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The cost of doing nothing: Testing the benefits of water disposal risk reduction with water management Activism investing in Latin America

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Abstract

Objective: This paper answers What would the performance of an investor be if she or he invested only in public companies with proper water management practices in Latin America (LATAM)? Methodology: The research uses the water-to-revenues (WTR) ratio to measure water management quality. It simulates the performance of an investor invested mainly in companies with the best WTR (from January 6th, 2005, to Abril 20, 2022). Results: Comparing the simulated portfolio's performance against a broad market portfolio, the results suggest that both portfolios have similar performance in the short term. In the long term, the tests found that the WTR has a low systematic (market) risk (beta of 0.26), and its performance is more stable (mean-variance efficient) than the market portfolio. The tests also control the impact of some LATAM currencies' depreciation. Conclusions: The results could be useful for investors to engage in water management activism through investing, motivate companies to engage in better water management practices, and reduce the future risk that water disposal represents to the world in years to come.

JEL Classification: G11, G24, G32, Q25, Q53.

Keywords: Water disposal risk; water management; portfolio management; ESG investing; water investing; firm risk; Latin American stock markets

El costo de hacer nada: Una prueba de los beneficios de la reducción del riesgo de disposición de agua por medio de inversión activista en agua

Resumen

Objetivo: Se responde la pregunta ¿cuál sería el desempeño de un inversionista si invierte solo en compañías con un adecuado manejo de agua en Latino Amética? Metodología: Se emplea la razón de consumo de agua entre ingresos (WTR) para medir la calidad de las políticas de manejo de agua en la empresa. También simula el desempeño de un inversionista invertido principalemente en empresas con el mejor WTR (del 6 de enero del 2005 al 20 de abril del 2022). Resultados: Al comparar el portafolio simulado contra el de mercado, los resultados sugieren que ambos tienen un desempeño similar en el corto plazo. En el largo plazo, las pruebas evidencian que el portafolio WTR tiene un riesgo sistemático menor (beta de 0.26), y su desempeño es más estable (media-varianza eficiente). Los resultados controlan el impacto de fluctuaciones cambiarias en algunos paises latinoamericanos. Conclusiones: Los resultados pueden ser de utilidad para inversionistas activistas de consumo de agua, motivar mejores prácticas de manejo de agua en las empresas y reducir el riesgo de disposición de agua en años venideros.

Clasificación JEL: G11, G24, G32, Q25, Q53.

Palabras clave: Riesgo de disponibilidad de agua; manejo de agua; administración de portafolios, inversión ESG; riesgo de la empresa; mercados de valores latinoamericanos.

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1. Introduction

Environmental Social and Governance investing (ESG investing) and water management disclosure are related issues for companies and investors. The former has seen ESG practices (including water management ones) as a way of engaging in a better relationship between reputation and profits (Dawkins & Fraas, 2010; Fombrun, 1990; Hasseldine et al., 2005; Lee et al., 2016; Tetlock, 2011). Also, some firms engage in fundamental ESG practices to better impact their environment and stakeholders. This practice significantly improved their total or market risk profile and debt or equity rising costs (Delgado-García et al., 2013; Jo & Na, 2012; Kölbel et al., 2017; Oikonomou et al., 2012; Orlitzky & Benjamin, 2016; Salama et al., 2011).

As mentioned before, it is of broad interest to Academia and financial practice to test if ESG investing has no significant impact on the investor's financial performance (risk-return or mean-variance). This relationship has been widely discussed in the last 20 years and is of growing concern in the financial industry worldwide (Merton & Venegas-Martínez, 2021).

There are two potential perspectives regarding ESG, namely ESG investing (socially responsible investing) and ESG corporate practices, one in favor of its application and the other that suggests that ESG practices hurt earnings or portfolio performance. These two perspectives could be considered the Friedman (Friedman, 2007) vs. Freeman (E. Freeman, 1984; R. E. Freeman, 1994) debate. The former author suggests that ESG shouldn't be practiced due to its impact on profits and security pricing. The latter means that even if these practices could harm financial performance, the financial benefit is long-term.

This paper's position is similar to the latter author: even if there is no benefit in a company's mean-variance (risk-return) performance, implementing ESG practices could lead to no difference in the performance of an ESG company with a non-ESG one.

The main research interest is ESG investing from the perspective of a given investor who manages a portfolio of Latin American stocks. The relationship between ESG practices and the performance of an ESG portfolio is also widely discussed in the Financial Economics and Financial Econometrics fields. The main interest of the current research is the mean-variance performance of an ESG investing portfolio focused mainly on water management practices. Water management is a specific topic of the environmental pillar in corporate ESG practices and is measured in almost all ESG company scoring methods. Methods include the ones of MSCI (MSCI Inc., 2019), Robecco-Sam, or Refinitiv (2022a) ESG scores.

From its origins in religious practices to its development of social or environmental activism, corporate social responsibility (CSR) has evolved into what is known as ESG (environmental, social, and governance) practices. This contemporary evolution comes from the anti-war financial markets activism in the decades of 1970, thanks to the interest of regulators and multilateral organisms such as the United Nations (2005a, 2005b; 2015) or the World Economic Forum (2022). The evolution and the proper definition of the terms corporate CSR or ESG practices are outside the scope of this paper, along with the description of what is ESG or socially responsible. Regarding ESG investing, the interest reduces in using good ESG scores to develop a screening process. A process that selects, from a broader investment set of securities Φ, a subset $\phi \subset \Phi$ that the investors consider has the best ESG practices in Φ. Therefore, the discussion in ESG investing focuses more on how it should be done than what it is (Eccles et al., 2020; Eccles & Stroehle, 2018). A better discussion of ESG investing or socially responsible investment can be found in Berry and Junkus (2013). In an OECD-sponsored report, Boffo and Patalano (2020) discuss the relevance that ESG investing has developed in the last years and how the methods of ESG scoring have evolved to allow a proper ESG rating methodology for investors and banks. Why banks? Because several countries, such as Germany, the Netherlands, the U.K., and the U.S., have rules and laws that motivate banks to lend or invest in ESG companies or projects.

From the three dimensions of ESG, paying attention to the environmental one is necessary. For interest in this paper, the World Economic Forum (2022) signals the disorderly environmental transition as one of the most critical risks to mind in the following decades. The Carbon Disclosure Project for water security, or CDP, (CDP water security, 2021), a branch of the Norges Bank, has described how much will be lost if we do nothing regarding water security. Water security refers to the availability of sweet drinking water for humans. Either for their Economic activities or personal consumption. CDP concludes that the cost of doing nothing on this matter is higher than the costs that companies incur if they invest in proper water management and recycling processes. This statement is a starting and motivating point for this paper's research question.

The main interest in this paper, stated as a question, is: How can a given investor motivate a given company to engage more in water management practices and disclose them? More specifically, If this investor engages in investment activism in companies with properly disclosed and executed water management activities, will she or he lose profitability or, at least, mean-variance efficiency?

The present paper tested this question from the perspective of a US-dollar (USD) investor with a portfolio in the four main Latin-American (LATAM) stock markets: Argentina, Brazil, Chile, and Mexico. Why these four markets, and why Latin America? Because Latin America is one of the biggest commodity producers region (World Bank, 2020), it is a natural diversification region for most institutional investors' portfolios, and because these four markets are the biggest in terms of market capitalization, measured in U.S. dollars (World Federation of Exchanges, 2020). The paper's position is that even if there could be a similar performance to a conventional (market) LATAM portfolio, there is no significant performance loss in the long term. Even if a LATAM water investor could face some underperformances against a market or passive portfolio strategy, this effect holds in the short term. The benefits are three in the long-term: 1) The water-focused performance of the water portfolio (WTR) is similar to the market one in the long-term, 2) the risk exposure reduces significantly in the water portfolio against the market one (this would be in line with most of the literature in ESG and water investing), and 3) With a long-term performance similar to the market portfolio, the investor motivates the implementation and disclosure of better water management practices in LATAM companies. A potential result of this investing style is reducing water disposal risk in these countries.

