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Navigating Risk in the US Transport Industry: Insights from a CAPM-Based ARDL Approach

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Abstract

This study assesses the systematic risk of 45 publicly listed U.S. transportation companies using the CAPM framework, grouping them into five categories. We apply the ARDL technique, which provides dual risk insights—short-term and long-term. This method reduces endogeneity concerns, as each variable is modeled through a single-equation approach. The transportation sector plays a crucial role in the U.S. economy, accounting for up to 10% of GDP, with the logistics market approaching $2 trillion in 2019. Our analysis shows that long-run (LR) investments are less sensitive to market fluctuations and tend to be more profitable, whereas short-run (SR) investments are more exposed to market volatility but can be offset by long-run recoveries. The study provides useful guidelines for equity investments in the transportation sector, underscoring its potential for substantial returns despite its cyclical nature. Measuring systematic risk is thus essential for making informed investment decisions in this field.

Keywords: Systematic Risk; CAPM; ARDL; Equity Investments; Logistics Industry; Market Fluctuations; Investment Profitability: Transportation Sector.

1. Introduction

Transportation is a crucial sector for a country's growth and development. This is even more true in a global economy such as the United States of America, where economic opportunities have been increasingly linked to the mobility of people and goods. When transportation systems are efficient, they provide financial and social opportunities and benefits that translate into positive multiplier effects such as improved accessibility to markets, employment, and additional investment. The transportation stock market has a considerable impact on the U.S. economy, as a large share of GDP is linked to the performance of the transportation sector (Zagorchev et al., 2011). This is because the transportation sector in the United States is used as a bellwether for the economy. Thus, if transportation stock prices are rising, some investors often interpret this as a sign of optimism in the market toward growth. The rationale is that an expanding economy will likely lead to more frequent travel and delivery of goods. It is one of the most widely diversified sectors due to the presence of different types of transportation and therefore the subject of considerable interest from the scientific community. The largest percentage of freight in the U.S. is transported by truck (60%), rail (10%), ship (8%), and air freight (0.01%) (Sprung and Chambers, 2016).

Typically, people who invest have one goal in mind: to earn a good return on their investment. Returns can be determined by the type of investment, the timing, and the risks associated with it. This means that returns can vary widely, often making it difficult for investors to plan for their financial future. Essentially, when investors decide to invest in transportation companies, they purchase either individual stocks or financial products such as investment funds and/or ETFs. In general, transportation stocks provide direct portfolio exposure to the state of the economy and have a reputation for signalling whether good times or bad are coming. It tends to be the case that demand for shipping can rise or fall dramatically during economic periods, so transportation stocks are better suited to investors who are comfortable with cyclicality. In fact, in the stock market, transportation companies are considered cyclical stocks. A stock is defined as cyclical when the underlying business generally follows the economic cycle of expansion and recession, performing well during economic expansions and experiencing declining profits during recessions and other difficult economic periods. During recessionary periods, it is not appropriate to invest in transportation companies because, during these periods, the sectors that remain strong are generally the essential sectors, or so-called defensive sectors, such as health care, utilities, or consumer goods. Indeed, the economic contexts we have experienced in recent years, such as the Covid-19 pandemic, clearly showed this complexity in the transportation sector and its hypersensitivity to the economic environment (Nundy et al., 2021). Nevertheless, investing in transportation companies allows an investor to take advantage of expanding economic growth, due to the close link between the stock market and a country's economic development (see Marques et al., 2013). That's why investing in transportation is usually an activity that particularly appeals to risk-taking investors looking for the large returns these stocks are capable of providing, especially over the long term. Therefore, it is crucial to analyse the performance of U.S.-listed transportation companies and to analyse their systematic risk (i.e., the risk factor associated with the performance of the market as a whole). Therefore, the study focuses on the risk analysis of 45 American companies in 5 different modes of freight transport, listed on the two most important markets in the world (NYSE and Nasdaq). For systematic risk analysis, we use the Capital Asset Pricing Model (CAPM) methodology. To our knowledge, this is the first time that the short-run and long-run systematic risk have been analyzed using the ARDL method for listed U.S. transportation companies.

