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THE IMPROVEMENT OF THE WASTE MANAGEMENT SYSTEM IN KAZAKHSTAN: IMPACT EVALUATION

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Abstract: Many countries are updating their consumption models from the conventional linear model to circularity in an era of overconsumption and, as a result, steady growth in waste. One of the important markers of the circular economy is waste management. This study aims to analyze the potential of improving the waste management system with the implementation of the Action Plan for the transition to a circular economy. Analysis of panel data with fixed and random effects and the synthetic control method were used. Data was collected for Kazakhstan and 27 European Union countries for the period 2010-2020. Appropriate tests, such as the Fischer test, Wald statistics, and placebo test, were carried out for reliability and adequacy of the research results. Results showed that the recycling rate of municipal waste in Kazakhstan would be significantly higher if the Action Plan for the transition to a circular economy were adopted. Conclusions and recommendations have been drawn based on the findings and analysis.

Keywords: waste management, recycling rate, circular economy, synthetic control method.

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Introduction

The global dilemma in the modern world is to transform the existing consumption model based on production-consumption-waste into a circular economy (CE), which is regenerative and based on production-consumption-reuse. The circular economy was founded on the 3R (reduce, recycle, reuse) premise, which has since been expanded to 10R (refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, recover).

One of the first stages of the introduction of the circular economy is the strengthening of the waste management system. Waste creation is reduced in a circular economy via careful product design and a manufacturing process in which resources are constantly circulated in a "closed system". Waste has become a global phenomenon, and raw commodities are in higher demand than ever. It is estimated that roughly 80% of all materials and consumer products are discarded, and more than 30% of processed food is discarded after it enters the food supply chain (Cichocka, 2020).

The problem of waste recycling is being actively discussed and implemented in the EU, China, and the USA both at the national and industry levels. In developing

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countries, including Kazakhstan, waste management is non-centralized, manifested in certain areas of business or industries. There is no systemic and widespread. In this regard, the purpose of this study is to assess the potential for improving the waste management system in Kazakhstan through the introduction of government measures to develop a circular economy.

The article is structured as follows. The literature review is presented in the second part of the article, focusing on waste management and recycling problem, also on the research methodology for the development of circular economy indicators in various countries. The methodology is presented in the third chapter covering the hypothesis, data, research methodology, and proposed model. The fourth chapter presents the actual data analysis, including econometric panel data analysis and results of the synthetic control method, also results of relevant tests to check the adequacy of the model. Then, the conclusions and the recommendations are presented.

Literature Review

Conceptual Review

The circular economy fosters environmental conservation and social prosperity while providing economic growth that is consistent with long-term development. The circular economy may both reduce environmental devastation and boost the generation of new value-added across the system. According to the European Commission (EC), the transition to a circular economy will result in an additional 600 billion euros in yearly economic benefits for the European Union's (EU) manufacturing sector (Korhonen et al., 2018).

In this regard, the European Commission announced its first circular economy action plan in 2015. It contained policies to help Europe transition to a circular economy, increase global competitiveness, advance long-term economic growth, and create new jobs. This action plan included some rather lofty goals. In order to speed things up, even more, the New Action Plan was adopted in 2020. It's one of the cornerstones of the European Green Deal, the EU's new strategy for long-term growth. The new Action Plan, which builds on previous efforts, focuses on design and production for the circular economy, with the goal of ensuring that the resources utilized remain in the EU economy for as long as feasible.

