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RESEARCH ARTICLE

PIRAEUS PORT AND CITY: A COMPREHENSIVE ANALYSIS OF CORRELATIONS AND DEPENDENCIES

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Abstract

Background: The Piraeus city-port area constitutes one of the most important economic hubs in Greece, the largest port in the country. This study focuses on the examination of the city-port, exploring whether it can be a harmonious or a rivalry relationship, considering several economic and technical aspects of the two entities.

Aim: This study seeks to assess the economic impact of the port on the city and vice versa by examining the regression between the macroeconomic data of the Piraeus region and the economic data of the Piraeus Port Authority.

Methodology: Data from the annual financial balance sheets of the Piraeus Port Authority and data for the macroeconomic indicators of the city for the years 2010 to 2020 were used for statistical analysis. Linear regression models were employed for this analysis, using the statistical program IBM SPSS Statistics.

Conclusion: The results indicate significant relations and dependencies between the two data sets, highlighting the substantial contribution of the port to the local economy, and vice versa.

Introduction:-

The assessment of the port-city dipole is a crucial process that facilitates the understanding of their interdependence by identifying correlations and connections between these two components. The study focuses on the multifaceted interdependencies of Piraeus' port-cite dipole by examining the impact of the port's operations to the city's economic activities, employment levels, and overall developmental trajectory. Also, the study examines how the city's characteristics can influence the port's performance and the challenges it encounters. Recognizing that ports drive economic development in cities, and vice versa, the evaluation of the dynamics within this dipole is essential for informed decision-making and strategic planning.

Within this context, the study encompasses a regression analysis of carefully selected and collected data related to the economic characteristics of the port and the economic and developmental characteristics of the city of Piraeus. This analytical approach serves as a tool for assessing the relationships within this port-city dipole.

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Methodology:-

The study focuses on the case Piraeus's port and city and examines the statistical analysis of the relationship between the port and the city, aiming to quantify the extent of this interconnection based on economic indicators. For this purpose, several macroeconomic indicators from the Piraeus Regional Unit and economic indicators from the annual balance sheets of the Piraeus Port Authority (PPA) for the years 2010 to 2020 are utilized.

Firstly, the dependent variables are identified as the economic elements of the port. These elements include, inter alia, the cash flow of the PPA, total liabilities and loans, earnings before tax, the total taxes and several macroeconomic indicators such as the ratio of debt to equity and the overall liquidity. These data are analyzed and evaluated by examining the impact of these characteristics on economic aspects of the city, GDP, GDP per capita, Gross Value Added and employment by activity sector. The aim of this analysis is to examine the impact of economic performance and activities of the port on the economic development of the city, and thus on the quality of life and employment of its inhabitants.

Next, a new approach is introduced, using the city economic characteristics as independent variables of the regression analysis. This approach allows the examination of the impact of the economic characteristics of the city on the port, analyzing how the growth of the city of Piraeus affects the demand, operation and performance of the port. Specifically, it examines the economic development of the city, the number of employees by industry and other factors of the city can affect the demand for services and goods provided in the ports.

By combining the two approaches, a complete picture of the interdependence between the two elements is obtained. The analysis covers a period of ten years, identifying the fluctuations and interdependencies between them based on real data. The data collected for the city and port of Piraeus are statistically analyzed using IBM SPSS Statis 28.0.1.0. and linear regression models.

Initially, in the linear regression models the macroeconomic indicators of the city are set as dependent variables and then the PPA indicators. Statistically significant models are considered to be those with a p-value less than or equal to 0.05. The stepwise regression method is followed. The independent variables are examined for their collinearity and intercorrelation. The linear regression model tables in the Appendix show the coefficients of the constant linear model and the unstandardized Beta coefficient, the modified Beta coefficient and the R Square coefficient.

Discussion:-

Redefining the city-port relationship

By examining the historical evolution of the city-port relationship and studying successful European city-port models, it becomes evident that the various spatial dynamics inherent in port cities and their interaction with the port are directly shaped by changes in the economy and production (Lee, Song, & Ducruet, 2008).

Between the city and the port, spatial transition zones exist and are ripe for exploitation. These transition areas may encompass urban voids, transport networks or pre-existing port facilities, such as piers, where port activities may still exist or coexist (Daamen& Vries, 2013).

The utilization of depreciated and abandoned old port facilities and their integration through redevelopment into the functions of the urban environment has been a decisive factor in the evolution of port cities and their transformation into centers of prosperity, well-being and development. This process facilitates the reconnection of port with cities extended toward the waterfront through cultural regeneration on their coastal fronts, thus forming a leisure environment and an attraction for tourism and business interests, such as clusters of businesses that are identical to port activities.

The majority of these businesses are established in the intermediate transition zones, often located in the area between the city and the port. These zones, characterized by spatial concentration, gradually form a strongly competitive business environment (Dooms, van der Lugt, & de Langen, 2013). The close spatial proximity of these firms to the port's business functions contributes to the development of business synergies. This process is one of the most essential factors contributing to the restoration of the city-port relationship. Motivated by the competitive environment of the area, it attracts many businesses that may not be related to port activities but remain relevant to the city's labor market.

The review of the city-port relationship through different time periods and through exemplary European city-ports models has contributed to a more complete understanding of the spatial transformations that have taken place over time in port cities. Also, the review provides an understanding of how these transitions have influenced and shaped both parties and the relationship between them. Taking the prominent example of the Port of Rotterdam into consideration, it is concluded that in its early stages of evolution, the issues related to the port development primarily manifested on a spatial and geographical scale. These developments were tangible outcomes influenced by concurrent international trends and influences of the era. An illustrative historical example is the Second World War, during which ports essentially gave birth to cities. In contrast, during the early 20th century, the relationship between port and city was gradually deteriorated, leading to the eventual detachment from each other. This disconnect persisted throughout the latter half of the century, resulting in these two entities functioning as distinct and separate entities (Jacobs, Ducruet, & de Langen, 2010).

The necessity imposed by the transport industry, particularly the movement of containers (logistics), was the reason for the city's ties with the port to be severed. In some cases, behaviors were adapted to the requirements of this new mode of transport operation, which later transformed ports into centers of administration and decision-making. Globalization led to the total extinction of those that couldn't survive the competition.

Cities' interest in coastal areas intensifies according to the degree of technological modernization of ports. The greater the degree of technological modernization, the stronger the interest of cities in coastal areas. This situation replaces the previous scenario in which the city's economic status was closely tied to the port. By the end of the 20th century, traditional port activities had undergone significant modernization, resulting in increased productivity through new packaging methods, the development of administrative and logistical services and the introduction of information systems.

The reconnection between city and port has been achieved through urban renewal, where the city successfully transformed industrial areas into attractive destinations. Thus, it is found that coastal front redevelopments are driving forces for a more comprehensive urban development (Hein, 2016).

