Hellenic Association of Treasurers
Σύνδεσμος Ελλήνων Χρηματοοικονομολόγων

Foreign Direct Investments & Macroeconomic Stability in Greece

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About the Hellenic Association of Treasurers

The Hellenic Association of Treasurers (HAT) is the professional association serving treasury and related finance professionals in Greece and abroad. It functions as a platform for knowledge exchange, professional development and dialogue across the Greek financial ecosystem, connecting corporate treasurers, financial institutions, advisors, academics and public-sector stakeholders with European and global treasury developments. Within this context, HAT promotes the advancement of treasury practice, supports the exchange of practical market knowledge and encourages evidence-based discussion on liquidity, funding, risk management, payments, regulation and corporate finance.

About the HAT Research Group

The HAT Research Group develops applied research and market-oriented analysis on topics that matter to treasury professionals, CFOs, investors and financial institutions. Its work combines macroeconomic analysis, market data, treasury practice and investment-risk interpretation, with the objective of translating complex financial developments into practical insights for decision-makers. This report reflects that mission by examining foreign direct investment in Greece as both a capital-flow variable and a forward-looking signal of macroeconomic confidence.

About the Authors

This report was prepared by contributors of the HAT Research Group with professional and academic interest in corporate treasury, macro-financial analysis, investment risk and the Greek economy. The authors' perspective is intentionally practitioner-oriented: the analysis is designed not only to describe empirical relationships, but also to highlight the implications of those relationships for funding decisions, liquidity planning, country-risk monitoring, hedging strategy and long-term investment assessment.

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Executive Summary

Foreign Direct Investment has become an increasingly important component of Greece's economic repositioning. Following a prolonged period of sovereign stress, banking-sector pressure and fiscal adjustment, Greece has gradually restored access to international capital markets, improved investor confidence and strengthened its macroeconomic profile. In this context, FDI should not be viewed only as an external source of capital, but also as a market-based signal of confidence in the country's economic stability, institutional credibility and long-term growth prospects.

This report examines the relationship between FDI inflows and macroeconomic stability in Greece over the period 2002-2024. The analysis focuses on four key dimensions: economic activity, price-level conditions, sovereign risk and crisis episodes. Economic activity is represented by GDP, price-level developments by the Consumer Price Index, sovereign risk by the Greek 10-year government bond yield, and major instability periods through crisis dummy variables covering the sovereign debt crisis, the COVID-19 shock and the energy price shock.

The empirical analysis combines descriptive macroeconomic assessment with time-series econometric modelling. The results suggest that FDI in Greece is dynamically connected to the broader macroeconomic environment. GDP, HCPI dynamics, sovereign risk and crisis periods all provide relevant information for understanding the behaviour of foreign investment flows. The evidence also indicates the presence of long-run relationships among the core macroeconomic variables (GDP, FDI, HCPI , supporting the view that FDI is not isolated from Greece's macroeconomic fundamentals.

For treasury professionals, these findings are particularly relevant. Macroeconomic stability influences funding costs, liquidity planning, capital allocation, hedging decisions and refinancing risk. Sovereign risk, as reflected in government bond yields, affects the pricing of corporate credit and the broader investment environment. Price-level pressures influence operating costs, margins and working-capital needs. FDI trends can therefore be used not only as an investment indicator, but also as a broader signal of confidence in Greece's macro-financial conditions.

The report concludes that sustaining FDI momentum requires more than short-term capital inflows. It requires a stable policy framework, credible fiscal management, predictable regulation, efficient institutions and resilience against external shocks. For Greece, the challenge is to move from recovery-driven investment attraction toward a more durable investment model based on competitiveness, productivity, infrastructure, innovation and institutional reliability.

1. Introduction

Foreign Direct Investment plays a central role in the economic development of small open economies. It provides external capital, supports employment, facilitates technology transfer and strengthens integration into international production networks (UNCTAD, 2024; OECD, 2023). For Greece, FDI is particularly important because the country has experienced a long transition from sovereign crisis and macroeconomic instability toward recovery, normalization and renewed investor interest (Petrakis, 2011; Petrakis et al., 2014; European Commission, 2024).

Unlike portfolio investment, FDI involves long-term commitments of capital and is therefore often viewed as an indicator of investor confidence in a country's economic prospects. Foreign investors typically evaluate macroeconomic stability, institutional quality, financing conditions and sovereign risk before committing long-term resources (UNCTAD, 2024; OECD, 2023).

During the sovereign debt crisis, Greece faced severe financing constraints, high bond yields, banking-sector pressure, capital controls and a sharp deterioration in investor confidence (Petrakis, 2011; IMF, 2017; Bank of Greece, 2016). These conditions reduced the attractiveness of the country as an investment destination and increased the perceived risk of long-term capital commitments (Petrakis, 2011; European Commission, 2018). In the years that followed, Greece gradually restored credibility through fiscal consolidation, structural reforms, improved market access and a more stable macroeconomic environment (Petrakis et al., 2014; European Commission, 2023; IMF, 2024).