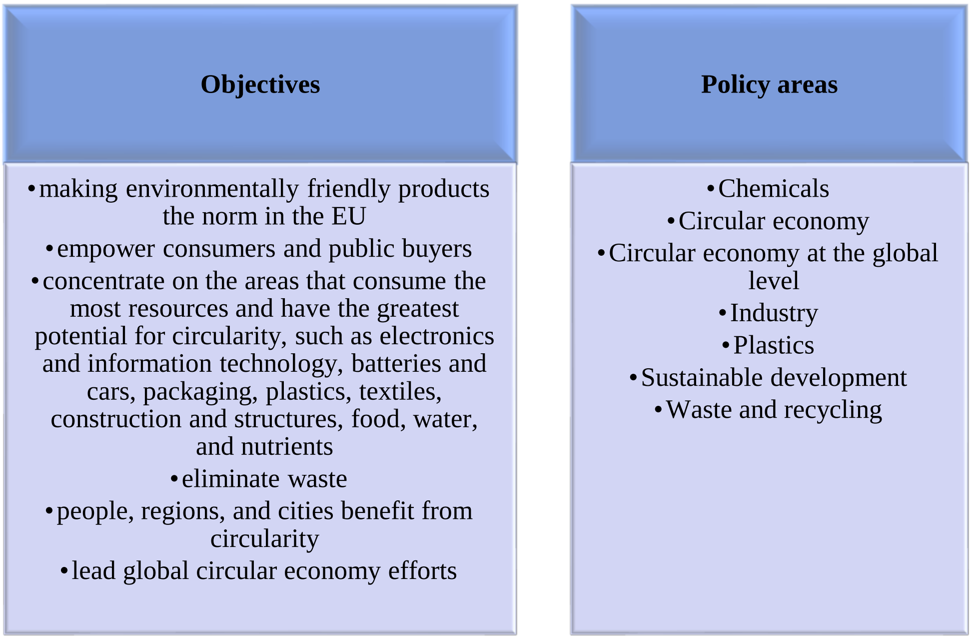

Figure 1: Objectives and policy areas of the New Action Plan.

Recycling and waste management are significant and urgent in the attention of not only the European Commission but also governmental organizations around the world, as shown in Figure 1. To reduce the detrimental effects on the environment, efficient waste management is required. Recycling operations provide economic and social value as well as environmental benefits (Malinauskaite et al., 2017; Chen and Tung, 2010; Deja et. al, 2021) and are one of the primary methods indicated for sustainable development.

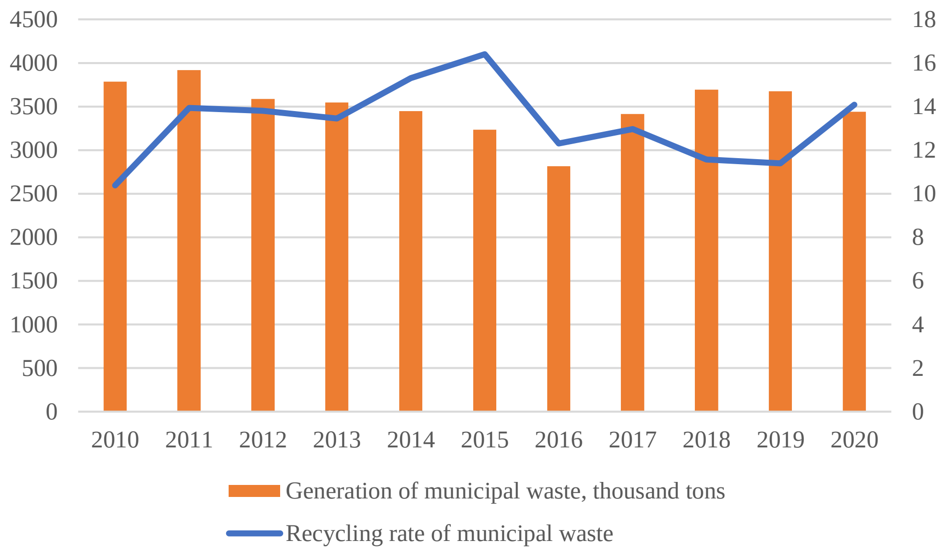

Figure 2: Generation and recycling rate of municipal waste in Kazakhstan.

In Kazakhstan, the recycling rate of municipal waste has an ambiguous dynamic but remains at a low level compared to other countries. It should also be considered that the increase in the generation of municipal waste, especially in recent years, exceeds the increased level in their recycling (Figure 2).

The central indicator for measuring the transition to a circular economy is the recycling rate, the prevailing standard due to current legislation, which is thus included in the series of long-term reports. The European Union, for example, has increased – based on the Circular Economy Action Plan – recycling targets for various materials contained in municipal solid waste, thereby seeking to increase the recycling of these materials (Fellner & Lederer, 2020; Bien, 2022). China also uses a "recycling factor" to process non-hazardous and hazardous industrial waste. On the contrary, the scientific literature includes a rich set of indicators for measuring the circular economy that have been proposed and tested in recent years. They range from simple indicators of recycling and waste disposal to resource productivity, substitution factors, inventory availability, material storage time, and product complexity factors (García-Barragán et al., 2019; Moraga et al., 2019; Parchomenko et al., 2019). However, comprehensive measures of circularity outcomes are not available in many countries.

At the same time, the preferred measures should aim to achieve the overall goals of the circular economy, which ultimately include reducing waste (to be recycled) and reducing the demand for primary raw materials, since both are associated with significant environmental impacts and face with global restrictions. When these two goals (reduced waste and reduced demand for raw materials) are taken into account, it becomes apparent that the recycling rate – probably the only publicly available CE indicator –combines the solution of the main aspects of these goals.