The remainder of the paper is organized as follows. Section 2 presents the theoretical framework of the CAPM. Section 3 provides stylized facts on the U.S. transport sector. Section 4 details the model specification and the ARDL methodology. Section 5 describes the data. Section 6 reports the empirical results and discussion. Section 7 concludes with policy implications.

2. Theoretical framework of CAPM method

While the application of beta in assessing systematic risk is well established in the finance literature, its specific application to the transport sector has been underexplored. Comparisons can be drawn with studies in other sectors, such as manufacturing or technology, where understanding sector-specific betas has provided critical insights into investment risks and opportunities. This study fills this gap by focusing on the transport sector, which is pivotal to the U.S. economy yet remains underrepresented in beta-based risk assessments. Many studies have been conducted to test the ability of the Capital Asset Pricing Model (Sharpe, 1964; Black, 1972) to explain the relationship between the return on a security and its degree of riskiness. This relationship is measured through a single risk factor, called the beta (β) of the stock, which captures the variation of a security's return over time in response to market changes. The CAPM has been present in the literature for over four decades. Despite the long-standing debate over its theoretical and empirical validity (Campbell, 2000), it continues to be used because of its simplicity and straightforward interpretation.

William Sharpe's (1964) CAPM marked the birth of modern asset pricing theory. Before this, there were no asset pricing models grounded in the fundamental principles of investment opportunities with the ability to generate clear and verifiable predictions of the risk–return relationship (Fahad and Laura, 2017). The backbone of the CAPM is the so-called "portfolio choice theory" developed by Harry Markowitz in 1959, which introduced a model characterized by risk-averse investors seeking to maximize expected utility. Over the decades, empirical analyses aimed at verifying the validity of the CAPM have been widely criticized because the returns of some securities were not correlated with beta, or because beta, in combination with other variables, was not always statistically significant and therefore unable to explain average returns alone (Fama and French, 1992). Roll's (1977) criticism is based on the fact that CAPM tests rely on the assumption that the market portfolio lies on the efficient frontier; however, the real market portfolio is not observable, as it is purely theoretical. Roll argues that since the market portfolio encompasses all risky assets available in the market, it should include, at least in theory, all assets—both financial and real—which are difficult to quantify (e.g., real estate, human capital, etc.). According to Roll, the market portfolio used in CAPM applications does not allow reliable conclusions regarding its efficiency in terms of mean and variance (i.e., risk–return), as it represents an improper approximation of the true market portfolio. For this reason, subsequent studies sought to expand the set of covariates in the basic CAPM equation to better explain the determinants of security returns. In this regard, the most relevant contributions were made by Fama and French (1992) and Carhart (1997). Fama and French made a major contribution to the evolution of CAPM literature by testing which variables, besides beta, could influence the return on a security. Their results show that, contrary to the assumptions of CAPM, beta—whether alone or in combination with other variables—is not always statistically significant and therefore cannot fully explain average returns.

In 1993, they developed the "three-factor model," which added two additional factors (or regressors) to explain excess returns: portfolio size and the market-to-book value. The authors concluded that the three-factor risk–return relationship provides a good model for explaining the returns of portfolios constructed on the size and book-to-market-equity variables (Fama and French, 1993). Subsequently, Carhart (1997), building on the Fama and French (1993) three-factor model, introduced an additional factor—momentum—which captures the tendency of a stock's price to continue rising if it has been rising, or falling if it has been falling. Novy-Marx (2013) criticized the Fama and French three-factor model, arguing that it fails to fully explain expected returns. As a result, Fama and French (2015) expanded their 1993 model by adding profitability and investment factors.

Table 1. Summary review on CAPM.

Author	Years	Contribution
Markowitz	1958	*Portfolio selection*
Sharpe	1964	*Capital asset prices: A theory of market equilibrium under conditions of risk*
Black	1972	*Capital market equilibrium with restricted borrowing*
Ross	1976	*The arbitrage theory of capital asset pricing.*
Fama-French	1992	*The cross-section of expected stock returns*
Roll	1997	*A critique of the asset pricing theory's tests Part I: On past and potential testability of the theory*
Carhart	1997	*On persistence in mutual fund performance*
Fama-French	2015	*A five-factor asset pricing model. Journal of financial economics*

Source: Author elaboration

To recap most critiques of the CAPM have done nothing but add factors to the model, always focusing on ad hoc created datasets (e.g diversified portfolios and the industry sector, (Foye, 2018; Jareño et al 2020).