The freedom of movement in the redeveloped spaces along the coastal fronts creates a bridge of communication between the city and the port. This, by acting as a recreational space for different population groups and stimulating the multifunctionality of these areas, enlivens previously deserted port zones (Nebot, Roja-Jimenez, Pie Ninot, & Perea-Medina, 2017). Interventions in the hearts of historic centers serve as a link connecting the city to the port. Widened roads and streets concentrate and channel traffic from the sea fronts to city centers, promoting harmonious transitions. Interventions and new uses implemented at port level, such as maritime museums, aquariums, combined with a strong maritime presence (ships, sailing boats, etc.) give cities a strong maritime character.

On the opposite side of the extraordinary benefits and overdevelopment resulting from the implementation of redevelopment, interventions and changes of uses in port cities, there is the risk of underdevelopment in the rest of the port area and the city. This can lead to degradation, as all urban developments and new uses, modern commercial business activities, warehouses, loading and unloading areas, transport points, high-rise office and business complexes, giant commercial complexes, interconnection with public transport (trains, buses, etc.), and the development of the port and its surroundings. etc.) are concentrated on the other side of the city and the port. A typical example of the intensity of the differences due to overdevelopment in one part and degradation in another is seen in the Asian and African port cities (Singapore, Shanghai, Cape Town, Dubai, etc.) with the presence of luxurious and monumental tourist cities next to poor neighborhoods and suburbs. These differences arise partly due to the different policies of these countries and partly due to the marginalization of traditional traditions.

A turning point in the redefinition of city-port relations for many European port cities was the period of the upgrading of the seafront, creating a new, unified spatial framework for urban functions. However, it can be observed that the redevelopments managed to maintain the city's balance and the new urban fabric smoothly integrated into existing structures, ensuring that no resident relocations occurred in the name of 'upgrading' the areas.

The implementation of simple interventions with a simple design gives new purposes for both the port and the city, enhancing the quality of their image and their relationship. The sea front is tasked with connecting these two elements while still meeting necessary requirements. Creating a 'multifunctional city', which can accommodate multiple activities and different populations, through the rehabilitation of its urban image, the promotion of modern

landmarks and the use of a new architectural vocabulary, constitutes the development catalyst for 21st century port cities. Cities and ports are closely linked in multiple dimensions (Lugo, Alatriste-Contreras, &Pumain, 2020).

Norcliffe, in a concise review of the relations between ports and cities, identifies as a key element of social diversity in the structure and form of the urban segment, the very close coexistence of two extreme economic, and consequently social groups, which are continually generated and dependent on port activity: a 'merchant' class on the one hand, and a working class on the other. This contrast is particularly pronounced in the urban fabric and planning of Piraeus, as its initial establishment and creation (see early 19th century) served as a catalyst for progress, stability and urban advancement for all social classes (Norcliffe, 1996).

The case Piraeus port and city

Piraeus is the sixth most important European port, in terms of measured passenger traffic, showing the third highest growth rate (+5.5% compared to the period 2013-2014) (Eurostat, 2016 report, 2014 data). In addition, the broader Piraeus port area holds around the16th spot in terms of cargo handling ranking among European port, with an annual growth rate of approximately 9.5% (Eurostat, 2016 report, 2014 data).

The city-port relationship has evolved through six stages: from antiquity to the 19th century, a narrow relationship; the Industrial Revolution era (early 19th century) marked expansion with steam technology; between the two world wars, industrial modernization began; two decades post-World War II, containerization emerged; the 1980s brought coastal front regeneration; and from 1990 onward, the city-port relationship evolved in a global mega-network of combined transport (Hoyle&Pinder, 1992).

Since the 1960s, Piraeus has experienced rapid growth in Greek merchant shipping centered in the port. The significant increase in port's traffic is a sign of developments that brought prosperity to the city, as numerous important infrastructure projects were planned and important shipping companies were established around the port (Kotzamanis, 1997; Bournova, 2016).The intersection point of the city and the port, located at the boundary of the port and the city, is undeniably influenced by the presence and operation of the port, a relationship dating back to the existence of ports and cities. . The theoretical research on the waterfront, however, is relatively recent, spaning only seventy years. This delay can be related with the end of the Second World War.The transformation in the shipping and port industry was rapid. A tenfold increase in cargo volume on early 1960s led to the need to develop specialized infrastructure and masterplans for ports and waterfronts. Notably, urban planning, architecture, and spatial planning have played minimal roles in studying the interface zone, with geography, economics, and shipping dominating the literature. Key milestones include James Bird's 'Anyportmodel' (1963) and Yehuda Hayuth's coining of the term 'port-city interface' in 1982. The influence of post-Fordism on economics since 1970 and correspondingly of postmodernism and neoliberalism on culture is obvious. This period marked the beginning of discussions on the city's retreat from the waterfront and its potential recovery.Over time, the once symbiotic relationship between the city and the port, has become increasingly detached, leading to their independence as separate entities.

Introduction to port and city data

In this chapter, the characteristics of the city and the port selected as data for the assessment of dipole interdependence are presented and analyzed. The financial data and port indicators were extracted from the published annual financial reports of the PPA spanning from 2010 to 2020, and they are presented in Figures 1 and 2 (PPA, 2023).