Departing from this brief introduction and the paper's motivation, the next section discusses the previous works (in ESG and water investing) that motivate the current research efforts. This discussion reviews the results that test the relation between ESG practices and financial performance (company’s profitability or stock price performance). Also, it reviews the positive impact between ESG practices or water management practices on the total or systemic company risk, along with the lack of literature on this subject. The third section gives detail of the input data gathering and processing. Also, it details the simulating process of the market and water investing portfolios. The same section shows and discusses the main results. The concluding remarks and the guidelines for further research are discussed in the fourth and last section.

2. Literature review and theoretical motivations of this paper

As mentioned, water management or consumption practices are specific aspects of the environmental pillar of ESG. As detailed in this brief literature review, there's scant literature about water management practices and company profitability and, most of all, water management and water portfolio performance. Departing from this, this section will briefly review the relevant literature about the ESG company performance relationship. In the context of Financial Economics, "performance" means either the profitability of a given company measured with the return on equity (ROE), the return on assets (ROA), or the profit margin (either net or operational). Also, the term applies to stock market price performance in terms of the supply, demand, or risk level of a given company's stock. Given the investor-specific perspective of this paper's interest, performance relates to either stock market price (return) and risk level exposure (either market or specific).

Following this ESG performance (either in price formation or investor benefits) review, The study relates to the water management-performance (WM-P) perspective. ESG performance or ESG investing is a widely discussed topic when writing this paper. The evolution of the term corporate social responsibility (CSR) to ESG will not be discussed herein, given its specific topic. The discussion will concentrate on this relation, given the present paper's investor-based perspective. As mentioned by Berry and Junkus (2013) and Chatzitheodorou et al. (2019), the terms refer to an investment style in which the investor prefers to invest in ESG companies to manage an ESG portfolio. Therefore, the companies of interest must fulfill ESG criteria that the investor considers appropriate for her or his long-term financial performance and sustainability level. Despite this, and as mentioned previously, there is a debate that an ESG company sacrifices its company performance (profitability) due to costs incurred with ESG practices. That is, sometimes a company is profitable if it has a negative social or environmental impact. To comply with sustainability rules, it must invest in more expensive production processes or sacrifice production to be ESG compliant. This perspective is debated by Friedman (2007), being financial performance the only sustainability task a company must comply with. The other view is the one presented by Freeman (1984; 1994). He suggests that the benefits of ESG practices are in the long-term because the company improves its customer or employee relations, reduces legal, reputational, or social risks, and, as a result, increases its productivity.

From an ESG-profitability perspective, several works tested the ESG-ROE (ROE: return on equity), ESG-ROA (ROA: return on assets), or ESG-profit margin in companies of the U.S., Japan, France, Korea, Australia, Mexico and countries of the European Union. Blasi, Caporin, and Fontini (2018) tested the relation between ESG practices and the financial performance of 988 US companies and found a positive link between ESG, ROE, or ROA. That is, between ESG practices and profitability.

Brogi and Lagasio (Brogi & Lagasio, 2019) made a similar test between ESG practices disclosure and ROA. They did this in a sample of the companies listed (from 2000 to 2016) in the MSCI KLD stock index (an ESG company stock index in the U.S.). Their results align with Blasi, Caporin, and Fontini because they also found a positive and significant relationship between ESG practices and profitability. Xie et al. (2019) extended the previous works to U.S., Japanese and Chinese companies and found similar conclusions to the ESG-profitability relation. From a multi-country perspective, Sethi, Martell, and Demir (2017) found the same positive and significant association between ESG and profitability in the world's prominent 1,200 public (stock market traded) companies. Galbreath (2013), Crifo, Diaye, and Pekovic (2016), and Lee, Cin, and Lee (2016) found similar results in Australia, France, and Korea. As noted, the cited works in this paragraph found evidence that refutes Friedman's position that ESG practices harm the company's performance and suggests that ESG practices have no financial cost. In the case of Mexico, García-Santos (2019) and Alonso-Almeida et al. (2009), Mendoza et al. (2022), and Godinez-Reyes et al. (2021) found similar conclusions in the ESG exchange-traded companies in that country.

Some works relate ESG company quality with stock price performance from a market price-performance perspective. Two competing theories explain ESG stock's demand (Derwall et al., 2011):

1. The "shunned stock" hypothesis states that ESG companies' stock prices will increase because investors want to be more ESG and are willing to pay a higher stock price (sacrifice return) to raise their ESG portfolio profile. That is, there is no fundamental-specific factor that motivates price increases. Only ESG motivations.

2. The "errors in expectations" hypothesis suggests that the ESG quality of a given company and the ESG benefits in the long term are not priced by stock markets. Therefore, an extra stock price performance (alpha generation) could benefit from the ESG quality.

This paper takes a theoretical position on the shunned stock hypothesis. Given this explanation of ESG investors' demand, water-responsible companies could enhance their performance and reduce systematic risk. The current research's position is that the portfolio manager could engage in water management activism and invest only in companies with good water management practices in Latin America (LATAM). Therefore, the good performance of this LATAM water portfolio should result from market preferences due to proper water management processes in each company (a related context to the shunned stock hypothesis).

The first works that tested either the stock price, portfolio, or stock index performance in ESG investment are those of Hamilton, Jo, and Statman (1993), Statman (2000), and Statman and Glushkov (2009). These two works explore the performance of ESG stock indexes, such as the Domini social index, or companies with ESG scores of KLD. They tested these indexes or stocks against the conventional market (ESG and not-so-ESG companies) indexes or portfolios invested in "sinful" or non-ESG industries such as tobacco, alcohol, or gambling. The results in these works favor the performance of ESG investing against conventional (market) or sinful strategies. Following these, other works found similar results in the U.S., the U.K., some countries in the European Union, Mexico,

Canada, and other Asian countries (Chan & Walter, 2014; De la Torre et al., 2016; Schröder, 2003, 2004, 2007; Ziegler et al., 2007). Practically all these previous works found that there is either a better or, at least, similar performance of ESG investing against a broad market one. A relevant work by Hong and Kacpersyk (2009) found that sinful investing performs better than ESG. Despite this result, ESG total and specific risk (the risk level due to company and not market issues) is higher in sinful investment. This result, systematic risk reduction in ESG (water) companies, is a result that I also want to test herein.

Following the trend of ESG (water) investment style, several countries motivated ESG investing among institutional investors, either in terms of bank lending regulation (Nizam et al., 2019; Ziegler et al., 2007) or pension fund investment policy. Some works test the benefit of ESG investment in pension funds (Amalric, 2006; O. De la Torre-Torres et al., 2018; Hongbo et al., 2006; Sethi, 2005) and found that ESG investing enhances the performance of the fund's portfolio or, at least, mimics the performance of the investment policy benchmark.

As noted from the previous works in ESG investing, practically all found evidence that favors its performance or, at least, finds a similar performance to an investment policy benchmark. These results suggest that it is better to invest in ESG stocks or that it is appropriate to do it without return performance loss.