To our knowledge, no author has ever considered the systematic risk analysis of the U.S. freight sector. Transportation stock market studies have focused on the influence of crude oil prices on the stock market (see Basher and Sadorsky, 2006). Others have sought to test determinants that impact the market performance of transportation firms, such as disasters (Kowalewski and Śpiewanowski, 2020), sports (Buhagiar et al., 2018), news (Li, 2018), environment (Alsaifi et al, 2020) political events (Shanaev and Ghimire, 2019) and the impact of pandemic diseases such as SARS (Chen et al., 2009) and Covid 19 (Ho, et al., 2021).

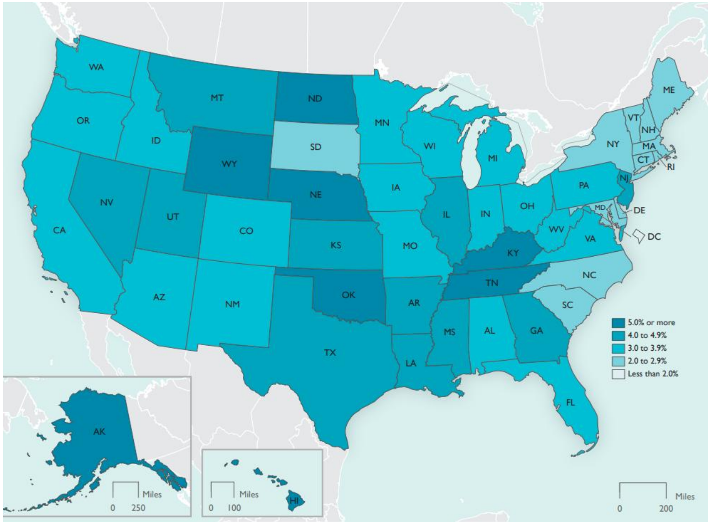
3. Stylized facts

One of the largest industries in the United States is the freight sector, involving both exports and imports. Estimates of the size of the global logistics industry range from $8 trillion to $12 trillion annually. A common rule of thumb used by many forecasters is to express this as a percentage of GDP. In the United States, on average, up to 10% of GDP is attributed to the logistics industry. Based on economic activity in 2019, the U.S. logistics market was approaching the $2 trillion level. Due to the size of its territory and the distribution of its population, the U.S. transportation system is highly extensive. What distinguishes the U.S. is its efficiency, thanks to well-developed highway, rail, air, and maritime networks. In terms of length, the country has the world's longest rail and road networks and the fifth-longest inland waterway network. Within the continental United States, 45% of freight transport, measured in ton-kilometers, is moved by truck. Railways play a relatively important role compared with other countries, moving nearly 30% of goods (Wiegmans et al., 2018).

Transportation contributes to the economy by enabling the production of goods and services and by employing workers in transportation occupations across both transportation and non-transportation industries. In particular, according to the Freight Analysis Framework estimates, the U.S. freight transportation system moved nearly 17.7 billion tons of goods in 2016, valued at more than $18.1 trillion. The value of total U.S.

international freight trade increased from nearly $2.5 trillion in 2000 to $3.4 trillion in 2017 (Sprung and Chambers, 2016). Transportation's contribution to the economy can be measured by its share of gross domestic product (GDP). The demand for transportation ($1,489.7 billion) accounted for 8.9 percent of U.S. GDP (as measured in chained 2009 dollars) in 2016. The transportation industry's contribution to a state's GDP also depends on the state's geography, population density, industrial composition, and the presence of transportation hubs. States with larger total GDPs, such as California ($2.7 trillion) and Texas ($1.70 trillion), also show large transportation and warehousing activities of $69.2 billion and $60.0 billion in 2016, respectively (see Figure 1).