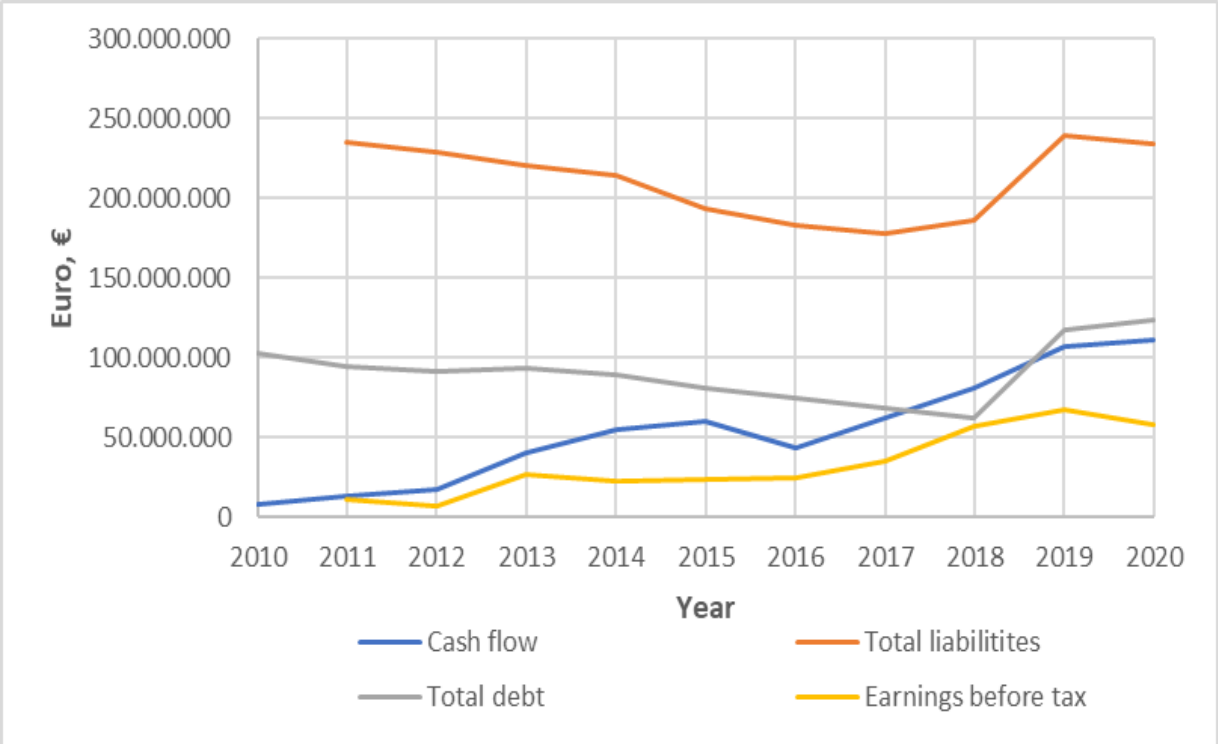


Fig 1:- Financial data of the PPA.

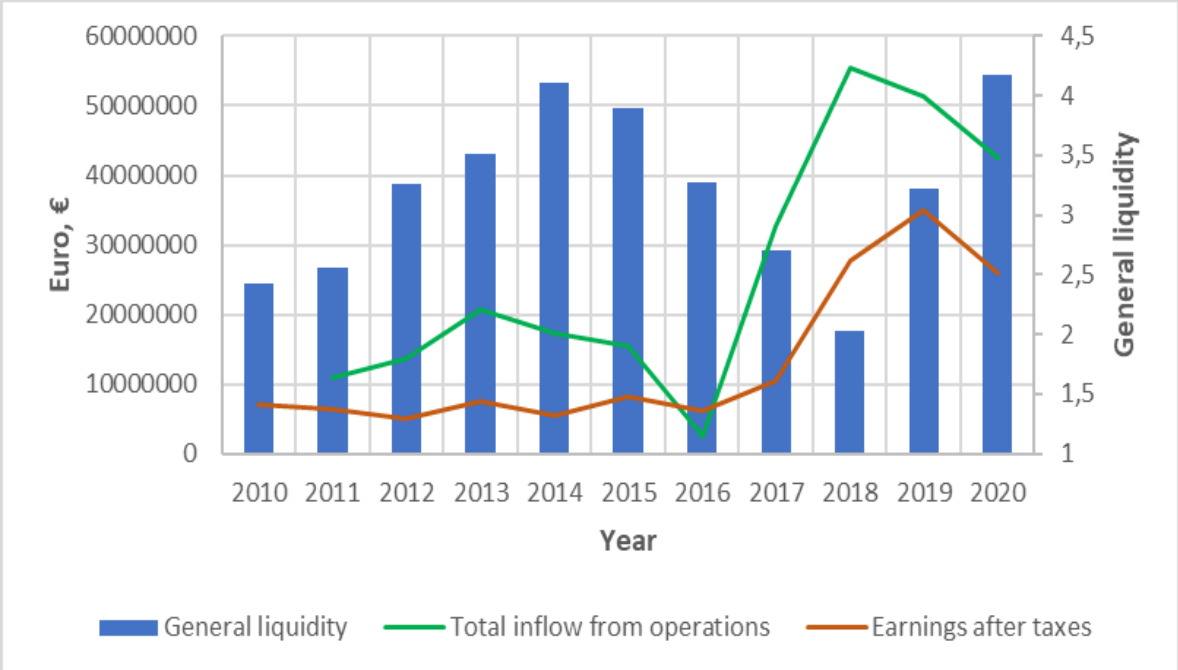


Fig 2:- General liquidity and financial data of the PPA.

The city related data are economic and development data from the Hellenic Statistical Authority, for the Regional Unit of Piraeus, as presented in the following Figure and Tables of the Appendix (Hellenic Statistical Authority, 2023). The selection of sectors was based on their potential to be associated with the port, choosing business sectors where the operation of the port could have an impact.

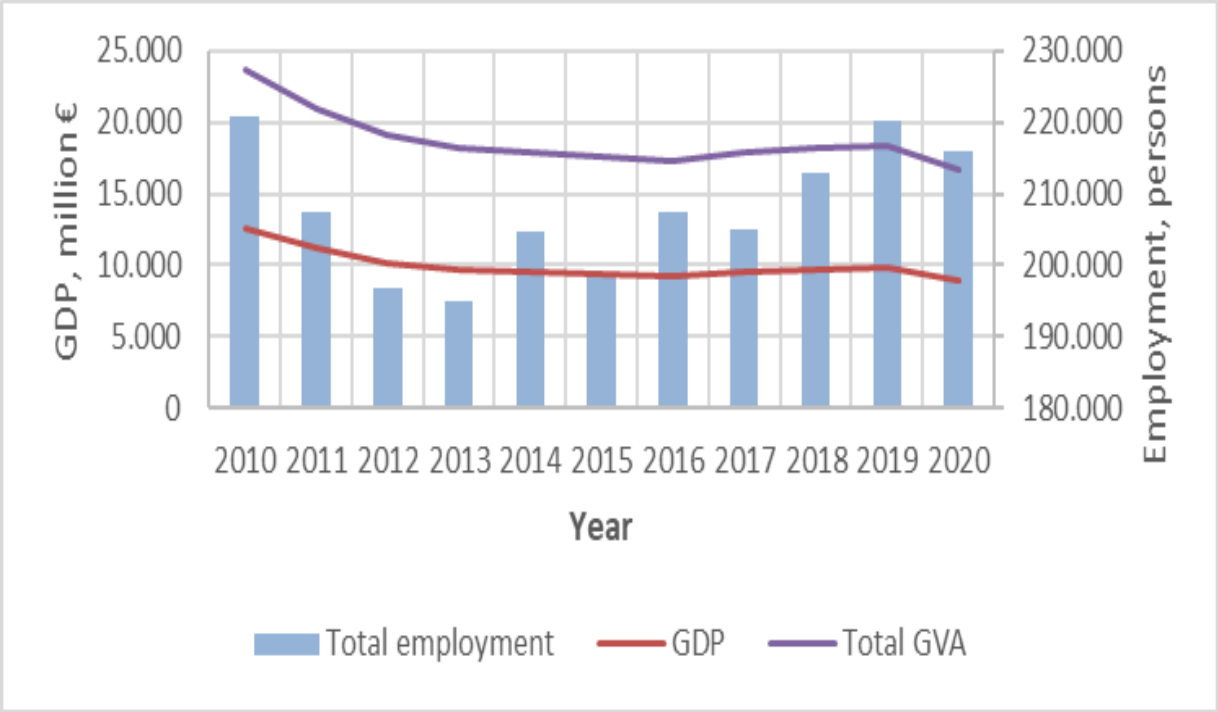


Fig 3:- Economic data for the Regional Unit of Piraeus.