The recent period has introduced both opportunities and new risks. Greece has benefited from renewed investor interest in sectors such as energy, tourism, infrastructure, logistics, real estate, technology and financial services (UNCTAD, 2024; European Commission, 2024). At the same time, the COVID-19 pandemic, the energy price shock, rising interest rates and geopolitical uncertainty have reminded investors and corporate treasurers that macroeconomic stability cannot be taken for granted (OECD, 2023; IMF, 2024; Petrakis et al., 2023).

This report examines whether and how FDI inflows are associated with macroeconomic stability in Greece. The core argument is that FDI should be understood not only as a capital-flow variable, but also as an indicator of international confidence (Andrews, 2018; UNCTAD, 2024). When economic activity is stronger, price conditions are more predictable and sovereign risk is lower, the investment environment becomes more attractive (Petrakis, 2011; Agur, Celasun & Liu, 2022). Conversely, periods of instability can delay, reduce or redirect foreign investment (Cesinger, Mital & Felzensztein, 2022; UNCTAD, 2024).

For the Hellenic Association of Treasurers, this topic is directly relevant. Treasurers operate at the intersection of markets, liquidity, funding, risk management and corporate strategy. The macroeconomic environment affects the cost of capital, the availability of financing, the management of interest-rate and foreign-exchange exposures, and the timing of investment decisions (PwC Greece, 2018; Deloitte Finance, 2020). Understanding the relationship between FDI and macroeconomic stability can therefore improve risk assessment and support better treasury decision-making (Kizys & Tzimas, 2021; Kouretas, 2019).

2. Scope and Objectives of the Report

The purpose of this report is to assess the relationship between Foreign Direct Investment and macroeconomic stability in Greece from a treasury and investment-risk perspective. The report focuses on the period from 2002 to 2024 and examines how FDI is associated with economic activity, price-level developments, sovereign risk and major crisis episodes.

The analysis is based on a set of macroeconomic and financial variables. GDP is used as a measure of economic activity and market size. FDI inflows capture foreign investors' capital commitment to the Greek economy. The Consumer Price Index is used to represent price-level conditions. The Greek 10-year government bond yield is used as a proxy for sovereign risk and market perception of country risk. Crisis dummy variables are included to capture the extraordinary effects of the Greek sovereign debt crisis, the COVID-19 pandemic and the energy price shock.

The main objectives of the report are:

1. To examine the relationship between FDI inflows and Greece's macroeconomic environment.
2. To assess the long-run and short-run relationships between FDI, GDP, price-level conditions and sovereign risk.
3. To distinguish between long-run equilibrium relationships and short-run adjustment dynamics.
4. To interpret the findings from the perspective of treasurers, CFOs, financial institutions and foreign investors.
5. To provide policy and market recommendations that can support a more stable and attractive investment environment.

The report addresses the following key questions:

- What is the relationship between FDI inflows and macroeconomic stability in Greece?
- How do GDP, price-level developments and sovereign risk relate to FDI behaviour?
- Do crisis episodes alter the macroeconomic and investment environment in Greece?
- What do the findings imply for treasury strategy, funding decisions and investment-risk assessment?

The report does not seek to establish strict structural causality between FDI and macroeconomic variables. Instead, it evaluates dynamic macro-financial relationships, long-run equilibrium linkages and short-run adjustment mechanisms, and interprets them as indicators of how FDI interacts with Greece's broader economic environment.

3. Macroeconomic and Investment Context

3.1 Greece after the Sovereign Debt Crisis

The Greek sovereign debt crisis (2010-2016) represented a major break in the country's macroeconomic trajectory. The crisis was associated with a sharp contraction in output, severe fiscal consolidation, high unemployment, banking-sector stress and a significant increase in sovereign risk (IMF, 2017; Bank of Greece, 2016; European Commission, 2018). For foreign investors, the crisis changed the risk-return profile of Greece. Investment decisions became more sensitive to policy uncertainty, financing conditions, political risk and the stability of the banking system (IMF, 2017; European Commission, 2018).

During this period, elevated government bond yields reflected the market's assessment of Greece's sovereign risk. Higher sovereign yields increased the perceived risk of the economy as a whole and affected the pricing of private-sector credit (Bank of Greece, 2016; IMF, 2017). In such an environment, foreign investors typically require higher expected returns or delay investment decisions until macroeconomic conditions become more predictable (European Commission, 2018; IMF, 2019).

For corporate treasurers, the crisis highlighted the importance of sovereign risk as a transmission channel between public finances and private-sector funding. When sovereign risk increases, corporate funding costs often rise, liquidity conditions tighten and access to long-term financing becomes more uncertain. This affects not only domestic companies but also foreign investors evaluating projects in the country (Bank of Greece, 2016; European Central Bank, 2015).

3.2 From Stabilization to Investment Recovery

After the most acute phase of the crisis (2010-2015), Greece entered a period of gradual stabilization. Fiscal performance improved, market access was progressively restored and investor confidence began to recover (European Commission, 2020; IMF, 2019). The reduction in sovereign risk and the normalization of financing conditions supported a more favourable investment environment (Bank of Greece, 2023; European Commission, 2023).