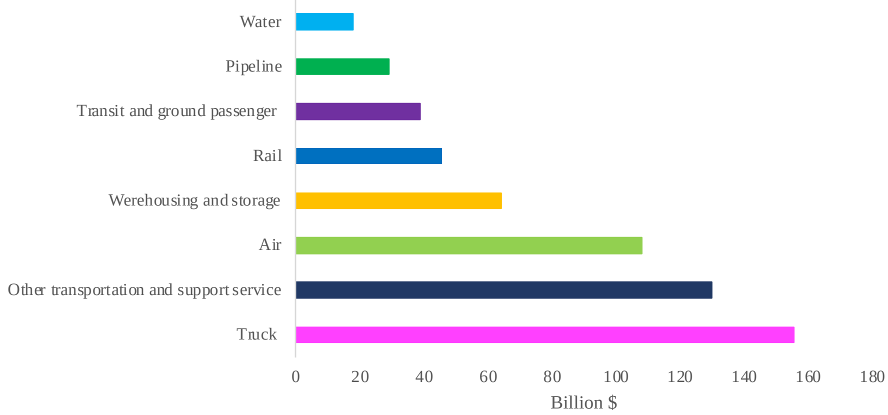
Figure 1. State Gross Domestic Product from Transportation and Warehousing as a Percent of State Total Gross Domestic Product, 2016.



Source: U.S. Department of Commerce, Bureau of Economic Analysis, "Regional GDP and Personal Income".

Freight transport is carried out by a variety of modes. The largest percentage of goods in the United States is carried by truck (60%), rail (10%), ships (8%) and air transport (0.01%) (Sprung and Chambers, 2016). Figure 2 shows transportation services' contribution (value-added) to GDP by transportation industries. In 2017 the three transportation industries with the largest contributions were trucking ($155.5 billion, 0.80 percent of GDP), other transportation and support activities ($129.9 billion, 0.67 percent), and air ($108 billion, 0.56 percent).

Figure 2. Transportation and Warehousing's Contribution to GDP by Industry (2017)



Source: U.S. Department of Commerce, Bureau of Economic Analysis, GDP by Industry.

4. Model specification and methodology

The aim of this work is to estimate the risk in the transport market. Following Sharp 1964's approach, the basic model expressed as follows:

$$R_{it} = \alpha_0 + \beta R_{jm} + \varepsilon_i \tag{1}$$

where $R_{i,t}$ is the return on assets i period t and R_{Jm} the yield of the j-th market at time t. Before risk calculation procedures, it is necessary to calculate given the share prices, the returns. In the following analysis, stock yields against market indices are calculated following Fahad and Laura 2017 approach and He and O'Connor, 2018:

$$R_{i,t} = ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right) \tag{2}$$

where $R_{i,t}$ is the log-return on assets i period t, and $P_{i,t}$ is the price of the asset i in period t, that is, the closing price (or value) of the security (or index) at time t. The time series of the companies' returns are shown in Figure A1 of the Appendix[1]. From equation (1) the beta (β) coefficient is then expressed as:

$$\beta_j = \frac{cov(R_i, R_m)}{var(R_m)} \tag{3}$$

Beta is a coefficient that defines the measure of the systematic risk of a financial activity (i.e. the tendency of an activity's return to vary as a result of market changes). It allows to measure the exposure of a stock to systematic risk within the Capital Asset Pricing Model. In other words, beta is a measure of the systematic riskiness of the stock: it measures the expected change in the yield of the stock for each change of one percentage point of market return. The values that beta can take are positive, negative or 0; can be interpreted as follows:

Shares with a β>1: tend to amplify market movements (share is riskier than the market). They express greater variability than that of the market portfolio and for this reason they are defined in "aggressive" jargon: these securities always "beat" the market, both positively and negatively, that is, they earn more than the market in case of rises, they lose more of the market in case of downs.

Shares with β <1: they are characterized by less variability than that of the market portfolio and for this reason they are defined in "defensive" jargon: these stocks "are always beaten" by the market, i.e. they earn less than the market in case of rises and lose less of the market in the event of a decline.

[1] The Appendix is available at the following link https://bit.ly/3WuN1sJ

Finally, stocks with a beta which assumes values between 0 and 1, tend to be defensive i.e. they tend to move less than proportional to the benchmark.