The Impact of Port Characteristics on the City

In this chapter, the characteristics of the city and the port selected as data for the assessment of dipole interdependence are presented and analyzed. The financial data and port indicators were extracted from the published annual financial reports of the PPA spanning from 2010 to 2020, and they are presented in Figures 1 and 2 (PPA, 2023).

During this regression analysis, models were examined using the macroeconomic indicators of the city of Piraeus as dependent variables. From all the regressions, it was observed that the PPA's cash flows were the independent variable that produced the most statistically significant information. The rest PPA variables, when used as independent variables in the linear regression models, were either rejected as statistically insignificant or exhibited sporadic and negligible correlations.

As shown in Tables of the Appendix, PPA's cash flows, when considered as an independent variable, displayed a negative relation with the GDP index of the Regional Unit of Piraeus. Regarding the total employment index of Piraeus, no statistically significant relation was observed with PPA's cash flows. Consequently, the type and intensity of the correlation per employment branch, as categorized by ELSTAT, were investigated. Based on the results, it can be observed that cash is correlated with employment in the sectors of financial and insurance activities, construction, and agriculture and fishing, showing a low-intensity negative correlation. On the contrary, PPA's cash reserves showed a low-intensity positive relation with employment in the wholesale and retail trade sectors, professional, scientific, and technical activities, and employment in the real estate management sector.

Table 1:- Measures of Position of Linear Regressions with the PPA variables as dependent variables.

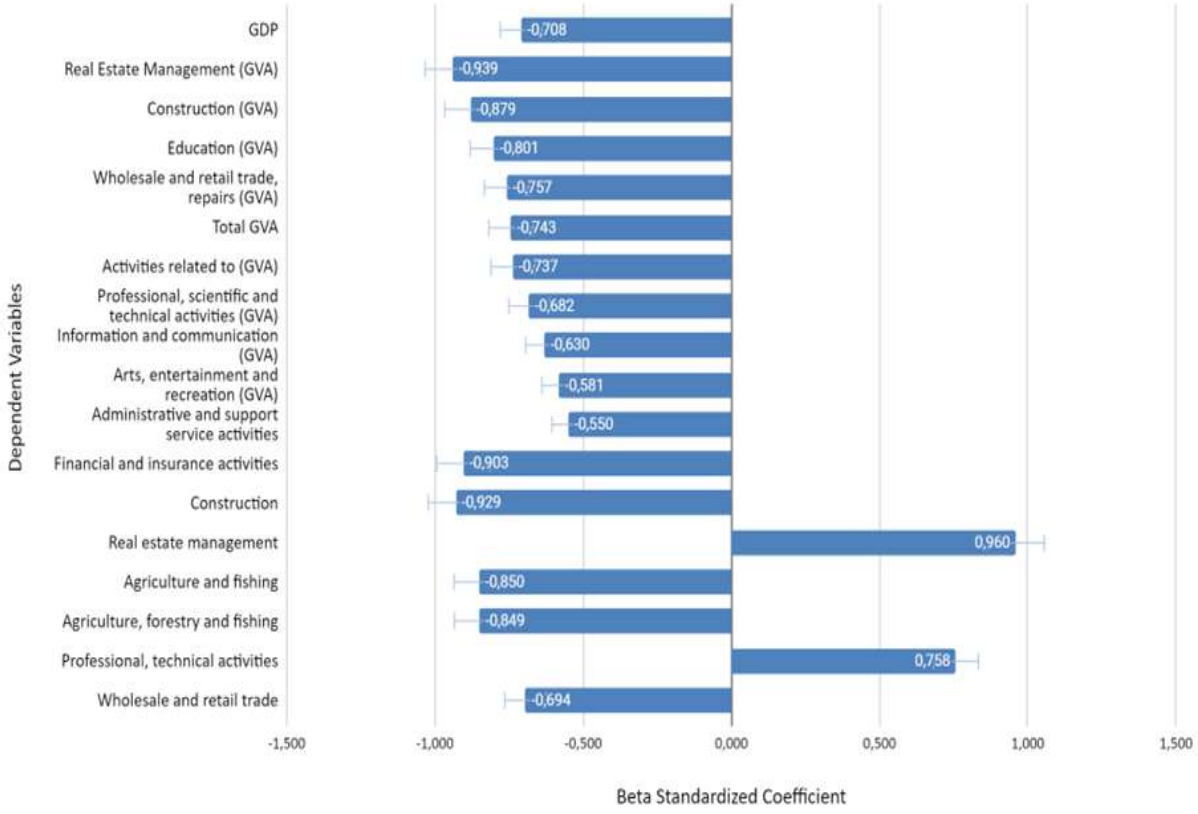
	Standard Beta Coefficient	**R Square**
Minimum Price	0,550	0,302
Maximum Price	0,960	0,921
Average Price	0,77500	0,61150
Median	0,75750	0,57400
Typical Error	0,028917	0,044807
Source	0,410	0,619
Standard Deviation	0,122686	0,190099

Variance	0,015	0,036

Table 1 displays the basic measures of position and dispersion for the standardized beta and R Square coefficients for the regression models with Piraeus macroeconomic indicators as dependent variables and PPA cash flows as independent variables. The minimum value for the standardized Beta coefficient and for the value of the R Square coefficient was 0,550 and 0,302, respectively, and were observed in the model with the dependent variable Gross Value Added of the administrative and support activities sector.

Figure 4 depicts the values of the standardized Beta coefficients for the regression models with cash flows as the independent variable and the city's macroeconomic indicators as the dependent variables. It is observed that for the majority of the models, the correlations are negative, with the only exceptions being the values related to employment in the real estate management sector and in the professional, scientific, and technical activities sector (0,960 and 0,758, respectively). Regarding the negative correlations, it is noted that the range of coefficients varies between -0,550 and -0,939, without high variation. However, it should be noted that the negative correlations do not imply a negative economic correlation between the port and the city, as the increase in cash flows may be the result of the organization's reluctance to make investments at a given time trying to avoid possible high risk.

Fig 4:- The standard Beta coefficients of the models with city's macroeconomic indicators as dependent variables.