The works of Salama, Anderson, and Toms (Salama et al., 2011), Jo and Na (Jo & Na, 2012), and Botha (Botha, 2015) found, in U.S. companies, that the ESG score or the fact of engaging in ESG activities has a significant negative relation with systematic (market), total or the specific (company) risk. It is essential to mention this risk typology because following the capital asset pricing model (Lintner, 1965; Sharpe, 1963, 1964) or CAPM in classical Financial Economics models, the performance of a given company's stock ($\boldsymbol{r_{i,t}}$) could be explained by a market portfolio or stock index's return ($\boldsymbol{r_{m,t}}$) through the next auxiliary regression model:

$$r_t = \alpha + \beta r_{m,t} + \varepsilon_t \tag{1}$$

In (1), r_t is the return or price percentage variation of the security of interest, $r_{m,t}$ is the market portfolio returns, ε is the residual or unexplained return component by (1), and β is a sensitivity measure of the stock price percentage return, given a unit (1%) increase or decrease in the market portfolio price return. The lower the value β (closer to zero or even negative), the better for portfolio diversification (risk reduction). From (1) and following conventional ordinary least squares estimation methods, the total risk of r_t ($\sigma_{r,t}$) is the result of the systematic (market) risk ($\beta\sigma_{r_{m,t}}$) and the residual, specific, or company risk (σ_{ε_t}):

$$\sigma_{r,t} = \beta\sigma_{r_{m,t}} + \sigma_{\varepsilon_t} \tag{2}$$

Therefore, the works mentioned in previous paragraphs measure the relation of ESG practices either with $\boldsymbol{\beta}$ (systematic risk) or the company (specific) risk ($\boldsymbol{\sigma_{\varepsilon_t}}$).

From a water management policy and profitability perspective (ROE or ROA), no work test this issue, and only the work of Zeng et al. (Zeng et al., 2020) test the relation between water management disclosure with systematic and specific risk as in (2). The author did this test on Chinese stock markets (A series) companies. The author found that there is also a negative relation between water management disclosure and the total and systematic risk level. A result that I extended to the WTR portfolio simulated in this paper.

As noted from the literature review, the relation between ESG score and ESG investment performance is widely discussed. From that set of works, the ones that study the benefits for a given investor in terms of mean-variance (risk-return) efficiency is a reduced set. Suppose a filtered subset to the works that measure the relation between portfolio performance (mean-variance efficiency) and the investment strategy of investing only in companies with good water management behavior. In that case, no previous literature deals with this issue. Departing from this gap, the present papers want to fill it by simulating the performance of a U.S. dollar and local currency-based investor in water-responsible LATAM stocks. The question is: If a given agent invests only in LATAM stocks with good water management practices, what will my mean-variance performance be? Suppose this agent found strong evidence favoring this “activist” or investment style. In that case, there could be evidence that motivates Institutional investors and regulators in Latin America to engage in policies that encourage better management practices in the region. Also, suppose investors feel comfortable investing in a good water management portfolio. In that case, they could create a higher demand for these companies’ stock, and the other non-compliant companies could feel motivated to enhance and disclose their water management practices. As a result, water-responsible companies will reduce their systematic risk, strengthen their stock price performance (due to the shunned stock hypothesis of Derwall (2011)), and gain access to better financing conditions.

As noted in the introduction, water, and climate change are future risks. Consequently, LATAM companies could enhance their water consumption (due to good water management investment) and reduce the water risk in the region. A critical issue to solve for the tests herein is how to measure appropriate water management. The present paper used the World Economic Forum's (2022) suggested metrics to measure stakeholder capitalism as a guideline. There are two types of metrics related: the planet core metrics and disclosures and the planet expanded metrics. From the former group, the author was interested in water consumption and withdrawal of water in water-stressed areas and, from the latter, the impact of freshwater consumption and the effect of water pollution. These metrics are closely related to recent European regulations about sustainability-related disclosures (European Union, 2019). Documents such as the two previous ones have shaped the ESG investing industry. Since the United Nations Millenium Declaration (United Nations, 2000, 2005a, 2006; United Nations Assembly, 2015), several goals have evolved to reduce the impact of human economic activities on the environment.

To measure the ESG quality of a given company, several companies have developed ESG rating methodologies. Examples of these are RobecoSAM, MSCI-KLD, and Refinitiv. These three are among the most representative and used in the financial services industry and make a third-party review of ESG activities of companies worldwide. Some works tested these methodologies' quality and explanation power, such as the one of Escrig-Olmedo and Fernandez-Izquierdo (Escrig-Olmedo et al., 2019). This work notes that the company with the broadest company ESG valuation set is Refinitiv. Refinitiv is a well-known financial data company. As part of its primary information services, it provides ESG scores for more than 9,000 companies worldwide, representing 70% of the world's market capitalization (Refinitiv, 2022b). Refinitiv presents its ESG scores on a global company base scale of 0 to 100. A company with an ESG score close to 100 has the highest ESG standards in a given industry (following the Refinitiv (2019) business classification) worldwide.

These scores comply with several ESG regulations and estimate the three pillars of interest (environmental, social, and governance). In the environmental pillar, there is a water consumption and management subset. From all these, this paper focuses on a metric consistent with the OCDE, United Nations, World Economic Forum, and world ESG regulations: the ratio of yearly water consumption (in cubic meters) divided by the U.S. dollar value of the company's revenues. The water-to-revenues (WTR) ratio for this research.

Following this, this paper's definition of proper water consumption and management is given with the previous ratio. Departing from this motivation, the author simulated the performance of a U.S. dollar and local currency-based portfolio invested in Latin America's four main stock markets (Argentina, Brazil, Chile, and Mexico). As mentioned in the introduction and related to the previous works, this paper wants to fill the gap about the benefit of ESG activists investing in engaging companies with proper water management practices in the region. More specifically, it tests if water investing has a mean-variance benefit (or at least there is no mean-variance loss). In a parallel target, it is of interest to expand the current literature on optimal ESG portfolio selection and performance (Chen et al., 2021; Escrig-Olmedo et al., 2017; Hübel & Scholz, 2020) by testing water-specific investing. The interest in ESG investing has grown exponentially (Amel-Zadeh & Serafeim, 2018; Robeco, 2022), and this paper offers results about water-specific investing in Latin America.

The next null hypothesis was tested in the portfolio simulations: "Investing only in companies with good water management leads to a better or similar performance than a market (passive) managed portfolio." For this purpose, the author used Refinitiv ESG data and checked for the accumulated return, the risk-return tradeoff, systematic risk exposure, and extra return generation from the simulated portfolio.

Given the brief theoretical, practical, and methodological motivations, the next section will explain how the data was gathered and the portfolio simulation's main assumptions and methods.

3. Methodology: input data processing and simulations

To test the null hypothesis in the simulated portfolio in the four currencies of interest, the author used weekly historical data from Refinitiv's databases. The simulations used the historical market capitalization ($MC_{i,t}$), measured as the free-float outstanding stock in each LATAM market multiplied by the current stock price $P_{i,t}$ at t. Also, the historical close price $P_{i,t}$ was used to calculate the continuous-time return as follows:

$$r_{i,t} = \ln\left(P_{i,t}\right) - \ln\left(P_{i,t-1}\right) \tag{3}$$

The data set used for the simulations comes from the stock members of the Refinitiv Argentina, Refinitiv Brazil, Refinitiv Chile, and Refinitiv Mexico price return indexes. These four indexes were of interest because these four countries' indexes are members of the Refinitiv Latin America price return index, the regional benchmark used in the simulations. The historical, price, market capitalization, and returns data set were formed by downloading the historical data of the stocks that were members of those indexes as of May 1st of 2022. From those stocks, the simulations used only the ones with the weekly market cap and price history from January 2nd of, 1998. The supplementary material (Microsoft Excel file) of this paper discusses the investment universe and presents the summary of the 301 Refinitiv identifier codes (RIC) of the stocks used in the simulations.

Table 1. The stock indexes of the investment universe in the simulated portfolios.