To estimate equation (1) the ARDL technique is used for the beta calculation, following the CAPM approach. To our knowledge, it is the first time that the ARDL technique has been used for the beta calculation in the transport sector. As expected by the theory, economic analysis suggests that there is a long-run relationship between the variables under consideration. In long run model if a long-term relationship among variables holds, the means and variances are constant and not depending on time. However, most empirical research has shown that the constancy of the means and variances is not satisfied in analysing time series variables. Hence, it is possible to note some time series that display the feature of diverging away from their mean over time while others may converge to their mean over time. Time series that diverge away from their mean over time are said to be non-stationary. Therefore, the classical estimation of variables (e.g. OLS) with this relationship most times gives misleading inferences or spurious regression. To overcome this problem of non-stationarity of a model, econometric analysis of time series data has increasingly moved towards the issue of cointegration[2]. Cointegration makes it possible to retrieve the relevant long-run information of the relationship between the considered variables that had been lost on differencing. That is, it integrates short-run dynamics with long-run equilibrium. This is the basis for obtaining realistic estimates of a model, which is the driver of a meaningful forecast and policy implementation.

Because economic analysis suggests that there is a long-run relationship between variables under consideration as stipulated by theory (Adrian and Franzoni, 2009) we implement the Autoregressive Distributed Lag cointegration technique (ARDL) to estimate betas of 45 listed American freight companies (Pesaran and Shin, 1999; Pesaran et al., 2001). In contrast to the other approaches (e.g. GMM), it is possible to obtain dual risk information (i.e. two betas): one for short-term and the other for long-term. Another important feature of this approach is that it does not matter whether the explanatory variables are exogenous (see Pesaran and Shin, 1999). Furthermore, since each of the underlying variables stands as a single equation, endogeneity is less of a problem in the ARDL technique because it is free of residual correlation (i.e. all variables are assumed endogenous). When there is a single long-run relationship, the ARDL procedure can distinguish between dependent and explanatory variables. That is, the ARDL approach assumes that only a single reduced-form equation relationship exists between the dependent variable and the exogenous variables (Pesaran et al., 2001). Based on the above, in order to calculate the model, we follow three steps:

1. *Determination of the Existence of the Long Run Relationship of the Variables*

The existence of the long-run relation between the variables under investigation is tested by computing the Bound F-statisticin order to establish a long run relationship among the variables (Pesaran et al., 2001).

[2] Cointegration is an econometric concept that mimics the existence of a long-run equilibrium among underlying economic time series that converges over time. Thus, cointegration establishes a statistical and economic basis which brings together short and long-run information in modelling variables. Testing for cointegration is a necessary step to establish whether a model empirically exhibits meaningful long-run relationships. If it fails to establish cointegration among underlying variables, it becomes imperative to continue to work with variables in differences instead.

2. Choosing the Appropriate Lag Length for the ARDL Model/ Estimation of the Long Run Estimates of the Selected ARDL Model

In order to select the appropriate model of the long run underlying equation, it is necessary to determine the optimum lag length by using proper model order selection criteria. In our analysis we use the Akaike Information Criterion (AIC) criterion, the model with the lowest AIC being the "best" model among all models specified.

3. Reparameterization of ARDL Model into Error Correction Model

When non-stationary variables are regressed in a model, we may get results that are spurious. One way of resolving this is to difference the data to achieve stationarity of the variables. In this case, the estimates of the parameters from the regression model may be correct and the spurious equation problem resolved. However, the regression equation only gives us the short-run relationship between the variables. It does not give any information about the long run behaviour of the parameters in the model, in order to resolve this, the concept of cointegration and the ECM becomes imperative. With the specification of ECM, we now have both long-run and short-run information incorporated. In particular, the error correction model of the ARDL model is as follows:

$$\Delta R_t = \alpha_0 + \alpha_1 (R_i)_{t-1} + \alpha_2 (R_m)_{t-1} + \sum_{i=1}^{n} \beta_{1i}\, \Delta(R_i)_{t-1} + \sum_{i=1}^{n} \beta_{2i}\, \Delta(R_m)_{t-1} + \varepsilon_t \tag{4a}$$

where Δ is the first difference operator, α_0 the drift component, and ε_t the usual white noise residuals. The coefficients α_1 and α_2 represent the long-run relationship whereas the remaining expressions with summation sign (β_1 and β_2) represent the short-run dynamics of the model. Eq. (4a) may also be written in the following way:

$$\Delta R_t = \alpha_0 + \sum_{i=1}^{n} \beta_{1i}\, \Delta(R_i)_{t-1} + \sum_{i=1}^{n} \beta_{2i}\, \Delta(R_m)_{t-1} + \rho EC_{t-1} + \varepsilon_t \tag{4b}$$

