of the model before the intervention, with lower values reflecting a more precise fit of the model to historical data, whereas the Post-Intervention RMSPE values depict the predictive accuracy of the model after the intervention. Notably, countries like Austria, Bulgaria, Estonia, Hungary, Lithuania, Latvia, Poland, and Slovenia exhibit a substantial increase in prediction errors, suggesting a detrimental impact of Croatia's intervention. Spain stands out with an exceptionally high Post-Intervention RMSPE, reflecting a substantial decline in predictive accuracy. This may be due to factors unrelated to the assumed reform. In contrast, Greece emerges as a success story, with a significantly lower Post-Intervention RMSPE, indicating a positive influence of Croatia's intervention on predictive accuracy. Croatia, as the treated country, experienced an improvement in predictive accuracy, with a lower Post-Intervention RMSPE, indicating a positive impact on its own outcomes. The analysis underscores the importance of assessing spillover effects, as the impact of Croatia's intervention varies across countries. Some neighbouring nations experience adverse effects, while others benefit from improved predictive accuracy.

In summary, the placebo testing and RMSPE analysis provide a robust framework for evaluating the effectiveness of the pre-bankruptcy reform in Croatia and its varying impacts on neighbouring countries. It allows us to discern the diverse impacts on neighbouring countries, emphasizing the need for a nuanced understanding of spillover effects and the potential for reforms to influence predictive modelling accuracy.

In addition to the placebo test, we employed the PDID method for cross-validation of our previous results. The results are presented in Table 5.

Irrespective of whether control variables (including production, capital formation, employment distribution between service and manufacturing sectors, human capital, openness, and labor economy issues) are included or not, the results consistently indicate a significant impact of the AFOPBS (pre-bankruptcy act) on reducing TFP movements in Croatia, accounting for both time and county fixed effects (mod-3 and mod-6). This robust effect of the AFOPBS, in this paper, is further substantiated. The consistent negative effect of the AFOPBS on TFP is observed across these different specifications, varied by the inclusion of control variables, time-fixed effects, and country-fixed effects.

5 Conclusion

TFP is a crucial economic indicator as it plays a pivotal role in improving the standard of living for the average individual in Croatia. In 2013, with a short time lag, the initial impacts on TFP materialized following the adoption of the AFOPBS. Croatia recently enacted this Act to enhance the payment process among economic entities, alleviate liquidity issues, and revitalize the economy after experiencing a severe recession. This measure aimed to shorten the duration of challenging economic years.

Through the SCM, we evaluated the effectiveness of the AFOPBS in potentially enhancing the trajectory of TFP, a fundamental driver of long-term improvements in living standards. The findings reveal a significant decrease in TFP shortly after the adoption of the AFOPBS in 2012, compared to the pre-reform period. By 2015, Croatia's TFP declined relative to synthetic Croatia, with another phase of decreasing trends emerging after 2017. Only the intermediate period experienced a brief upswing in TFP. Importantly, all of these effects withstood robustness tests, including placebo examinations and cross-validation using the PDID method.

This study demonstrates that, as a remedial policy aimed at addressing liquidity issues in Croatia, the AFOPBS has yielded mixed results regarding TFP. Both the initial and subsequent impacts of the AFOPBS on TFP reduction are statistically significant. It raises the question of whether the movement in TFP can be attributed to the introduction of the AFOPBS in 2012. While it is possible, the determination of whether these consequences are positive or negative is not straightforward.

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Appendix

Table 1: List of Confounding Variables and Their Explanations

Variable	Explanation
GDPPC	Gross Domestic Product per capita (current US$)
UEM	Total unemployment (% of labor force)
TLFPR	Labor force participation rate (%)
EMPPOP	Employment to population ratio (%)
GCF	Gross capital formation (% of GDP)
FDI	Net inflow of foreign direct investment (current US$)
PRMENR	Primary school enrollment (%)
INDEMP	Employment in industry (%)
SRVEMP	Employment in services (%)
EXPGNS	Exports of goods and services (% of GDP)

Source: The World Bank (World Bank, 2023.)

Table 2: Country Weights for the Synthetic Controls

Unit numbers	Country	Weight
1	Austria	0
2	Bulgaria	0,001
3	Estonia	0
4	Spain	0
6	Greece	0,283
8	Hungary	0,221
11	Lithuania	0,494
12	Latvia	0
13	Poland	0,001
16	Slovenia	0
		1,000

Source: Authors' calculation.

Table 3: Predictor Balance for TFP

	Treated	Synthetic	Sample Mean
GDPPC	0,986	0,985	0,966
UEM	14388,878	17469,922	21056,861
TLFPR	11,792	12,913	11,357
EMPPOP	52,406	54,341	56,831
GCF	46,245	47,301	50,378
FDI	22,894	19,693	22,945
PRMENR	4,336	4,848	4,974
INDEMP	93,497	100,315	101,271
SRVEMP	28,635	25,392	27,971
EXPGNS	57,917	65,855	64,412

Source: Authors' calculation.

Table 4: Post/prior RMSPE ratios for the TFP growth rate in Croatia and the control countries

Country	Prior Intervention RMSPE	Post Intervention RMSPE	Ratio
Austria	0,009	1,034	109,883
Bulgaria	0,009	1,915	207,161
Estonia	0,012	1,561	128,742
Spain	0,002	9,137	5529,906
Greece	0,133	0,167	1,255
Hungary	0,010	1,548	148,060
Lithuania	0,016	1,099	66,743
Latvia	0,045	0,666	14,668
Poland	0,023	0,362	15,690
Slovenia	0,019	1,241	64,979
Croatia	6,977	2,973	0,426

Source: Authors' calculation.

Table 5: PDID Estimation Results of the AFOPBS Effects on TFP in Croatia

Variable	mod-1	mod-2	mod-3	mod-4	mod-5	mod-6
treat*post	-0.083* (0.041)	-0.109* (0.034)	-0.157* (0.029)	-0.072* (0.032)	-0.116* (0.048)	-0.024* (0.025)
Control variables	NO	YES	NO	YES	YES	YES
Time fixed	NO	NO	YES	NO	YES	YES
Country fixed	NO	NO	YES	YES	NO	YES
R^2	0.121	0.158	0.356	0.324	0.329	0.278
Num. obs.	300	300	300	300	300	300

Source: Authors' calculation.

*Notes: *p < 0.05; the "*" symbol indicates statistical significance and values in parentheses represent standard errors.*