Empirical review

Econometric and economic studies quantifying the influence of environmental and waste management policies on the economic development of different countries abound in recent decades' economic literature.

The Computable General Equilibrium (CGE) model was used by Sjöström and Stblom (2009) to examine the solid waste program management relationship. To forecast the growth of waste in Sweden through 2030, the authors created a baseline scenario and four alternative scenarios. The scenarios differ in terms of GDP growth rates and projections regarding future waste intensity in enterprises and households' economic activities. As a consequence, it was established that in all scenarios, the impact of economic expansion on the increase of waste generation is visible. On the contrary, technological changes that lead to less intensive production processes and changes in the behavior of households, as a result of which their activities become less wasteful, have a strong reducing effect (Zielińska, 2020).

Busu (2019) used multiple linear regression to assess the relationship between the circular economy and economic growth. As a result of the data analysis from the European Union’s 27 countries, it was concluded that renewable energy factors, resource productivity, recycling speed, environmental employment, and innovation have a statistically significant effect on economic growth.

Other researchers analyzed the impact of circular economy indicators on economic growth using panel data from EU members. The findings support the conclusion that implementing the circular economy idea can boost economic growth and GDP while reducing natural resource use and improving environmental protection (Grdic et al., 2020; Hysa et al., 2020).

A predictive model was built in the study by Aguilar-Hernandez et al. (2021). After considering more than 300 ambitious and forward-looking scenarios for the transition to a circular economy at the national and interregional levels, the authors examined the impact of the circular economy on changes in gross domestic product, employment, and carbon dioxide emissions into the atmosphere. As a result, it was determined that by 2030 the development of indicators of the circular economy, in particular taxes on resources, technological changes, and consumption patterns, will contribute to a gradual increase in GDP, employment, and reduce CO_2 emissions.

Skvarciany et al. (2021) assessed the impact of a country's circular economy on the sustainable development of OECD countries using the Analytic Hierarchy Process (AHP) and the Evaluation Based on Distance from Average Solution (EDAS) methodology, as well as fixed effect panel data analysis. As a consequence, the hypothesis that the circular economy directly impacts and assists the sustainable development of the country was confirmed.

Dragoi et al. (2018), based on a cointegration analysis using a vector autoregression model, determined that the Romanian economy has the potential for a paradigm transformation, becoming cyclical. Apart from changing the national economy's paradigm, it's also worth considering the added economic value that the circular economy can generate through its environmental and social aspects, thereby expanding the potential to restore the economy's components and structures by promoting sustainable consumption, reducing energy consumption, and reducing environmental pressure.

Econometric approaches were also used by Pelau and Chinie (2018) in their research. The authors discovered a link between education and waste recycling levels using panel data analysis. As a result, it was discovered that a large proportion of the population with just elementary or partial secondary education had a negative impact on waste recycling in the economy, whereas higher education has a favorable impact. As a result, numerous measures targeted at raising the population's level of education will have a favorable impact on the recycling rate.

In the study by Tantau et al. (2018) recycling of municipal waste, as in our study, was considered as one of the most important indicators of the circular economy and was chosen as the dependent variable of the regression model. The authors analyzed panel data, including data from EU countries for the period 2010-2014. Even in such a short period, a statistically significant impact of independent variables, such as R&D costs, trade-in recyclable materials, environmental taxes, resource productivity, and material use, on the development of a circular economy was determined. Moreover, the Durbin-Hausman-Wu tests showed that the random-effects model is statistically more significant than the fixed-effects model. This conclusion was also confirmed in our study.

Based on the literature review, one can conclude that many researchers have used econometric methods to analyze the development of the circular economy's indicators in different countries. However, the synthetic control method for impact evaluation of a certain treatment on the development of indicators of the circular economy was not used.

Research Methodology

Due to the ambiguity of changes in the recycling rate in Kazakhstan, this study aimed to assess at what level the recycling of municipal waste would be in Kazakhstan if the country adopted an Action Plan for the transition to a circular economy like in the EU.

The authors put forward the following hypothesis:

Hypothesis: if the Action Plan for the transition to a circular economy is adopted in Kazakhstan, as in the European Union, the recycling rate of municipal waste would have a steady positive trend and would be much higher.

In order to analyze the level of recycling in Kazakhstan and Europe, the recycling rate of municipal waste was chosen. It is the dependent variable in the econometric model.