Where ρ is the speed-of-adjustment parameter and EC is the residual obtained from the estimated cointegration model of Eq. (4a). The error correction term (EC) is thus defined as: $EC_t = R_{i_t} - \gamma_1 R_{m_t}$ where $\gamma_1 = -(\alpha_2/\alpha_1)$ are the OLS estimators obtained from Eq. (4a). The error correction coefficient (ρ) is expected to be less than zero and implies the cointegration relationship. In order to investigate the existence of the long-run relationship among the variables in the system, the bound test approach developed by Pesaran et al., (2001) was employed.

4. Testing for parameter stability

The existence of cointegration does not necessarily mean that the estimated coefficients are stable. If the coefficients are unstable, the results will be unreliable. In order to test for long-run parameter stability, Pesaran and Pesaran (1997) suggest applying the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of recursive residuals of the square (CUSUM squared) tests proposed by Brown et al. (1975) to the residual of the ECMs to test for parameter constancy.

5. Data

The data on the listed transportation companies were obtained from Yahoo Finance (powered by Morningstar) and Commodity Systems, Inc. The period considered ranges from January 2010 to December 2019, with monthly observations. The dataset includes 45 U.S. transportation companies located in various states across the country, divided into five categories according to the type of transport activity: trucking (14), marine shipping (6), airlines (11), railroads (4), and air freight/couriers (10).

The U.S. transportation stocks considered in this study are listed primarily on the two major U.S. stock exchanges: the NASDAQ (National Association of Securities Dealers Automated Quotation) and the NYSE (New York Stock Exchange). According to the International Trade Administration, each category has its own specific characteristics:

Airlines and air freight: offer expedited, time-sensitive, and end-to-end services for documents, small parcels, and high-value items. Air firms also provide the export infrastructure for many exporters, particularly small and medium-sized businesses that cannot afford to operate their supply chain.

Freight rail: High volumes of heavy cargo and products are transported long distances throughout the US via rail network. Each day, this 140,000-mile system delivers an average of 5 million tons of goods and serves nearly every industrial, wholesale, retail, and resource-based sector of the economy. In 2017, Freight rail moved more than 70 per cent of the nation's coal, about 58 per cent of its raw metal ores, 1.6 million carloads of wheat, corn, and other agricultural products, and 13.7 million intermodal containers and trailers that transport consumer goods.

Maritime: This subsector includes carriers, seaports, terminals, and labour involved in the movement of cargo and passengers by water. Water transportation moves nearly 70 per cent of all U.S. international merchandise trade, including 72 per cent of U.S. exports by tonnage.

Trucking: Over-the-road transportation of cargo is provided by motor vehicles over short and medium distances. According to the American Trucking Association, trucking revenues were $700 billion in 2017. That year, trucks moved almost 11 billion tons of freight. Each company is identified by a number, the association between number and company name is shown in Table A1 in the appendix. Figure 3 shows the subdivision of publicly traded transportation companies in the various Federal States of the United States, in detail, the position of the number indicates the legal seat of the transport company. The 45 companies are divided according to the reference transport sector (i.e. red for Trucking, green for Marine shipping, blue for Airlines, yellow for Railroads and violet for Air/freight). The largest number of listed transport companies are located in the eastern part of the United States with a greater presence of marine shipping and airlines; trucking companies are more present in Central America, while on the West coast, there are airlines. The scarcity of businesses in the West is because motorways and railways are scarcer in the West and mostly follow an East-West axis to reach the most densely populated areas near the coast (Wiegmans et al., 2018).