The Impact of the Economic Development of the City on the Port

During this approach, linear regression models with macroeconomic variables of the Regional Unit of Piraeus as independent variables were investigated. Using the stepwise regression method, multiple regressions, sequential analyzes are performed to identify and select those models with high statistical significance that carry the information to explain the variation more clearly in the dependent variable. The correlations resulting from these regressions and considered important for the analysis are presented in the Tables of the Appendix. The following is an analysis of the correlations based on financial elements of the PPA.

Cash flow:
The total Gross Value Added and the total employment in Piraeus Region can explain with a high statistical significance the variation PPA's cash flows. Also, the correlation of the total Gross Value Added is negative, with a standardized Beta coefficient of -0,889 while the correlation with the employment coefficient is positive with a standardized Beta coefficient of 0,633. In absolute terms, there is a comparatively greater correlation of cash flows from the total GVA of the Piraeus Regional Unit in relation to the total employment.

Inflows from operations:
Inflows from operational processes are positively correlated with total employment, showing a standardized Beta coefficient equal to 0,685. More specifically, it appears that the correlation concerns employment in the construction sector, where the activities of the specific sector in the Piraeus region are numerous and related to the development, renovation and maintenance of buildings, infrastructure and port facilities. On the contrary, in terms of the relations with the Gross Added Values, there is a positive relation with the transport sector and a negative relation with the construction sector. This means that an increase in the GAV of the transport and storage sector implies a corresponding increase in the inputs from operational processes of the PPA, while the reverse is observed for constructions. The operations related to transport and storage in the Piraeus Regional Unit are critical parameters that affect the inputs from the operational processes of the PPA. Piraeus is one of the largest ports in Europe and an important center for the handling of goods. Therefore, freight transport and storage of goods affect the operation of the port and the PPA's inflows. The efficient organization and operation of the sector's activities affects the revenues arising from the operational procedures of the PPA.

Total taxes:
Taxes are positively related with total employment, showing a standardized Beta coefficient equal to 0,617. However, the model is characterized by low R Square (R2=0,380). Regarding the Gross Added Value, the sectors with which statistically significant information for correlation is obtained are the real estate management sector, with a negative correlation and a high standardized Beta coefficient (-0,964) and the transport and storage sector, with a positive correlation and relatively smaller intensity (0,741), in absolute values.

Debt-to-equity ratio:
A negative relation is observed between the ratio and the total GVA, as well as GDP per capita, presenting standardized Betas of -1,450 and -2,556, respectively. At the same time, there is a positive relation of the ratio with GDP values, showing a standardized Beta coefficient equal to 4,472 and a high statistical significance, as well as a high R Square. In addition, debt-to-equity is negatively affected by employment recorded in the real estate sector (standardized Beta coefficient -0,986), as well as by the GVA of the same industry (-0,914). However, regarding the GVA of various sectors, several relations of lower intensity emerge. GVA in the arts and entertainment sector, as well as in professional, scientific and technical studies sector shows a negative correlation with the debt-to-equity ratio, with a standardized Beta coefficient equal to -0,254 and -0,626, respectively. On the contrary, GVA in the construction sector shows a positive correlation with the specific ratio (standardized Beta coefficient = 0,660).

General liquidity:
A highly positive correlation of general liquidity with the total Gross Value Added is observed, showing a standardized Beta coefficient equal to 6,732. There is also a strong negative relation with GVA (B=-6,759), while to a lesser extent general liquidity is determined by Total Employment (B=0,971).

Earnings before taxes:
No statistically significant correlation with general macroeconomic indicators, such as GDP, total GVA and total employment is observed. However, focusing on employment by business sector, a relation with employment in the real estate sector emerges, showing a standardized Beta coefficient equal to 0,945. Regarding the Gross Added Value by sector, a fairly high and statistically significant negative correlation is found with the professional and technical activities sector (Beta=-1,437) and a smaller corresponding correlation with the construction sector (-0,627).

Earnings per share:
A statistically significant type of correlation with the GVA per business sector emerges. More specifically, a negative relation with a relatively high intensity is found with the real estate management sector, showing a Beta

coefficient equal to -1.398, and a positive correlation with the GVA of the arts and entertainment sector (Beta=0.955).

Earnings after taxes:
A relatively high intensity negative correlation, in absolute terms, is found with the GVA of the real estate management sector (Beta=-1,391), while at the same time a positive correlation is found, with a Beta coefficient equal to 0,965, with the GVA of the arts and entertainment sector.

Table 2 displays the measures of position and dispersion of the coefficients of the regression models, with the macroeconomic indicators of the Piraeus Regional Unit as independent variables and the financial data of PPA as dependent variables. It is observed that the minimum value for the modified Beta coefficient is 0,612 and corresponds to the correlation model of the inflows from operations with the GVA of the transport and storage sector. The corresponding highest value for the Beta coefficient, in absolute value, is 6,759 and concerns the effect of the GDP of the Piraeus region on the general liquidity of the PPA. The R Square coefficient obtains a maximum value of 0,991 in the model of the correlation of debt-to-equity with GVA sectors, and a minimum value (0,380) in the model of the correlation of total taxes with total employment.

Table 2:- Measures of Position of Linear Regressions with the city's macroeconomic data as dependent variables.

	Standard Beta Coefficient	**R Square**
Minimum Price	0,612	0,380
Maximum Price	6,759	0,991
Average Price	1,48103	0,87177
Median	0,95950	0,90700
Typical Error	0,256199	0,025772
Source	6,147	0,611
Standard Deviation	1,403259	0,141160
Variance	1,969	0,020

Figure 5 depicts the values of the standardized Beta coefficients derived from the regression models using as dependent variables the financial data of the PPA and as independent the macroeconomic indicators of the Piraeus Regional Unit.. Based on this analysis, several variables that are considered non-statistically significant are excluded, while at the same time three multiple linear regression models are derived for cash flow, debt-to-equity ratio and general liquidity.