The rate of municipal waste recycling is one of several circular economy metrics. It is used to track progress in the Waste Management focal area toward a circular economy. In a circular economy, the indicator reveals how end-user waste is utilized as a resource. Municipal waste is mostly end-user waste since it contains domestic waste as well as waste from other sources that are similar in nature and content to household waste. The sensible handling of municipal waste is difficult due to its varied nature. The rate of municipal waste recycling is a good measure of the overall waste management system's quality.

The indicator measures the municipal waste's percentage that is recycled. Material recycling, composting, and anaerobic digestion are all examples of recycling.

As new data are disseminated within two years of the reference year, data was collected for 2010-2020.

As independent variables were chosen GDP growth, population, and generation of municipal waste. All data are collected for the same period for 27 EU countries and Kazakhstan.

Data "recycling rate of municipal waste" and "generation of municipal waste" for the EU are obtained from the database of the European Commission in the section of indicators of the circular economy, for Kazakhstan in the database of the "Bureau of National Statistics of Agency for Strategic planning and reforms" of the Republic of Kazakhstan.

The "GDP growth" and "Population" data were collected from the World Development Indicators of the World Bank database.

Table 1 provides descriptive statistics on the data used for the analysis.

Table 1. Descriptive statistics.

Variable	Obs	Mean	Std. dev.	Min	Max
Recycling rate	308	34.75	16.11	4	67.2
GDP growth	308	1.5	3.15	-10.82	9.61
lnPop	308	15.92	1.29	12.93	18.2
lnGeneration	308	8.25	1.27	5.55	10.87

The analysis began with the construction of multiple linear regression. For this data structure, the panel data model is the most suited study instrument. For each object, panel data comprises both spatial and time-series data. When panel data is used, it is feasible to regulate the individual heterogeneity of economic items, which is not attainable with time series or spatial type models. Furthermore, neglecting it increases the risk of biased estimates. It is possible to examine their individual differences, taking into consideration the impact of unobservable elements in particular. The book Baltagi (2013) contains a list of panel data model attributes. The results were checked for validity and adequacy using Student's, Fisher's tests, and Wald statistics.

The synthetic control method was used to test the research hypothesis at the second stage of the analysis.

The synthetic control method aims at assessing the effects of the impact under study (in this case, the implementation of an action plan for the transition to a circular

economy) on the example of a small number of cases by modeling their quantitative indicators in a hypothetical situation, based on a limited range of similar control observations by assigning certain weights to these variables (Abadie & Gardeazabal, 2003; Abadie et al., 2010).
Let Y_{it}^0 be the outcome (Recycling rate of municipal waste) that would be observed for country i (Kazakhstan) at time t in the presence of the intervention (Action Plan of the transition to circular economy) for units $i = 1, \dots, J + 1$ and time periods $t = 1, \dots, T$. The intervention period is T_0, where $1 \leq T_0 \leq T$. Let Y_{it}^1 represent the outcome for country i at time t when the country is exposed to the intervention between $T_0 + 1$ and T. The treatment effect (intervention impact) for country i can then be described as $\tau_{it} = Y_{it}^1 - Y_{it}^0$. Between $T_0 + 1$ and T, however, Y_{it}^1 is detected and Y_{it}^0 is not. To determine the impact of the intervention, Y_{it}^0, the counterfactual, must be estimated.
Abadie et al. (2010) used the following model for potential outcomes to explain how to determine the treatment effect, τ_{it}:

$$Y_{it}^0 = \delta_t + Z_i\theta_t + \lambda_t\mu_i + \varepsilon_{it} \tag{1}$$

$$Y_{it}^1 = \delta_t + \tau_{it} + Z_i\theta_t + \lambda_t\mu_i + \varepsilon_{it} \ , \tag{2}$$

Z_i is a vector of relevant observed covariates (either time-varying or time-invariant) that are affected by the intervention, θ_t is a vector of parameters, λ_t is an unknown common factor, μ_i is a country-specific unobservable, ε_{it} is a transitory shock with a zero mean, and τ_{it} is a dummy variable that takes value 1 for the treated unit and 0 otherwise.
Suppose that the first country (Kazakhstan), $i = 1$, receive the treatment (Action Plan of the transition to circular economy) and the remaining J countries, $i = 2, \dots, J + 1$, do not receive. The proposed data-driven strategy is to approximate Y_{it}^0 by a weighted average of Y_{it}^1, considering the covariates Z during the pre-intervention period, $t \leq T_0$, as follows:

$$Y_{1t} = \sum_{i=2}^{J+1} w_i^* Y_{it} \tag{3}$$

$$Z_1 = \sum_{i=2}^{J+1} w_i^* Z_i, \tag{4}$$

$\sum_{i=2}^{J+1} w_i = 1$ and $w_i \geq 0$ are satisfied by the weights w_i. These two assumptions for the weights ensure that the model's results are not extrapolated. Finally, the treatment effect can be calculated using the following formula:

$$\widehat{\tau_{it}} = Y_{1t} - \sum_{i=2}^{J+1} w_i^* Y_{it} \ for\ t = T_0 + 1, \dots, T. \quad (5)$$