Figure 3. Map of USA Transport firms

Source: Our elaboration on Morningstar and Commodity Systems data

In order to study the relationship between the yield of a stock and the market return, we follow Sharpe’s (1964) approach. We therefore require two variables: the yield of the company’s stock and the market return. The first represents the income generated by the investment in relation to the capital invested and the duration of the transaction (Figure A1 in the Appendix shows the trend in returns for each company). The second variable, the market return, is calculated from the yields of the two equity indices and represents the expected excess return of risky securities in the market portfolio compared to the risk-free rate. For the yield calculation, see Equation (3) in Section 4. Table A2 in Appendix presents the descriptive statistics of the variables used in the analysis.

The sector with the highest average market performance is the tracking with 0.011 basis point, followed by Airlines and Air Freight/Couriers with 0.009 basis points and Railroad with 0.007. The highest average industry return is in the Airlines sector, followed by Railroad with 0.014 and 0.013 basis points respectively, the Marine Shipping sector has a negative return of -0.010 basis points. By sector analyzing the returns of companies in the Trucking sector, companies #14 and 9 have higher returns than the industry average, while company #11 and 13 perform negatively. For marine shipping, companies #17 and 19 have above-average returns and companies #16, 20 and 21 yields well below average. For the Airlines category, companies with above-average returns are #22, 23 and 32 while the returns of other companies do not deviate from the average value. For railroads, too, companies have values of returns close to the average except for #36 with a higher value. Finally, for Air freight/Courriers, the companies with the highest values are #37, 40 and 44 (with the highest value), while the number 38, 39 and 45 have below average and negative values. The category with the least average variability (i.e. a preliminary risk indicator) is railroads followed by Airlines and Air Freight, so the categories with the most variability are Marine shipping and Trucking.

6. Empirical Result

This section highlights the results of the ARDL analysis. The results are shown in extended form in the Appendix (Table A6); for ease of reading, they are represented graphically in Figure 4. This figure provides a graphical representation of the beta coefficient values. Two results emerge from the ARDL analysis: the long-run beta (LR) and the short-run beta (SR). The bars in the graphs display the value of the beta coefficient for LR (3.a) and SR (3.b) for each transport category.

As a guideline, a high beta value (e.g., above 1) indicates high systematic risk (greater than that of the market portfolio). In this case, investors will be willing to hold that portfolio or security only if its expected return is correspondingly high. On average, the analysis shows that although LR investments are less sensitive to market or economic fluctuations, they are considered profitable investment opportunities. Conversely, SR investors are more exposed to market fluctuations, whereas in the LR they can compensate for and recover from negative SR changes. In the LR, there is a risk that investments may lose value, but they also have more time to recover and achieve higher levels of growth. In the SR, it is worth focusing on the stock's upward and downward fluctuations (see bar patterns) to assess its sensitivity to economic shocks. In this case, the investors' objective could be to achieve maximum returns in the shortest possible time, albeit with considerable risk.

We then analyze the beta values for each transport category. In the trucking category, the LR shows positive beta values for all companies except company #10, which has a negative value. Two companies in particular (#12 and #13) have the highest beta values. A risk-averse investor in the LR will tend to consider less volatile stocks (with low beta values) as potential investment opportunities. In the SR results, companies #7, #10, #11, and #13 have zero beta values (they are free from fluctuations), while companies #2 and #12 do not show significant fluctuations. The remaining companies exhibit more pronounced variations, which may be considered attractive by aggressive investors willing to take on greater risk in pursuit of higher returns. Interestingly, company #14 shows significant downward swings in the SR and upward swings in the LR, indicating that it is highly reactive to market trends—inversely proportional in the short run and directly proportional in the long run.

The same reasoning applies to the marine shipping category, where firms in the LR show positive beta values that follow market trends but with more contained oscillations in both upward and downward movements. Company #16, on the other hand, has the highest beta value in both LR and SR, emphasizing its reactivity to market trends and, consequently, its higher risk. In contrast to the previous category, there are no beta values with significant SR fluctuations, indicating that these companies present low risk to investors.

In the LR for the airlines category, beta values are positive except for company #28. The companies with higher reactivity to the market—and therefore greater risk—are #24, #30, and #31. Stocks in the airline industry are typically highly traded, as they can be excellent long-term investments. Unlike the other categories, securities in the SR show greater volatility than in other freight transport categories. The largest fluctuations are found for companies #25, #28, and #29, representing profit opportunities for risk-loving investors. For example, the companies in the air transport sector have recorded their lowest values due to the transport crisis caused by the pandemic.

