

RIEMANNIAN APPROACH TO MAPPING CRYPTOCURRENCY IN THE FINANCIAL MARKET

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ABSTRACT

The valuation of the cryptocurrency market surpassed three trillion dollars in 2022, underscoring the burgeoning interest in digital currencies and decentralized finance. In response, on June 7, 2022, a bipartisan initiative led to the introduction of the “Responsible Financial Innovation Act,” positioning cryptocurrencies as commodities and designating the Commodity Futures Trading Commission as the primary regulatory authority for the cryptocurrency market. Intriguingly, a study by Kim et al. (2022, JABE & IJBR) utilized a non-Euclidean methodology, suggesting that cryptocurrencies, in terms of their price dynamics, resemble securities more than commodities. However, a critical assessment of Kim et al. (2022, IJBR) reveals a methodological gap: the non-Euclidean distances were employed to derive a Euclidean configuration of 28 asset classes via multi-dimensional scaling. This Euclidean structure was subsequently employed for asset class categorization using k -means clustering. This approach, while acknowledging the non-Euclidean distances among the 28 asset classes, leverages a Euclidean embedding for classification. In contrast, our research employs data depth to categorize asset classes without resorting to Euclidean embedding. We compare our findings with those of Kim et al. (2022, JABE & IJBR) for a comprehensive understanding.

Keywords: Commodities, Correlation Matrix, Cryptocurrency, Data Depth, k -Means Clustering, Non-Euclidean Distances, Securities

1. INTRODUCTION

Cryptocurrencies, as described by the White House Executive Order on March 9, 2022, represent digital assets utilizing distributed ledger technologies, like blockchain, to maintain and encrypt generation or ownership records (See also Lewis (2021) and Vigna & Casey (2015)). Although their direct application as a medium of exchange remains restricted due to limited vendor acceptance, the allure of cryptocurrencies as a store of value is undeniable. The digital asset market, with a recent global market capitalization of \$3 trillion, has seen rapid growth, attracting millions of investors worldwide, including 16% of adult Americans. While these assets offer opportunities for U.S. global financial leadership and technological advancement, they come with substantial risks. The May crash of a so-called stablecoin led to insolvencies resulting in a loss of over \$600 billion for investors and consumers (White House: Fact Sheet, September 16, 2022).

Despite this growing public fascination with digital currencies as an investment avenue, there exists a palpable regulatory ambiguity surrounding their classification within established asset categories. Illustrating this quandary, on June 7, 2022, the “Responsible Financial Innovation Act” was put forth by two U.S. senators (The Washington Post, June 7, 2022). This legislative proposal endeavors to establish a comprehensive regulatory framework for digital assets, categorizing most cryptocurrencies as commodities. It subsequently entrusts the Commodity Futures Trading Commission (CFTC) with the primary oversight of the cryptocurrency landscape.

However, this perspective isn’t universally accepted. Gary Gensler, the chair of the Securities and Exchange Commission (SEC), posits that most digital assets should be classified as securities, thereby