The key notion is that the synthetic control uses the weighted average of all control countries to simulate the counterfactual of the treated country that would have occurred in the presence of the intervention. Consider $X_1 = (Z_1, Y_{11}, \dots, Y_{1T_0})$ as the vector of pre-intervention characteristics for country $i = 1$, and $X_0 = (Z_j, Y_{jt}, \dots, Y_{jT_0})$ as the matrix of the same characteristics for the control units $j \in [2, j+1]$ for the best W^* choice. The synthetic control method calculates the unobserved counterfactual as a weighted average of the control countries' results, with weights set to mimic the afflicted country's pre-intervention characteristics (Aytug et al., 2017; Sansyzbayeva et al., 2020).

Abadie and Gardeazabal (2003) recommended limiting the range of prospective control countries, that is the donor pool, and defining a selection criterion when choosing them. In our situation, we chose 27 EU countries that adopted the Transition to the Circular Economy Action Plan in 2015 as donor pool.

The research is based on an annual frequency panel dataset spanning 28 countries from 2010 through 2020. As a result, the time before and following the approval of the Transition to a Circular Economy Action Plan in 2015 is sufficiently covered for empirical research.

Placebo tests were performed to check the results for validity. The placebo test for inference iteratively reassigns each country in this donor pool as the treated unit and applies the synthetic control method. Also, it obtains a permutation distribution of placebo treatment effects, and also compares the treated effect of the treated unit with the permutation distribution. The estimated treatment effect is statistically significant if its magnitude is extremely relative to the permutation distribution.

Research Results and Discussion

Before econometric modeling of the data, a comparative analysis of the main indicators of the circular economy in this study should be carried out.

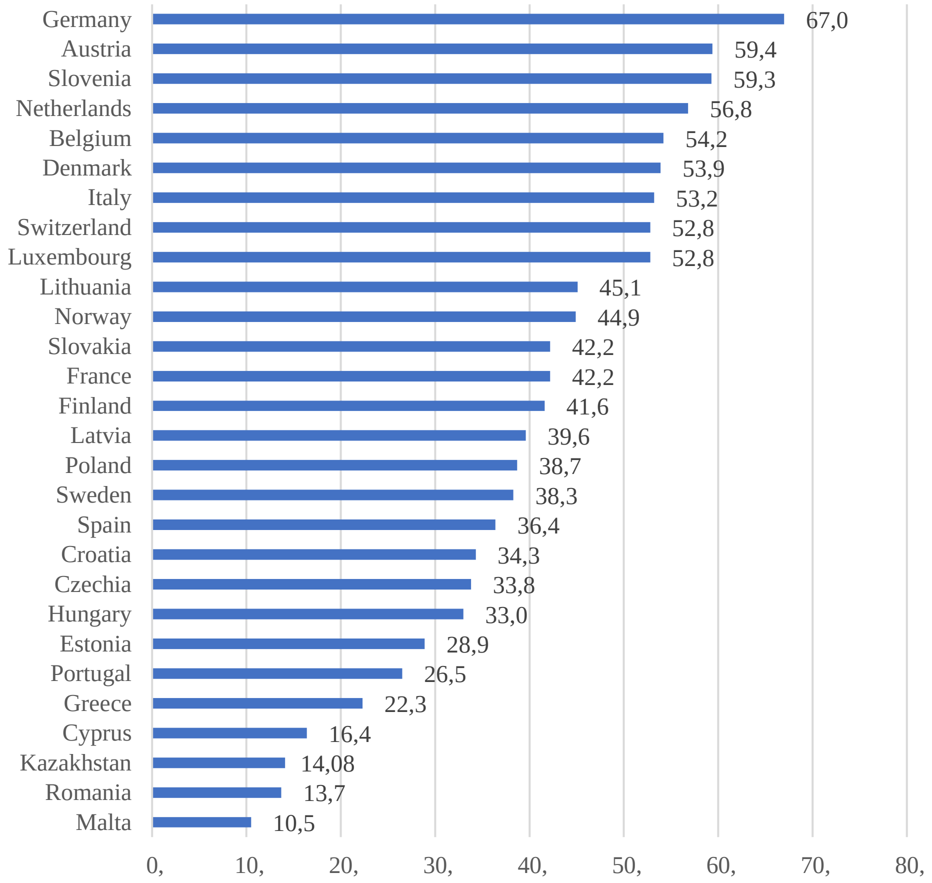

Figure 3: Recycling rate of the municipal waste, % (2020).