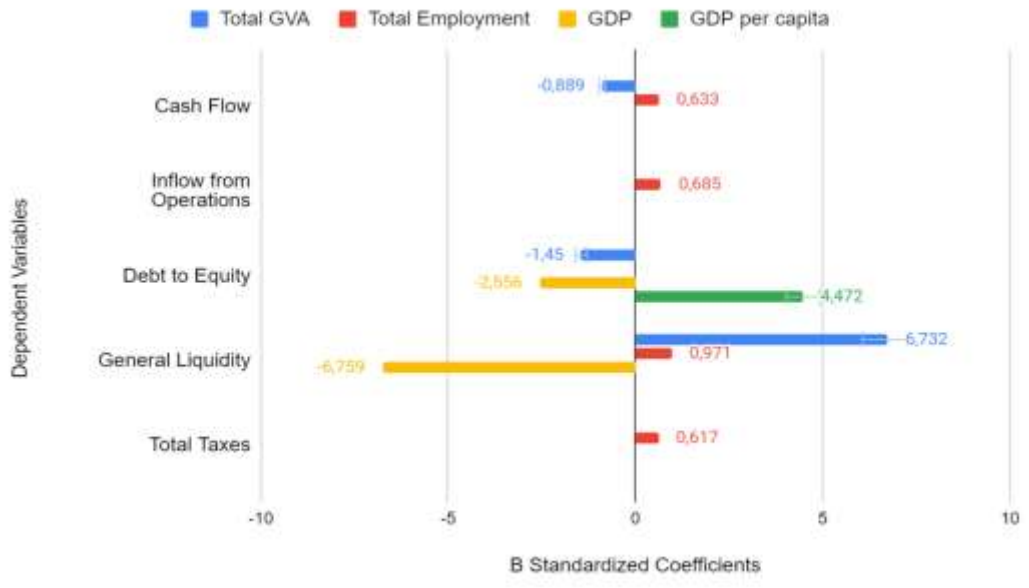


Fig 5:- Standardized Beta coefficients for the linear regression models with the variables of the PPA as dependent variables and the overall macroeconomic indicators of Piraeus Regional Unit as independent variables.

The Beta coefficients of the linear regressions using as independent variables the employment values per professional branch in the Piraeus Regional Unit are presented in Figure 6. It is observed that three of the examined sectors affect the financial data of the PPA. In particular, wholesale trade shows a positive correlation with all taxes (Beta=0,829), while the employment of the construction sector shows a negative correlation with the inflows from operational processes. In addition, there is a positive relation of the real estate management sector with PPA's cash flow and earnings before taxes, showing Beta coefficients equal to 0.945 and 9.941, respectively.

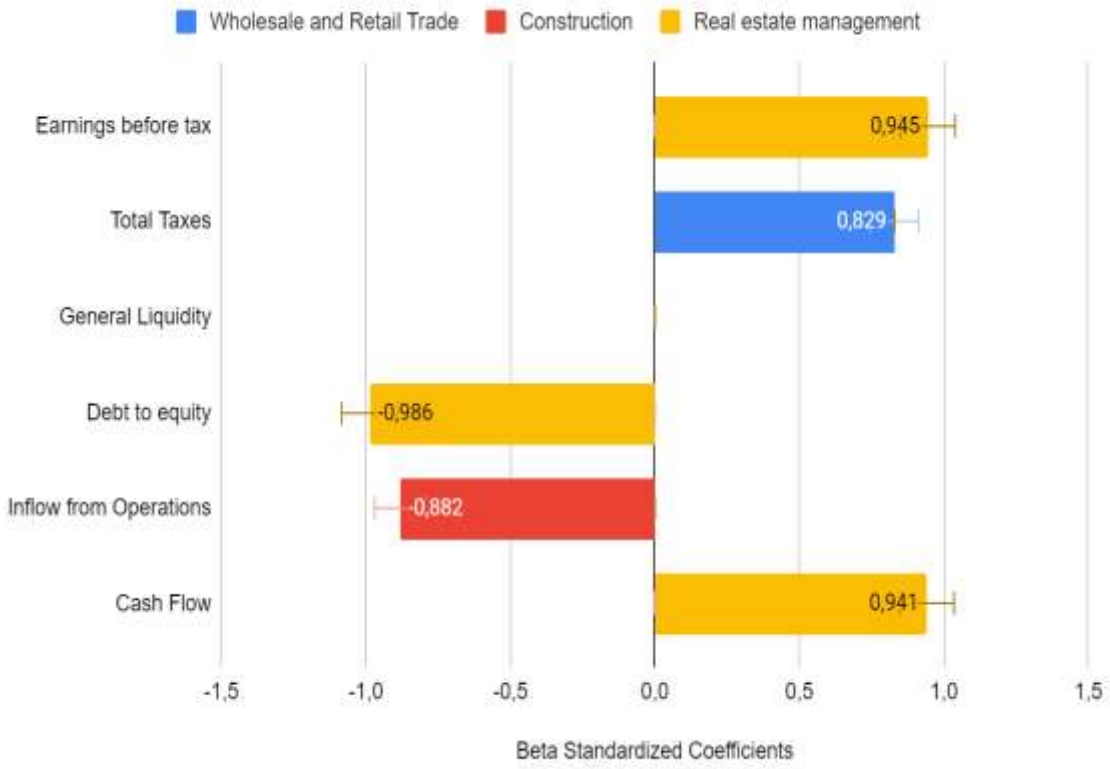


Fig 6:- Standardized Beta coefficients for the linear regression models with the PPA variables as dependent variables and employment indicators by business sector as independent variables.

Figure 7 summarizes the standardized Beta coefficients of the linear regression models with GVA indicators as independent variables per business sector of the Piraeus region. The variation in PPA's debt-to-equity ratio is explained by the GVAs of the arts and entertainment, real estate management, professional and scientific publications, and construction sectors, with the construction industry being the only one with positive correlation. Real estate management is negatively correlated with indicators such as cash flow, earnings after taxes, earnings per share, and total taxes. The greatest intensity of correlation, in absolute numbers, appears between professional, technical and scientific activities and the PPA's earnings before taxes, which are also negatively correlated with the construction industry. Arts industry GVA is positively correlated with both earnings per share and income after taxes.