RIC	*Index*	*Index type*	*Country*
.TRXFLDLAPU	Refinitiv Latin America price return index	Regional market cap. index	LATAM
.TRXFLDARP	Refinitiv Argentina price return index	Country-specific market cap. index	Argentina
.TRXFLDBRP	Refinitiv Brazil price return index	Country-specific market cap. index	Brazil
.TRXFLDCLP	Refinitiv Chile price return index	Country-specific market cap. index	Chile
.TRXFLDMXP	Refinitiv Mexico price return index	Country-specific market cap. index	Mexico

With the historical market cap ($\boldsymbol{MC_{i,t}}$) of each stock traded at the date $\boldsymbol{t}$, stock weighting methods to form each simulated portfolio depart from the following method:

$$w_{m,i,t} = \frac{MC_{i,t}}{\sum_i^N MC_{i,t}} \tag{4}$$

For the WTR portfolio, the authors first downloaded the water to revenues (RIC: TR.AnalyticWaterUse) of each company ($WTR_{i,t}$). In several cases, this indicator was not reported or measured in some years. For those specific cases, the company-specific portfolio investment level or weight is set to zero ($w_{water\ to\ revenues,i,t} = 0$). In the cases in which the company reported data on this field, the author determined the highest investment level according to the water consumption of that company. For this purpose, this ceiling (ic_t) in the investment level defined which companies are the most water-consuming ones related to revenues and estimated a water consumption weight $\mathrm{wcw}_{i,t}$. To estimate $\mathrm{w}_{wtr,i,t}$, the author first calculated an investment ceiling (ic_t) in this water to revenues subset of $m < N$ stocks by using the water to revenues (ic_t) value for each company (stock) as follows:

$$ic_{i,t} = 1 - \frac{WCW_{i,t}}{\sum_{i=1}^m WCW_{i,t}} \tag{5}$$

With (4) and (5) in each stock, the investment level $w_{wtr,i,t}$ in the WTR portfolio was estimated as follows:

$$w_{wtr,i,t} = w_{m,i,t} \cdot ic_{i,t} \tag{6}$$

Because (4) and (5) are normalized values by definition, $w_{wtr,i,t}$ adds to 1 ($\sum w_{wtr,i,t} = 1$) or 100% as in (4) or (5). A necessary condition of the stock investment levels in a portfolio selection process.

Once the investment levels $w_{m,i,t}$ and $w_{wtr,i,t}$ were estimated for each date t, the author calculated the *ex-post* simulated portfolio's return as follows:

$$r_{m,t} = \sum_i^N w_{m,i,t} \cdot r_{i,t} \tag{7}$$

$$r_{wtr,t} = \sum_i^N w_{wtr,i,t} \cdot r_{i,t} \tag{8}$$

To estimate de portfolio risk exposure, the simulations used the historical asset-specific $r_{i,t}$ data of the 52 previous weeks (one year). This time series formed a returns matrix or vectorial variable: $\mathrm{X} = [\mathrm{r_i} - \bar{r}_i]_{52\times N}$. This was used to estimate the time-fixed variance-covariance matrix:

$$\mathrm{C} = [\mathrm{X}'\mathrm{X}](52-1)^{-1} \tag{9}$$

The corresponding portfolio risk exposure (standard deviation) in each portfolio was estimated as follows ($\mathrm{w_m}$ and $\mathrm{w_{wtr}}$ are the market and WTR portfolio weight vectors):

$$\sigma_{m,t} = \sqrt{\mathrm{w'_m C w_m}} \tag{10}$$

$$\sigma_{wtr,t} = \sqrt{\mathrm{w'_{wtr} C w_{wtr}}} \tag{11}$$

With a risk-free asset rate (rf_t) the *ex-post* Sharpe ratio at t, was estimated as follows:

$$expostSR_{m,t} = \frac{r_{m,t} - rf_t}{\sigma_{m,t}} \tag{12}$$

$$expostSR_{wtr,t} = \frac{r_{wtr,t} - rf_t}{\sigma_{m,t}} \tag{13}$$

The risk-free asset in (12) and (13) was the 3-month Treasury bills for the U.S. dollar-based portfolios. For the specific case of the local currency performance, the simulations used a value of $rf_t = 0$. That is, the simulations used a pseudo-Sharpe ratio. An essential methodological note is that the U.S. paid negative rates in some weeks given their central bank Economic stimulus policies (in 2008 or 2020 as an example). In those specific weeks, rf_t was set to zero to avoid an atypical portfolio performance in that week. Given the risk exposure, the Sharpe ratio represents the expected (ex-ante) or received (ex-post) risk premium at t.

With (7) and (8), I estimated a historical portfolio return vector for the market portfolio or benchmark ($\mathrm{r_{m,t}} = [r_{m,t}]_{52\times1}$) and the water to revenues one ($\mathrm{r_{wtr,t}} = [r_{wtr,t}]_{52\times1}$). With these vectors, The author estimated the CAPM auxiliary ordinary least squares (OLS) regression following (1):

$$y = Rb + \varepsilon, R = [1, r_{m,t}], y = r_{wtr,t}, b = [\alpha_{wtr}, \beta_{wtr}] = [R'R]^{-1}[R'y], \varepsilon = y - Xb \tag{14}$$

The value of β in (14) is the systematic or market risk, as in (1).

Finally, the authors estimated an alternative version of Jensen's (1968) alpha. This performance metric measures the extra return the portfolio (investment strategy) paid free of systematic or market performance. The original Jensen's alpha is estimated as follows in an *ex-post* perspective:

$$\alpha = r_{wtr,t} - \beta_{wtr} \cdot r_{m,t} \tag{15}$$

In the simulations, (14) was estimated with 52 weeks of historical returns ($r_{wtr,t}$) at t, I proxied (15) with α_{wtr} in (14). In a two-variable OLS regression:

$$\alpha_{wtr} = \bar{r}_{wtr,t} - \beta_{wtr} \cdot \bar{r}_{m,t} \tag{16}$$

During the simulations, if the p-value of α_{wtr} was higher than 5%, the value was set to zero α_{wtr}. If the p-value suggests a non-significant value of α_{wtr}, the WTR portfolio leads to no overperformance than the market portfolio. For robustness purposes, the standard errors in (14) were estimated with the Newey-West (1987) estimation method.

As mentioned in the Sharpe ratios, the market and WTR portfolios were simulated in U.S. dollars and local currency. The simulations in local currency had the intention of controlling the impact of currency depreciation in the portfolios.

To test the benefit of a diversified WTR-market investment strategy (overinvesting the market with WTR stocks), the author simulated the performance of an optimal portfolio invested in the market portfolio (benchmark) and the water to revenues one. For this purpose, the author simulated an optimal portfolio that overinvested in water, from the market portfolio to revenues stocks. The optimal weights were estimated with a quadratic-programming algorithm to find the tangency portfolio. That is the portfolio with the highest Sharpe ratio. To find this optimal portfolio, the next classical portfolio theory optimization problem was used:

$$\underset{0 \leq w_{opt} \leq 1}{arg\ max} \frac{w'_{opt} e_2 - rf_t}{\sqrt{w'_{opt} C_2 w_{opt}}} \tag{17}$$

In the previous expression, w_{opt} is the simulated market portfolio's optimal investment level (weight). e_2 is the arithmetic mean (expected) return vector estimated with $r_{wtr,t}$, and $r_{m,t}$, and C_2 the corresponding sample covariance matrix.

With this simulated portfolio, testing a middle point investment strategy between the market-only (passive) management and the water-to-revenue (WTR) investment strategy was interesting.

The simulations of the hypothetical portfolios weekly were made from from January 2nd of, 2005 to May 30th 2 of, 2022 (903 weeks). The impact of trading feeswasn't included because nowadays, several trading fee schemes for institutional investors reduce that impact in portfolio management. For example, Institutional investors, such as mutual funds, pension funds, or exchange-traded funds (ETF), pay a yearly percentage of the mean trading amount. Usually, a 1% trading fee (plus taxes) for the entire year in the stocks traded amount. This scheme reduces the impact to 0.0192% of weekly trading fees. Some other related papers (O. V. De la Torre-Torres et al., 2021) include an effect of stock trading fees for institutional investors. In their simulations, and found a negligible impact. Another reason for not including stock trading fees is that the simulated market portfolio and the water to revenues (WTR) come from the same investment set of stocks in t.

The simulations were made in R 4.0 and Python 3.0, using the Tseries and Quantmod libraries in the steps above.