The undoubted leader in the recycling of municipal waste from all EU countries is Germany. More than 50% of the waste is also recycled in Austria, Slovenia, Netherlands, Belgium, Denmark, Italy, Switzerland, and Luxembourg. In one-third of the EU countries, the recycling rate of municipal waste exceeds 50%, which shows the effectiveness of Action Plan 2015. In addition, the New Action Plan adopted in 2020 aims to accelerate measures of the first plan.
Despite the steady growth of the recycling rates in EU countries for the past 5 years according to Eurostat data, the recycling rate of municipal waste in Kazakhstan is higher than in some countries in the EU (13.7% in Romania and 10.5% in Malta).
The panel data analysis' results, where the recycling rate of municipal waste is selected as the dependent variable, are presented in Table 2.

Table 2. Results of the analysis of panel data.

Variable	Fixed-effect	Random-effect
GDP growth	-0.1 (0.12)	-0.03 (0.12)
ln(Population)	-5.81*** (1.31)	-2.22*** (0.38)
ln(Generation of waste)	2.5*** (0.38)	2.48*** (0.38)
Constant	75.48*** (20.01)	18.2*** (3.83)
Number of observations	308	308
Number of groups	28	28
Test for significance	F(3, 277) = 16.14 [0.0000]	Wald chi2(3) = 53.24 [0.0000]

Note: *, **, *** - significance of coefficients at 10%, 5%, and 1% levels, respectively

Almost all variables presented in Table 2 have significant coefficients at the 1% level, except for the GDP growth rate variable, which has a non-statistically significant coefficient.

The Wald statistic Chi2(3) is used as a quality measure of the estimated models in GLS computations for panel data with random effects. The statistical significance of panel regressions with random effects is confirmed by the values in Table 2.

Hausman test supports the preference for the random effects panel data model rather than the fixed effects panel data model. In addition, the robust estimates of the coefficients' significance taking into account the influence of possible heteroscedasticity shown in Table 2.

The signs of the coefficients correspond to their economic meaning. It is quite logical to assume that an increase in the generation of waste in the country, the coefficient of which is positive, should also contribute to an increase in the recycling rate of municipal waste. The negative sign of the coefficient of variable population corresponds to the fact that population growth increases consumption, as a result of which the generation of waste increases. And when the growth rate of waste generation exceeds the growth rate of their recycling, the recycling rate falls accordingly.

Using the same set of panel data to assess the potential recycling rate of municipal waste in Kazakhstan, if an action plan is adopted as in the European Union, a synthetic control method was applied.

Since the first action plan was introduced in 2015, a treatment period was selected as 2015 accordingly.

Table 3. Composition of the synthetic control group in the analysis.

Country	Weight
Malta	0,752
Poland	0,248

Table 3 shows a list of potential counterfactual units for Kazakhstan, as well as the corresponding average weights calculated using the synthetic algorithm. Here, the synthetic counterfactual unit should resemble the features of the corresponding unit during the period 2010–2014. The minimization problem yielded these weights for the control countries.