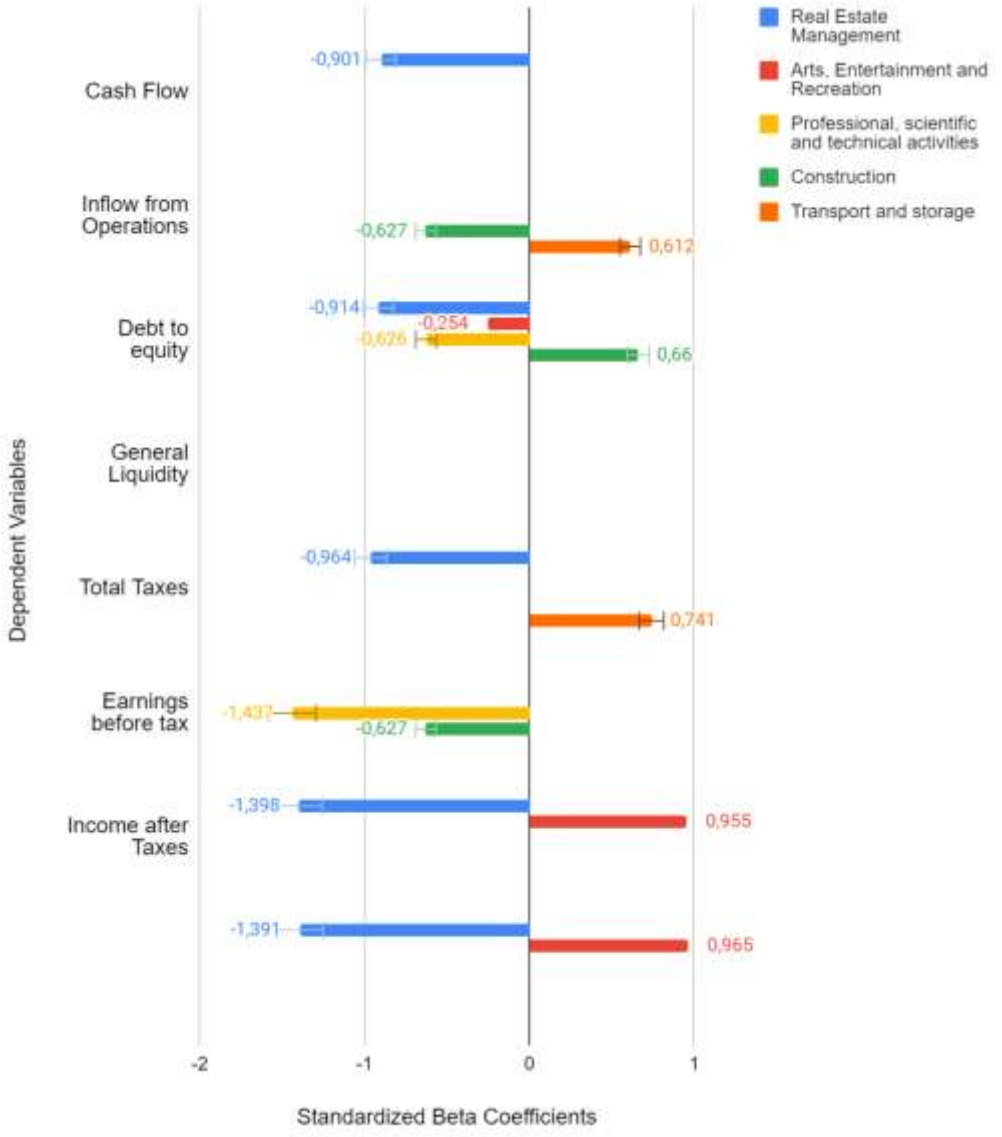


Fig 7:- Standard Beta coefficients for the linear regression models with the PPA's variables as dependent variables and GVA by sector as independent variables.

Conclusions:-

The interdependence between the city of Piraeus and its port encompasses multiple facets. In this study, the primary objective of the statistical analysis is to investigate the interrelation of the two poles particularly concerning economic and developmental indicators. The results of the analysis highlight the existence of a two-way correlation, operating at an economic level, between the port and the city. This correlation leads to the creation of multiple regression models that integrate dependent variables from both the Piraeus Port Authority and the Piraeus Regional Unit.The analysis produces a total of 43 statistically significant correlations between the city and the port, showing the effect of the economic indicators of the Piraeus Regional Unit on the port and vice versa.

During the initial evaluation of the financial data from the PPA as dependent variables, a high degree of statistical significance and consistency is found regarding the correlation of the city's indicators with the cash flow of the PPA. At the same time, it is concluded that the sector with the highest dependence on cash flow is real estate management,

followed by the construction sector. However, for the remaining financial data of the port, no statistically significant correlation is observed with the macroeconomic indicators of the Piraeus Regional Unit.

In addition, significant conclusions derive from the second phase of the analysis, which focuses on how the city's set of variables affect the financial elements of the PPA. In particular, a connection between the total Gross Value Added and the GDP of the Piraeus Regional Unit with the general liquidity of the PPA is evident. Likewise, a strong correlation emerges between the GDP indicators and the debt-to-equity ratio of the Piraeus Port Authority. In addition, it is concluded that the sectors that seem to influence the PPA indicators with a high statistical significance are the real estate management and construction sectors. It is worth noting that a positive correlation is found between the employment of the wholesale and retail trade sectors of P.E. Piraeus with all PPA taxes. With reference to the Gross Added Value by sector, several statistically significant findings are observed, mainly the dependence of the PPA indicators on the GVA of the real estate management and entertainment sectors.

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Appendix:-

Table 3:- Employment data for the Regional Unit of Piraeus.

Employment (persons)	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Agriculture, forestry and fishing	2.486	2.318	2.243	2.156	2.152	2.141	2.084	2.102	2.112	2.080	2.024
Industry, electricity and	21.035	18.856	17.153	16.467	17.263	15.572	16.371	16.431	17.063	17.415	17.428

water supply, sewage treatment, waste management											
Construction	10.526	8.940	7.167	7.302	7.540	7.142	7.252	6.850	4.761	4.919	4.804
Wholesale and retail trade	93.970	88.867	84.708	83.032	88.171	86.073	93.028	91.774	97.848	103.174	99.047
Financial and insurance activities	4.113	3.899	3.769	3.672	3.395	3.510	3.385	3.222	3.228	3.127	3.211
Real estate management	538	518	558	596	633	650	765	767	846	963	934
Professional, scientific and technical activities	17.184	17.057	17.888	18.428	20.150	18.912	19.256	18.599	19.518	19.829	19.377
Public administration and defense	54.133	52.330	50.293	50.462	52.133	51.853	52.672	52.534	54.119	54.817	55.346
Arts, entertainment	13.021	11.555	10.001	10.001	10.287	9.904	9.818	9.853	10.260	10.489	10.375
Total employment	220.944	207.417	196.671	195.072	204.743	198.619	207.522	205.013	213.006	220.158	215.898

Table 4:- GVA data for the Regional Unit of Piraeus.

GVA, million €	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Agriculture, forestry and fishing	59	54	51	46	49	50	41	44	42	45	45
Manufacturing, electricitysupply	832	762	713	672	678	724	705	721	726	723	733
Water supply - wastewater treatment, waste management	209	181	184	196	173	149	153	146	151	157	126
Construction	503	328	267	243	180	126	103	58	46	36	25
Wholesale and retail trade	1.541	1.397	1.231	1.146	1.126	1.177	1.142	1.180	1.213	1.120	1.045
Transportation and storage	2.024	1.742	1.552	1.561	1.551	1.452	1.433	1.672	1.762	1.750	1.581
Activities of accommodation and catering services	380	330	299	332	337	330	303	357	369	440	246
Financial and insurance activities	428	394	300	321	370	351	387	395	375	382	352
Real estate management	1.467	1.387	1.343	1.299	1.248	1.202	1.149	1.117	1.098	1.132	1.002
Professional, scientific and technical activities	441	376	346	336	309	302	279	287	296	319	331
Public administration and defense	1.405	1.303	1.235	1.105	1.120	1.121	1.107	1.103	1.10	1.093	1.085

Arts, entertainment	263	221	219	220	205	198	192	200	215	229	175
Education	524	498	481	441	429	418	418	414	421	421	408
Total GVA	11.076	9.770	8.959	8.592	8.418	8.254	8.042	8.320	8.432	8.523	7.763

Table 5:- Linear regression models of cash and GDP macroeconomic indicators.