In the railroads category, the long-run beta is very homogeneous—equal to or slightly above 1. This is because the railway sector is historically vital to the U.S. economy and benefits from high market stability. The low-risk profile is confirmed even in the short run, with limited fluctuations both upward and downward.

The last category, airfreight-shipping, presents positive beta values for all firms. For companies #36, #39, #41, #42, and #45, the beta value is relatively low, representing a low-risk investment opportunity in the LR. In the SR, the fluctuations—similar to those in the railroad category—are rather limited, except for company #38, which shows an extremely negative beta, highlighting its higher risk. Companies #36 and #43 show no fluctuations, as they have a zero-beta value.

It is worth noting that stock fluctuations depend on several factors, primarily the index on which the company is listed. The NASDAQ is generally more volatile and riskier due to the high presence of growth stocks, which implies higher potential returns. The NYSE, on the other hand, is considered less volatile and primarily lists “blue chips,” meaning shares of well-established and reputable companies. Although transport companies form a heterogeneous group and can represent an opportunity for investors seeking growth, it is important to remember that they are highly cyclical. The reference sector plays a crucial role in investment choices.

Investors should also bear in mind that transport companies depend on several variables that affect their value. For example, they are sensitive to changes in crude oil prices and fuel costs (Khan et al., 2021a). Companies strive to be as fuel-efficient as possible, but when oil prices rise, operating costs for transport firms also increase. Shipping demand must also be considered, as it can drop dramatically during periods of economic downturn. Investors must therefore become accustomed to fluctuations in the shipping industry, which often respond to changing conditions in the global economy (Notteboom et al., 2021). In addition, geopolitical events and government regulations can affect stock prices and, consequently, investment returns (Khan et al., 2021).

Each of the five transport categories analyzed can represent an investment opportunity, depending on the degree of risk investors are willing to take.

Figure 4. Beta Long run (*a*) and short run(*b*)

a *b*

7. Conclusion

The findings of this study have significant policy implications. Understanding sector-specific betas can help in designing targeted economic policies that cushion the transport sector against cyclical downturns. Furthermore, investors can use these insights to diversify their portfolios more effectively by considering the risk profiles of different transportation sectors. Future research could expand on this by incorporating additional variables, such as fuel costs or regulatory changes, to provide a more comprehensive risk assessment.

Freight transport is one of the sectors where profit margins remain substantial—a highly competitive industry that continues to grow with the introduction of new technologies, leading to the emergence of new profitability strategies. The study provides guidelines for possible equity investments in the transportation sector and highlights how this sector can offer significant returns in both the short and long term, while remaining subject to fluctuations and the cyclical nature of the economy. For this reason, providing a measure of risk is essential for any individual intending to invest.

The beta parameter, representing the sensitivity of a stock to market changes, is a useful indicator for measuring systematic risk. Risk analysis is therefore essential for investors to assess their exposure to market risk. In other words, correctly evaluating beta allows one to determine how much a stock (and the corresponding company) is exposed to systematic risk. The ARDL analysis shows that long-term investments tend to be less sensitive to short-term fluctuations and are therefore excellent investment opportunities, as systematic risk is almost always greater than one. A long-time horizon makes it possible to compensate for potential losses caused by negative market trends, although it requires committing the investment for a longer period. By contrast, the short term is characterized by greater risks, as investors are subject to larger stock fluctuations and have less time to recover potential losses (as could occur in the LR). For the transport categories considered, the beta values show fluctuations across different time lags, implying that stocks are more volatile in the short run, making the risk faced by investors more tangible. In conclusion, this study paves the way for future research on the relative importance of different policy instruments in addressing economic and transportation challenges for listed companies.

A limitation of our analysis lies in the fact that only one variable was considered in the investment choice; additional risk factors could be included in future studies. It is up to future research to extend the analysis proposed here by using more recent data covering a larger number of companies and risk factors. Despite certain limitations related to data availability, this article provides an initial framework for investors seeking to determine their investment choices and contributes to understanding the connection between the transport sector and the broader economy in both the long and short term.

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