The next section presents the simulation results once the general data gathering and processing steps are detailed.

4. Results discussion

This section presents the performance results of a U.S.-dollar-based portfolio, followed by the simulated portfolios valued in local currency.

4.1. U.S. dollar portfolio's results

Figure 1 shows the historical performance of the U.S. dollar (USD) based portfolios. The blue line represents the historical performance of the LATAM market portfolio, and the orange line is the WTR.

Figure 1. The historical base 100 value of the simulated portfolios in U.S. dollars.

In general terms, the four LATAM markets had an acceptable performance in the entire simulation period. The exception to this is the next sub-periods:

- 2008-2010: The sub-prime crisis increased risk-aversion among U.S.-dollar-based investors.
- 2015-2016: A period in which the U.S. had a presidential election and commercial trade rhetoric.
- 2018-2021: This period affected these four LATAM countries' risk perception, given

U.S. trading policies and the COVID-19 global crisis. Also, in this same period, Argentina suffered a currency depreciation episode due to the negotiations with the International Monetary Fund (IMF) and their electoral process in 2019.

In terms of analysis, if the reader adds all these periods, some countries, such as Mexico or Argentina, have suffered significant local-currency depreciation since 2016, affecting the general performance of the simulated portfolio. Even if the portfolios doubled (or more) their value in some periods (2008, 2010, or 2018), the currency depreciation led to "underperforming" results.

Despite this systematic issue in these four markets, it is essential to examine the performance of the WTR portfolio against the market or benchmark. Setting aside the potential price bubble formed in the 2006-2008 period (a bubble that needs review with Econometric techniques such as the one of Phillps, Shi, and Yu *(2012, 2015)*), the WTR portfolio had a more stable performance than the market one. From both portfolios, the WTR is the one that added value at the end of the simulation.

Figure 2 presents the weekly percentage variation (price returns) boxplot. Despite the final accumulated return of the WTR portfolio, the weekly returns performance suggests that the performance of both portfolios is statistically equal.

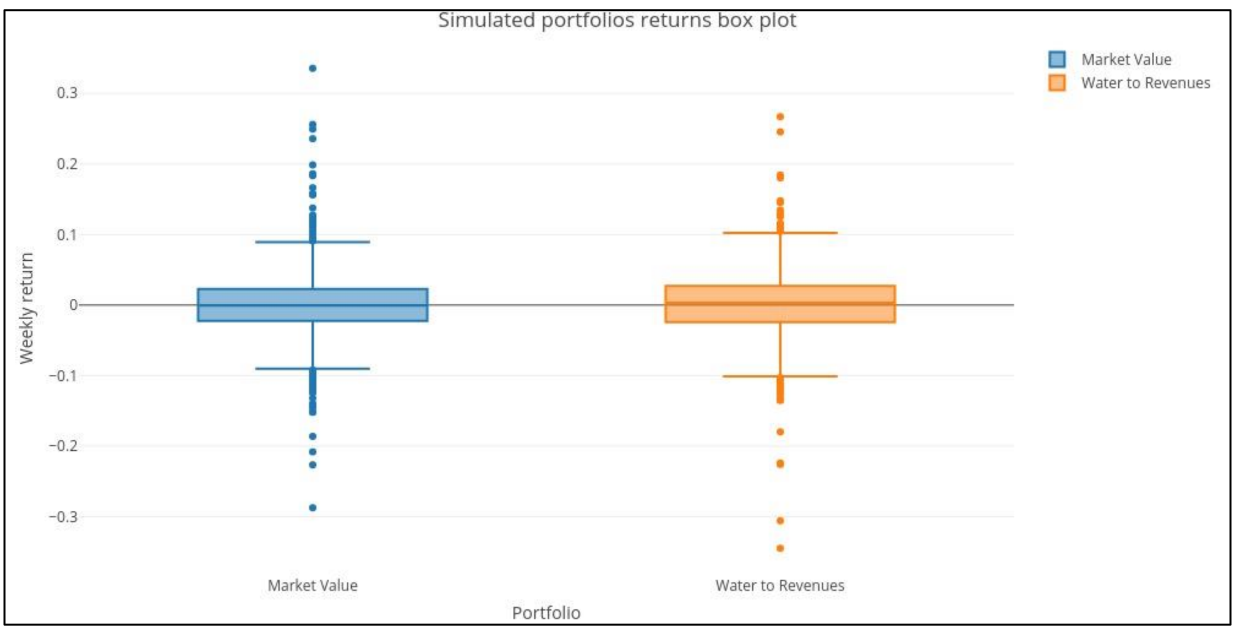

Figure 2. The simulated portfolios' returns boxplot (in USD).

A one-way analysis of variance (ANOVA) test and its non-parametric version, the Kruskal-Wallis test, support this conclusion. Tables two and three show these results, respectively.

Table 2. One-way ANOVA test of the simulated portfolios' weekly returns (in USD)

	Degrees of freedom	**Squared sums**	**Mean Squares**	**F statistic**	**p-value**
Portfolios	1	0.0004	0.0004	0.154	0.695
Residuals	1,804	4.582	0.003		

Table 3. Kruskal-Wallis test of the simulated portfolios' weekly returns

	Statistic	***parameter***	***p-value***
Kruskal-Wallis chi-squared	2.007	1	0.157

As noted, the two tests show that the historical performance of the portfolios is statistically equal in the short term. Table 4 summarizes the results of the CAPM auxiliary regression. The first column of that table shows that the WTR portfolio has no significant alpha. Despite paying a positive accumulated return (as in Figure 1), this portfolio does not create alpha (Jensen's alpha) or extra returns in the long term. Another relevant result is the low market influence (a beta value of 0.2620). Therefore, the performance of this portfolio is due to other non-market issues and, potentially, to other financial markets (such as the ones of the U.S.) influence.

Table 4. CAPM auxiliary regression and Engle-Granger cointegration test (portfolios in USD)

	CAPM	
Market	0.262***	0.170***
	(0.031)	(0.020)
Constant	0.001	83.743***
	(0.002)	(3.022)
Engle-Granger	---	0.2726
R^2	0.075	0.081
Note:	*means p-value<0.1,** means p-value<0.05,***means p-value<0.01	

The second column of Table 4 shows the auxiliary regression of the Engle-Granger (1987) cointegration test. The row Engle-Granger of Table 4, shows the p-Value of the Augmented Dickey-Fuller (1979) unit root test with one lag in the residuals. As noted, despite the returns boxplot and ANOVA or Kruskal-Wallis tests showing no short-term difference in the returns of the simulated portfolios, the performance of these suggests no relationship in the long term. Therefore, the WTR portfolio behaves according to market moves, but its value does not depend on systematic issues. That is, it moves accordingly to the performance of LATAM stock markets, but it has no significant long-term common trend with these. Thanks to the no cointegration conclusions and the low systematic risk (beta value) of 0.26. This last result goes in line with the findings of previous works that show an inverse and significant relation between ESG and water management practices disclosure and risk (total and systematic) (Jo & Na, 2012; Salama et al., 2011; Zeng et al., 2020).

Figure 3 shows the boxplot of the mean-variance (risk-return) perspective. The Figure depicts the weekly ex-post Sharpe ratios as in (12) and (13).