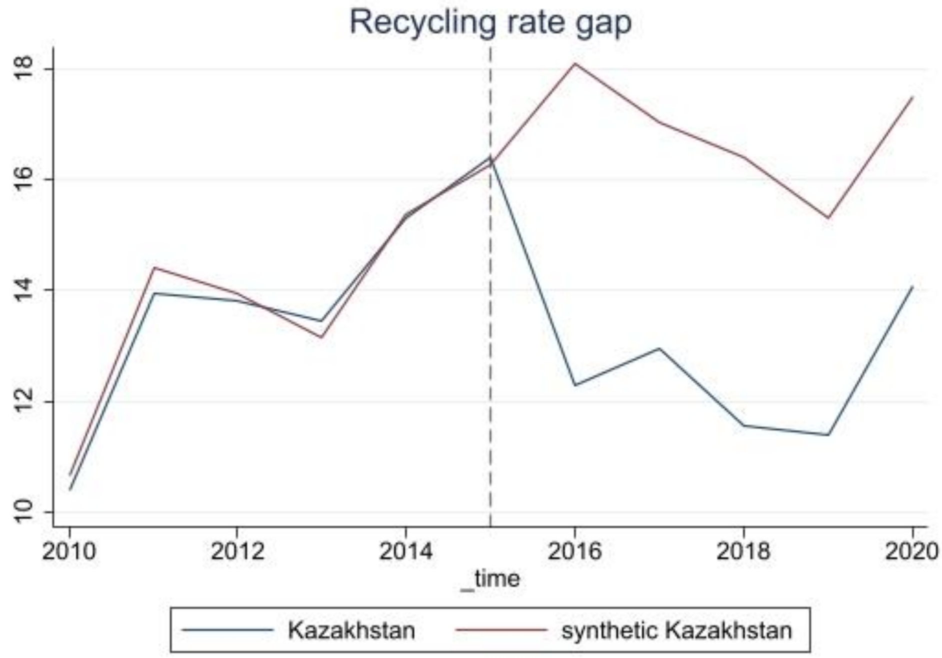

Figure 4: Synthetic counterfactual result for Kazakhstan.

Figure 4 shows the fluctuations in the recycling rate of municipal waste in Kazakhstan and synthetic units for the period 2010-2020. The blue line represents the actual recycling rates in Kazakhstan, and the red line is the average of recycling rates obtained from 2 synthetic counterfactuals that were selected from 27 countries in the donor pool. The treatment period is indicated by the vertical dotted line.
Synthetic counterfactuals give a good approximation of units for the period before treatment, 2010–2014, and synthetic (red line) and actual values (blue line) behave fairly similarly. Following the treatment time, the "synthetic Kazakhstan" line depicts what the recycling rate of municipal waste in Kazakhstan would be if an Action Plan was adopted like in the European Union. The Figure shows that the real share of waste recycling is lower than synthetic, but practically repeats the European trend (for example, a decrease in 2019 in both Kazakhstan and the EU).

Notably, pre-treatment outcomes are well matched and close to zero. Assuming a root mean square prediction error (RMSPRE) of 0.028, the results are robust and statistically significant.

As described in Abadie et al. (2010), placebo tests were used to assess the significance of the estimates obtained by iteratively applying the synthetic control method, which was used to assess the potential impact of Kazakhstan's adoption of the Circular Economy Action Plan on every other country in the donor pool. We transfer our recycling data to one of the 27 reference countries in each iteration, putting Kazakhstan in the donor pool.

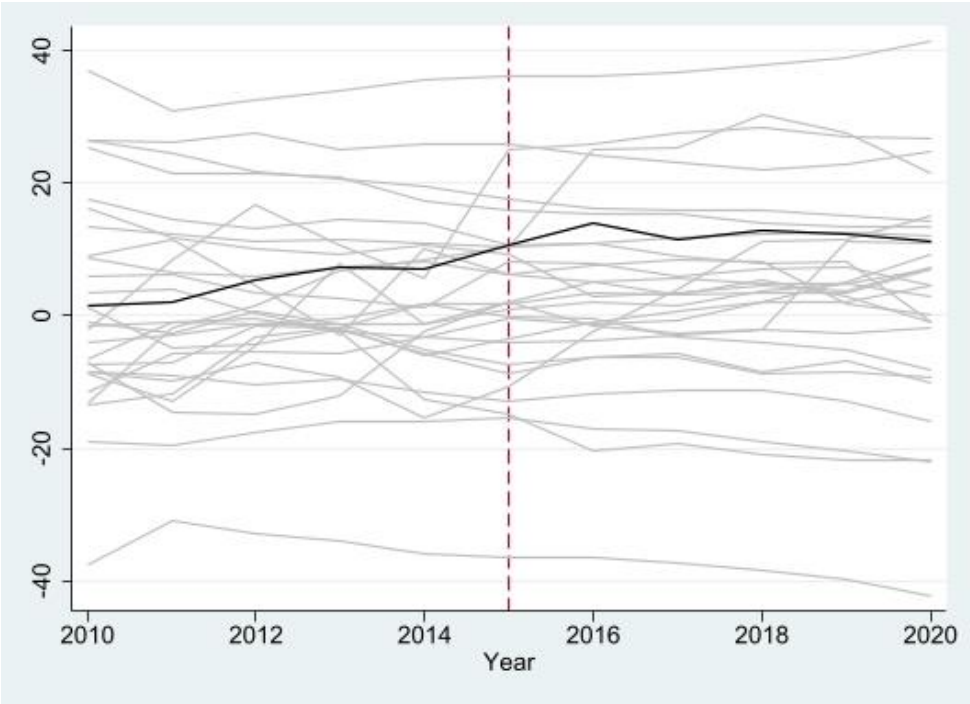

Figure 5: Placebo test results.