	Constant	**Unstandardized Beta**	**Standardized Beta**	**R Square**	**P – Value**
GDP (mil. euro)	11255,766	-1,837E-5	-0,708	0,501	0,022

Table 6:- Linear regression models of employment by business sector with "Cash Flow" as independent variable.

Dependent Variable	**Constant**	**Unstandardized Beta**	**Standardized Beta**	**R Square**	**P – Value**
Financial and insurance activities	4004,960	-7,401E-6	-0,903	0,816	0
Construction	9766,487	-4,183E-5	-0,929	0,863	0
Real estate management	443,807	3,871E-6	0,960	0,921	0
Agriculture, forestry and fishing	55,604	-1,072E-7	-0,849	0,720	0,02
Professional, scientific and technical activities	17387,828	1,972E-5	0,758	0,574	0,11
Wholesale and retail trade	84161,880	0	0,694	0,482	0,026

Table 7:- Linear regression models of cash flow and Gross Value Added by sector.

Dependent Variable	**Constant**	**Unstandardized Beta**	**Standardized Beta**	**R Square**	**P – Value**
Construction	450,264	-3,332E-6	-0,939	0,882	0
Education	401,925	-3,331E-6	-0,879	0,772	,001
Wholesale and retail trade, repair of motor vehicles and motorcycles	497,917	-7,911E-7	-0,801	0,641	0,005
Activities related to human health and social work	9.951,257	-1,721E-5	-0,743	0,552	0,014
Professional, scientific and technical activities	414,752	-1,155E-6	-0,737	0,486	0,015
Information and communication activities	383,314	-7,699E-7	-0,682	0,465	0,030
Arts, entertainment	207,158	-4,370E-7	-0,630	0,397	0,051
Administrative and support service activities	236,479	-3,291E-7	-0,581	0,337	0,078
Real estate management	215,554	-3,932E-7	-0,550	0,302	0,1

Table 8:- Linear regression models with the dependent variable PPA's cash flow and the independent variables resulting from the Stepwise regression method from the development characteristics of the Regional Unit of Piraeus.

	B	**Standardized B**	**Sig.**	**R Square**
Constant	-92.744.977,3		0,001	0,885
Real estate management	208.274,806	0,941	0,000	

Constant	-166.838.659		0,159	0,862
Total employment	2.471,409	0,633	0,002	
Total GVA	-33.429,726	-0,889	0,000	
Constant	329.276.959		0,000	0,811
Real estate management (GVA)	-224.960,027	-0,901	0,000	

Table 9:- Linear regression models with the dependent variable PPA's inflows from operations and the independent variables resulting from the Stepwise regression method from the development characteristics of the Regional Unit of Piraeus.

	B	**Standardized B**	**Sig.**	**R Square**
Constant	-285.181.151		0,041	0,470
Total employment	1.508,780	0,685	0,029	
Constant	103.221.029,8		0,000	0,777
Construction	-11.544,001	-0,882	0,001	
Constant	-107.391.713			0,919
Transportation and storage (GVA)	92.523,493	0,612	0,005	
Construction (GVA)	-105.629,706	-0,627	0,004	

Table 10:- Linear regression models with the dependent variable PPA's total taxes and the independent variables resulting from the Stepwise regression method from the development characteristics of the Regional Unit of Piraeus.

	B	**Standardized B**	**Sig.**	**R Square**
Constant	-60099816.7		0,062	0,380
Total employment	319,277	0,617	0,043	
Constant	-49.270.758		0,003	0,688
Wholesale and retail trade	604,588	0,829	0,002	
Constant	11.917.405,13		0,063	0,908
Real estate management	-31.900,253	-0,964	0,000	
Transportation and storage	20.256,915	0,741	0,000	

Table 11:- Linear regression models with the dependent variable PPA's debt-to-equity and the independent variables resulting from the Stepwise regression method from the development characteristics of the Regional Unit of Piraeus.

	B	**Standardized B**	**Sig.**	**R Square**
Constant	111,597		0,397	0,967
Total GVA	-0,022	-1,450	0,000	
GDP per capita€	-0,025	-2,556	0,049	
GDP	0,061	4,472	0,000	
Constant	-106,487		0,000	0,972
Real estate management	-0,089	-0,986	0,000	

Constant	0,871			0,991
Real estate management	0,002	-0,914	0,000	
Arts and entertainment	-0,156	-0,254	0,020	
Professional, scientific and technical activities	-0,190	-0,626	0,004	
Construction (GVA)	0,063	0,660	0,036	

Table 12:- Linear regression models with the dependent variable PPA's general liquidity and the independent variables resulting from the Stepwise regression method from the development characteristics of the Regional Unit of Piraeus.

	B	**Standardized B**	**Sig.**	**R Square**
Constant	-9,600		0,262	0,872
Total GVA	0,014	6,732	0,006	
Total employment	7,625E-5	0,971	0,032	
GDP	-0,012	-6,759	0,004	

Table 13:- Linear regression models with the dependent variable PPA's earnings before taxes and the independent variables resulting from the Stepwise regression method from the development characteristics of the Regional Unit of Piraeus.

	B	**Standardized B**	**Sig.**	**R Square**
Constant	-58.069.835,4		0,000	0,892
Real estate management	125.988,705	0,945	0,001	
Constant	-107.391.713		0,050	0,906
Professional, scientific and technical activities (GVA)	523.059,943	-1,437	0,000	
Construction (GVA)	-277.563,709	-0,627	0,004	

Table 14:- Linear regression models with the dependent variable PPA's earnings per share and the independent variables resulting from the Stepwise regression method from the development characteristics of the Regional Unit of Piraeus.

	B	**Standardized B**	**Sig.**	**R Square**
Constant	2,012		0,012	0,907
Real estate management (GVA)	-0,004	-1,398	0,000	
Arts and entertainment (GVA)	0,018	0,955	0,003	

Table 15:- Linear regression models with the dependent variable PPA's income after taxes and the independent variables resulting from the Stepwise regression method from the development characteristics of the Regional Unit of Piraeus.

	B	**Standardized B**	**Sig.**	**R Square**
Constant	48.320.192,57		0,017	0,811
Real estate management (GVA)	-107.591,711	-1,391	0,000	
Arts and entertainment (GVA)	453.287,602	0,965	0,004	