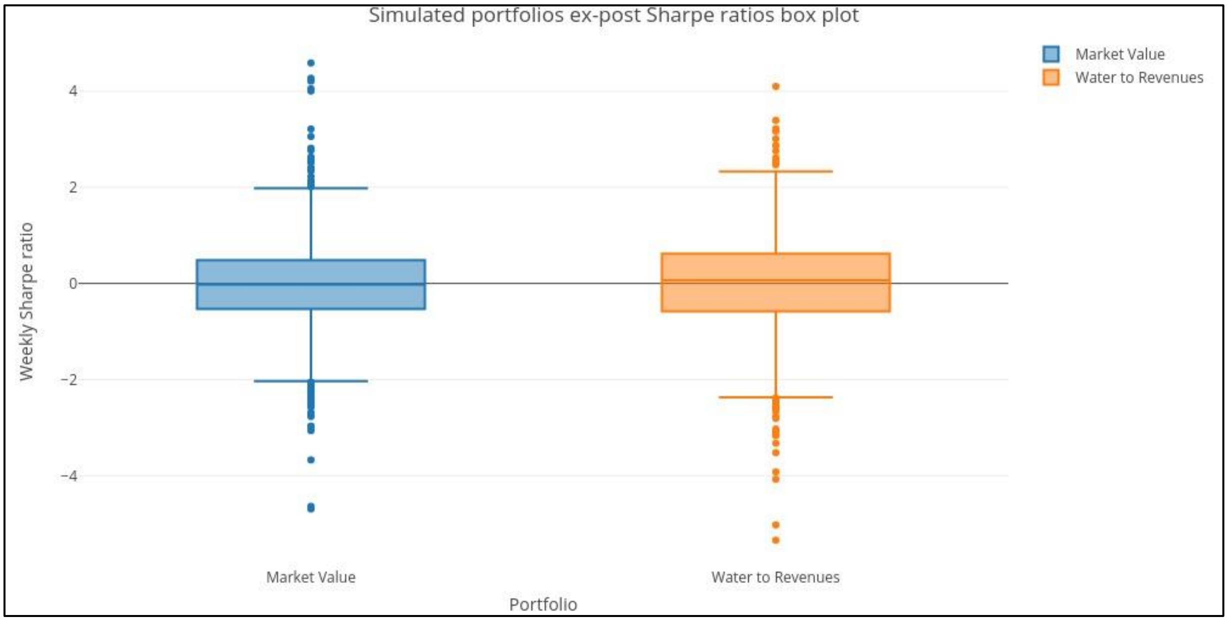

Figure 3. The simulated portfolios' Sharpe ratios boxplot (in USD).

As noted, the weekly values are statistically similar. A result confirmed in Tables 5 and 6 with the corresponding ANOVA and Kruskal-Wallis tests.

Table 5. One-way ANOVA test of the simulated portfolios' Sharpe ratios

	Degrees of freedom	Squared sums	Mean Squares	F statistic	p-value
Portfolios	1	0.067	0.067	0.062	0.803
Residuals	1,804	1,950.502	1.081		

Table 6. Kruskal-Wallis test of the simulated portfolios' Sharpe ratios

	Statistic	*parameter*	*p-value*
Kruskal-Wallis chi-squared	1.357	1	0.244

The simulations suggest that there is no significant difference in the performance of the WTR portfolio against the market one in the long term. Despite this result, Figure 1 and the cointegration results test suggest that the differences in the performance of these two portfolios could lead to diversification benefits by investing in a two-asset portfolio with a market portfolio as one asset and the WTR as the other.

Departing from this potential result, the author simulated the portfolio, from January 6th of 2006 to April 22nd of 2022 (851 weeks of simulations), the performance of a portfolio that solved the optimal portfolio selection problem in (17). Figure 4 shows the historical base 100 values of the market, WTR, and optimal portfolio.

Figure 4. Historical performance of the Market, WTR, and mean-variance optimal portfolios (in USD).

As noted, the optimal selection problem led to a portfolio fully invested in the WTR. This result is of interest because given a mean-variance (risk-return) tradeoff. With the optimal selection problem in (17) in all the simulated weeks, the most efficient portfolio is the WTR. This result suggests that even if the investor losses accumulated return in some periods, the risk exposure and risk-return tradeoff are the most appropriate for a given investor.

Departing from this optimal risk-return selection, A sensitivity test was carried out for three different investment levels in the WTR portfolio. Figure 5 depicts the of the optimal portfolios, along with othe with 50% and 75% investment levels in the WTR.

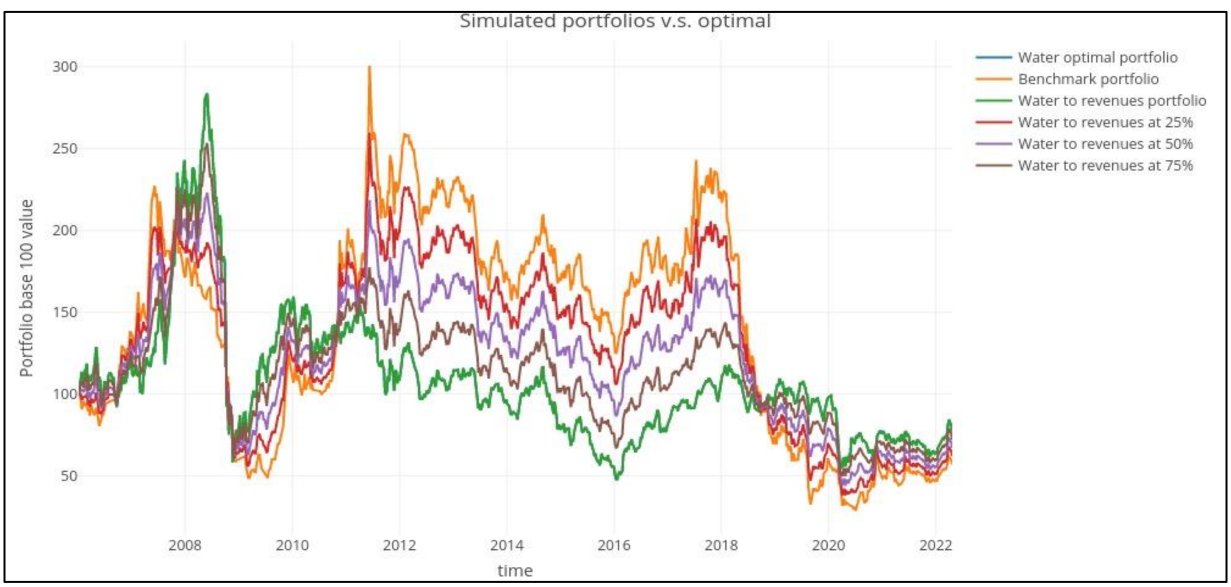

Figure 5. Historical performance of the Market, WTR, mean-variance optimal portfolios (in USD), and 25%, 50%, and 75% investment in the WTR portfolio.

An important conclusion of these results is that a given investor could engage in water management activism. That is, she or he could invest only in "water responsible" companies, and even if she or he loses some potential return benefits, her or his risk-return (mean-variance) profile is appropriate in the long term. A given investor could engage in a whole WTR investment strategy or a 50%-50% in WTR and Market portfolio one. As noted in Figure 5, the investor's mean-variance (risk-return) profile is still appropriate. This result holds even though Mexico and Argentina had negative F.X. performance. An ANOVA test of the six simulated portfolios' returns in Figure 6 shows the same conclusion as in Table 2. That is, the performance of the WTR, market, optimal, and 25%, 50%, and 75% in WTR investment are statistically equal (the ANOVA table was omitted due to space restrictions. The reader can consult it upon request).

To isolate the impact of currency depreciation, the next section shows the results of the simulated portfolios valued in local currency.

4.2. Local currency portfolio's results

Figure 6 shows the historical performance of the market and WTR portfolio values in local currency. Except for the 2020-2022 period, the WTR portfolio (in local currency) performed better during almost all the simulation's time windows. The last move or "jump" in the 2020 period corresponds to two events: 1) the price increase of technological stocks (in the case of Argentina) and 2) some commodities and COVID-19-related industries. Therefore, the WTR underperformance in this period is due to market movements of commodity companies and farmaceuticals with undisclosed WTR data.

Figure 6. The historical base 100 value of the simulated portfolios in local currency.

Despite this short-term result, the WTR simulated portfolios outperformed the market one. Following the same review as in the market portfolio, Figure 7 depicts the portfolio returns boxplot.