The findings of the placebo test are presented in Figure 5. The gap, which is associated with each of the 27 test runs is represented by the gray lines. In that instance, the gray lines depict the difference between each country's recycling rate and its synthetic version in the donor pool. The black line reflects Kazakhstan's calculated gap. Figure 5 shows that the results are statistically significant and dependable.

This result confirms the hypothesis that the recycling rate of municipal waste in Kazakhstan would be significantly higher if the Action Plan for the transition to a circular economy were adopted.

Conclusion

This article aims to assess the potential of improving the waste management system in Kazakhstan in case of the adoption of the Action Plan for the transition to a circular economy as in the European Union. According to the research results, we conclude that the hypothesis put forward is confirmed: in a counterfactual situation, the recycling rate of municipal waste in Kazakhstan would be much higher.

Recycling is a vital part of achieving a circular economy and sustainable development because of the good impact it has on the environment, and its positive social and economic value. The recycling rate has become a significant topic for public institutions, as well as academia, businesses, and non-profit organizations, in order to design efficient programs.

However, municipal waste recycling rates are simply one metric of circularity. Transitioning to a greener, circular economy necessitates not only policy regulation, investments, and technology innovation, but also societal behavior change.

For full transition to a circular economy in Kazakhstan taking into account the European experience, it is proposed to raise awareness of the population about the principles of circularity; at the business level, initiatives on sustainable products, including the creation of ecodesign for sustainable products, a review of requirements for packaging and packaging waste; at the state level – legislative proposal to justify the environmental requirements of companies concerning biodegradable and compostable bio-based plastics, measures to decrease the impact of microplastic pollution on the environment, revision of the Industrial Emissions Directive.

The results give managerial implications both at the state level and in private structures. If the Action Plan had been introduced, waste management would have been developed at a higher level.

A limitation of the study is that for Kazakhstan there are no similar indicators of the circular economy as for the countries of the European Union. For example, the contribution of recycled materials to raw materials demand, end-of-life recycling input rates, circular material use rate, trade-in recyclable raw materials, etc. Future study directions are precisely related to the availability of more comprehensive indicators of circularity, in addition to the recycling rate, not only for Kazakhstan, but also for other EAEU countries.

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POPRAWA SYSTEMU GOSPODARKI ODPADAMI W KAZACHSTANIE: OCENA ODDZIAŁYWANIA

Streszczenie: Wiele krajów aktualizuje swoje modele konsumpcji z konwencjonalnego modelu liniowego do modelu obiegu zamkniętego w erze nadmiernej konsumpcji, a w rezultacie stałego wzrostu ilości odpadów. Jednym z ważnych wyznaczników gospodarki o obiegu zamkniętym jest gospodarka odpadami. Niniejsze opracowanie ma na celu analizę potencjału poprawy systemu gospodarki odpadami wraz z wdrożeniem Planu Działań na rzecz przejścia na gospodarkę o obiegu zamkniętym. Zastosowano analizę danych panelowych z efektami stałymi i losowymi oraz syntetyczną metodę kontroli. Dane zostały zebrane dla Kazachstanu i 27 krajów Unii Europejskiej za lata 2010-2020. Dla wiarygodności i adekwatności wyników badań przeprowadzono odpowiednie testy, takie jak test Fischera, statystyki Walda i test placebo. Wyniki pokazały, że wskaźnik recyklingu odpadów komunalnych w Kazachstanie byłby znacznie wyższy, gdyby przyjęto Plan działania na rzecz przejścia na gospodarkę o obiegu zamkniętym. Na podstawie ustaleń i analiz sformułowano wnioski i rekomendacje.

Słowa kluczowe: gospodarka odpadami, wskaźnik recyklingu, gospodarka o obiegu zamkniętym, syntetyczna metoda kontroli.

哈萨克斯坦废物管理系统的改进：影响评估

摘要：在过度消费的时代，许多国家正在将其消费模型从传统的线性模型更新为循环模型，从而导致浪费的稳定增长。循环经济的重要标志之一是废物管理。本研究旨在分析通过实施向循环经济过渡的行动计划改善废物管理系统的潜力。采用固定效应和随机效应的面板数据分析和综合控制方法。收集了 2010-2020 **年期**间哈萨克斯坦和 27 **个欧盟国家的数据**。为了研究结果的可靠性和充分性，进行了适当的测试，例如 Fischer 测试、Wald 统计和安慰剂测试。结果表明，如果通过向循环经济过渡的行动计划，哈萨克斯坦城市垃圾的回收率将显着提高。根据调查结果和分析得出结论和建议

关键词：废物管理，回收率，循环经济，综合控制方法