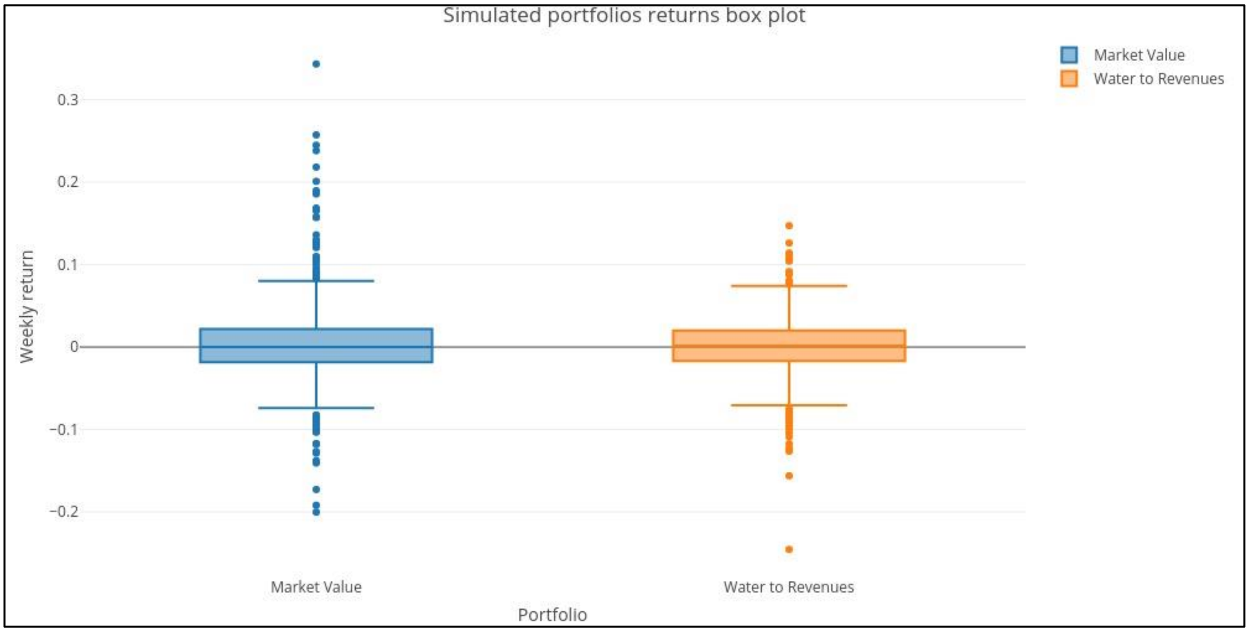

Figure 7. The simulated portfolios' returns boxplot (in local currency).

As noted in Figure 7, the conclusions align with Figure 2. The performance (returns) of the market and WTR portfolios are similar. Tables 7 and 8 present the results of the ANOVA and Kruskal-Wallis tests (correspondingly). The reader can conclude that the returns (in the short term) have the same performance. Following the results of Figure 7, the market portfolio has more extreme outliers than the WTR, suggesting that the risk exposure could be higher. A similar result to the case of the simulated portfolios in USD.

Table 7. One-way ANOVA test of the simulated portfolios' weekly returns (in local currency)

	Degrees of freedom	Squared sums	Mean Squares	F statistic	p-value
Portfolios	1	0.001	0.001	0.758	0.384
Residuals	1,804	3.185	0.002		

Table 8. Kruskal-Wallis test of the simulated portfolios' weekly returns (in local currency)

	Statistic	*parameter*	*p-value*
Kruskal-Wallis chi-squared	0.165	1	0.684

Despite the previous short-term result, Table 9 shows the CAPM auxiliary regression and the Engle-Granger cointegration test.

Table 9. CAPM auxiliary regression and Engle-Granger cointegration test (portfolios in local currency)

	CAPM	Cointegration
Market	0.119***	0.122***
	(0.024)	(0.011)
Constant	0.001	171.217***
	(0.001)	(3.557)
Engle-Granger	---	0.9106
R^2	0.027	0.125
Note:	*means p-value<0.1,** means p-value<0.05,***means p-value<0.01	

Contrary to the findings in Table 4, the influence of the market portfolio is lower measured in local currency (0.119 v.s. 0.262). This finding suggests that even if the ANOVA test shows similar performance, the impact of systematic risk in the WTR portfolio is low. The cointegration test confirms this finding, given a high p-value in the augmented Dickey-Fuller unit root test in the cointegration column.

By controlling the impact of currency depreciation, the reader can conclude that the simulated portfolios (especially the WTR) had statistically equal performance. This conclusion suggests two things: 1) the WTR has a low systematic risk exposure, and 2) the risk-return tradeoff of the WTR portfolio is due to more company-specific (non-market) issues. Still, this relationship does not hold in the long term.

Figure 8 presents the boxplot of the ex-post Sharpe ratios and, in Tables 10 and 11, the corresponding ANOVA and Kruskal-Wallis tests. These tables show the same conclusion as in the case of the USD simulated portfolios: there is no significant mean-variance efficiency difference in the short term.

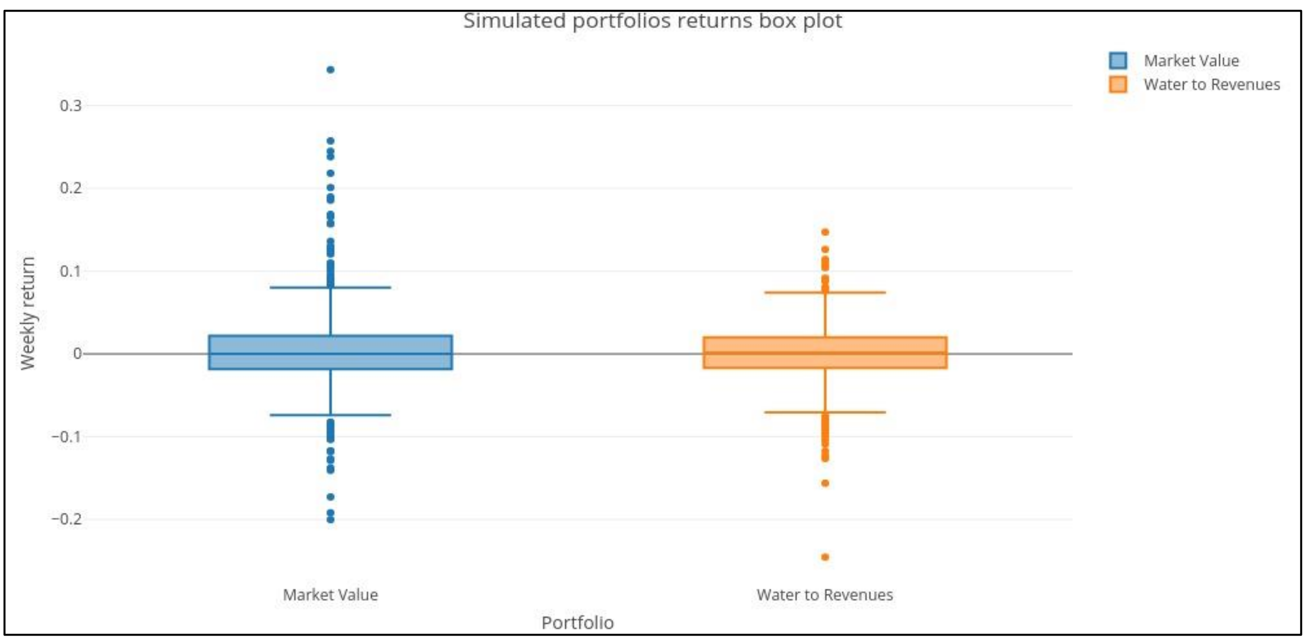

Figure 8. The simulated portfolios' Sharpe ratios boxplot (in local currency).

Table 10. One-way ANOVA test of the simulated portfolios' Sharpe ratios (in local currency)

	Degrees of freedom	Squared sums	Mean Squares	F statistic	p-value
Portfolios	1	0.413	0.413	0.387	0.534
Residuals	1,804	1,925.370	1.067		

Table 11. Kruskal-Wallis test of the simulated portfolios' Sharpe ratios (in local currency)

	Statistic	*parameter*	*p-value*
Kruskal-Wallis chi-squared	0.022	1	0.882

4.3 Consequences of results

This section presents the performance results of the two simulated portfolios in USD and local currency. In the former scenario (USD valuation), the portfolios had a lousy performance at the end of the simulations because two countries (Argentina and Mexico) had a currency depreciation. Despite this, four interesting results emerge:

1. The water to revenues (WTR) portfolio had a more stable (mean-variance efficient) performance than the market one.
2. In terms of accumulated return, the WTR paid a better return than the market one, but this outperformance holds only in the short term.
3. Given the CAPM, cointegration, and ANOVA tests, the WTR portfolio had a statistically equal performance to the market one in the short term. In the long-term, the WTR portfolio had no significant alpha (Jensen's alpha) generation (extra return) and significant, low systematic risk (beta of 0.26), and no cointegration with the latter. This result aligns with the literature *(Jo & Na, 2012; Salama et al., 2011; Zeng et al., 2020)* that found evidence that disclosing water management practices reduces total and systematic (market) risk. Departing from the previous results, it is crucial to note that even if the performance of the WTR is not as spectacular as the market in some periods, the WTR is a relatively stable portfolio.
4. It is possible to extrapolate the previous findings in an optimal portfolio selection in a combination of WTR-market portfolios as assets. In that case, the most mean-variance efficient portfolio is the one fully invested in the WTR, and a combination of 50% in WTR and 50% in the market portfolio could improve the performance. Therefore, fully engaging in a WTR investment strategy or a market-WTR overweighted (50% WTR-50% market) could lead to proper portfolio performance. This conclusion could motivate WTR activist investing practices in Latin American Public companies.

Controlling the impact of currency depreciation, similar results were found in the simulations than the USD ones. The only difference is that both portfolios paid a positive accumulated return. This finding suggests that currency market impact mainly affects the not-so-spectacular performance of the USD portfolios. An effect that could reduce by hedging with currency futures or options (a practice suggested for further research).

5. Conclusions

ESG investing is an emerging investment style that has become important. So important that the ESG quality of a managed portfolio has become an essential perspective of portfolio management and related regulatory actions around the globe.

This investment style has become so crucial that its benefits are in current discussion among academics and practitioners. General theoretical ESG mean-variance performance discussion is about the benefits of ESG practices in terms of investment returns or risk exposure.

One position suggests ESG investing pays better returns than the conventional (market or passive). Others suggest the contrary and even that investing in "sinful" stocks (the ones of gambling, tobacco, weapons production, or companies with high environmental impact) is better than the ESG one.

There are several conclusions in the current literature about ESG investing, but there is little attention to the benefits of motivating proper water management practices through investing.

Despite this effort, there's little literature about the relationship between water management activities and portfolio performance. The scant literature shows that water-responsible companies (companies with disclosed water management activities) have lower total and systematic (market) risk than the opposite cases. This paper try to fill this gap for the Latin American case.

The main question addressed in this paper is: What would the performance of a given investor be, had she or she invested only in water-responsible companies in Latin America? Would she or he lose mean-variance performance against a market portfolio?

To answer this question, the performance of a portfolio invested in stocks members of the Refinitiv price return index was simulated. More specifically, the stocks of the four Latin American (LATAM) stock exchanges with the highest capitalization and trading volume in LATAM (Argentina, Brazil, Chile, and Mexico). From January 6th of 2005 to April 20th of 2022, the author simulated the weekly rebalancing of a U.S. dollar (USD) based portfolio in the 301 stock members of this index (market portfolio). The weighting method used in this portfolio is the market capitalization scheme. In parallel, a portfolio invested in stocks of companies that reported a water to revenues (WTR) ratio was simulated. This portfolio assumed an investment style weighted more (less) in stocks with the lowest (highest) WTR. This paper used the WTR ratio to proxy a company's general (and proper) water management practices. This water consumption metric aligns with the proposals of the World Economic Forum, the United Nations, and authors such as Griggs (2013), the United Nations (2000) or the World Economic Forum (2022).

This paper's hypothetical position was that the mean-variance efficiency of the WTR portfolio is equal to or better than the market portfolio.

The simulation results suggest that, despite the performance of the USD WTR portfolio was worse than the market in some periods, its mean-variance efficiency is still equal. The WTR has a low systematic risk (beta of 0.262). This result aligns with previous works that test water management disclosure and risk relationship (Jo & Na, 2012; Salama et al., 2011; Zeng et al., 2020).

The historical simulated returns of both portfolios and the Sharpe ratios are statistically equal. This finding suggests that the WTR portfolio's mean-variance efficiency is similar to the market. Therefore, the investor fully engaged in the WTR strategy does not loss mean-variance efficiency.

Also, by selecting an optimal tangency portfolio invested in the simulated WTR and market portfolios, the results show that the mean-variance optimal portfolio is fully invested in the WTR strategy. This result confirms that the WTR portfolio has better mean-variance efficiency regarding expected parameters and optimal portfolio selection.

To test the sensitivity of the mean-variance portfolio, three more portfolios invested, in 25%, 50%, and 75% in the WTR (the rest in the market portfolio) were simulated. The results suggest that investing 50% in WTR and 50% in the market portfolio enhances an investor's mean-variance efficiency. Therefore, a given investor could engage either in an entire WTR investment strategy or an active 50%-50% WTR-market portfolio. She or he could do this without losing mean-variance efficiency against a LATAM market portfolio.

The same portfolios were simulated in local currency again to control currency market impacts. This perspective led to similar conclusions. The only difference is that the WTR strategy is better for local investors than USD-based ones.

This paper presents the first proof of the benefits a given investor could have in activism investing by allocating her or his resources mainly to WTR-efficient companies. The evidence of these findings could motivate LATAM companies (a region highly focused on commodities and some water-intensive industries) to engage in better water management practices. These companies could enhance their productivity, reduce systemic risk, and consequently access better financing and valuation conditions.

This result could hold because WTR investors could shun stocks with poor WTR ratios and prefer the best ones. The shunned stock hypothesis predicted a systematic risk reduction and better financing conditions (Derwall et al., 2011), which holds in this paper's results.

Despite these first results suggesting a proper mean-variance efficiency if an investor engages in water management investing (WTR) strategies, there are still some extensions to make to the present paper.

Review these findings in other countries and regions, such as North America, Europe, Asia-Pacific, the Middle East, or Africa, could be a natural and interesting extension. Other water management items, such as the percentage of recycled water used by a company or the quality of the water management policy, could be another exciting perspective.

The extension of the current results in other currencies and even a region-specific or country-specific comparison could be of interest, along with using different optimal portfolio selection methods with water management quality. That is an extension of using other optimal ESG portfolio selection processes, such as Ballestero et al. (2012) or Gasser, Rammerstorfer, and Weinmayer (2017).

Finally, extending this paper's simulations with currency hedging strategies could be of practical interest. This guideline is suggested to strengthen this paper's results and neutralize the effect of adverse currency movements on the portfolio's performance.

The core idea of the current research and the suggested guidelines is to give the proper answer to an investor related to the benefits of activist water investing and its impact on appropriate water management activities from companies worldwide.

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Author Contributions: Conceptualization, data gathering, simulations, numerical tests, methodology, formal analysis, investigation, writing—original draft preparation, review and editing, O.V.D.l.T.-T. The author has read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflict of interest in the tests and results presented herein. The funders had no role in the study's design, in the collection, analyses, or interpretation of data, in the writing of the manuscript, or in the decision to publish the results.

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