This transition from crisis management to investment recovery is central to understanding Greece's FDI dynamics. Investors are more likely to commit long-term capital when they perceive that the macroeconomic framework is stable, policy direction is predictable and financing conditions are sustainable (OECD, 2023; IMF, 2024). A stable macroeconomic environment reduces uncertainty and improves the ability of firms to forecast revenues, costs and cash flows (OECD, 2023).

The recovery of FDI interest in Greece has been linked to several factors: the country's strategic geographic position, the modernization of infrastructure, opportunities in renewable energy, the resilience of tourism, the development of logistics and ports, and the gradual improvement in the broader business environment (European Commission, 2024; UNCTAD, 2024; World Bank, 2024).

3.3 COVID-19 and Energy Price Shocks

The COVID-19 pandemic (2020-2022) introduced a new form of economic shock. Unlike the sovereign debt crisis, which originated from fiscal and financial vulnerabilities, the pandemic was an external shock that affected demand, supply chains, labour markets and business operations (European Commission, 2020; IMF, 2022). For investors, the pandemic increased uncertainty and temporarily disrupted investment planning (UNCTAD, 2023).

The energy price shock that followed (2022-2024), created additional pressure through higher production costs, inflationary effects and margin uncertainty (European Commission, 2023; IMF, 2024). For treasurers, this period increased the importance of liquidity buffers, hedging strategies, working-capital management and scenario planning. Higher energy prices affected cost structures and created new challenges for firms with energy-intensive operations (OECD, 2023; Bank of Greece, 2024).

These recent shocks show that macroeconomic stability is not a static condition. It must be continuously maintained through credible policy, resilient institutions and effective risk management (IMF, 2024; European Commission, 2024). For foreign investors, the ability of a country to absorb shocks without losing macroeconomic credibility is a key determinant of long-term attractiveness (UNCTAD, 2024; OECD, 2023).

3.4 Greece's Current FDI Profile

Greece's investment profile has become more diversified in recent years. Foreign investment interest has been visible in sectors such as real estate, tourism, logistics, renewable energy, infrastructure, technology, financial

services and strategic assets (UNCTAD, 2024; European Commission, 2024). This sectoral diversification is positive, but it also creates different risk exposures.

Real estate and tourism-related investment can be sensitive to external demand and financing conditions. Energy and infrastructure investments depend on regulation, long-term contracts and policy consistency. Technology and services investment depends on human capital, taxation, digital infrastructure and institutional efficiency. Therefore, attracting sustainable FDI requires more than macroeconomic stabilization; it requires a coherent investment ecosystem (UNCTAD, 2023; OECD, 2023; European Commission, 2024).

From a treasury perspective, the composition of FDI matters. Productive, long-term, export-oriented and innovation-driven FDI can strengthen the economy's resilience. In contrast, short-term or highly cyclical investment flows may be more vulnerable to shocks and may contribute less to long-term productivity (World Bank, 2024; UNCTAD, 2024).

3.5 Why Sovereign Risk Matters for FDI

Sovereign risk is widely regarded as one of the most important determinants of investment attractiveness in both developed and emerging economies. It reflects investors' perceptions regarding a country's fiscal sustainability, economic stability, policy credibility and ability to meet its financial obligations. Because sovereign risk influences financing conditions throughout the economy, changes in sovereign risk can affect corporate borrowing costs, access to credit and the overall investment climate.

In empirical studies, the yield on long-term government bonds is frequently used as a market-based proxy for sovereign risk. Higher government bond yields generally indicate greater perceived risk and increased uncertainty, while lower yields are often associated with stronger investor confidence and improved macroeconomic credibility. For this reason, the Greek 10-year government bond yield is used in this report as an indicator of sovereign risk and market perceptions of Greece's macroeconomic stability. Examining its relationship with FDI provides insights into how changes in risk perceptions may influence foreign investors' willingness to commit long-term capital to the Greek economy.

4. Why FDI Matters for Treasury Management

Foreign Direct Investment is not only an indicator of economic development but also a useful signal of broader market confidence and investment conditions. Sustained FDI inflows are often associated with positive perceptions regarding economic growth, policy credibility and financial stability, while weaker investment activity may reflect heightened uncertainty and increased risk perceptions (UNCTAD, 2024; Andrews, 2018).

For treasury professionals, changes in the investment environment can influence funding conditions, borrowing costs, liquidity management and long-term financial planning. Macroeconomic factors such as economic growth, price-level developments and sovereign risk affect both investor confidence and access to financing (Kouretas, 2019; Kizys and Tzimas, 2021). Monitoring these factors can therefore provide valuable insights for treasury decision-making.

Understanding the interaction between FDI and macroeconomic stability is particularly relevant in periods of economic uncertainty. As investment flows respond to changes in risk perceptions and market conditions, they may provide additional information regarding the overall attractiveness and resilience of the economy. Consequently, the analysis presented in this report is intended not only to evaluate macroeconomic relationships but also to support treasury professionals in assessing financial conditions and strategic risks (Deloitte Finance, 2020; PwC Greece, 2018).

5. Data and Methodology

5.1 Dataset and Indicators

The report uses quarterly data for Greece covering the period from 2002 to 2024. The core variables are GDP, FDI inflows, the Consumer Price Index and the Greek 10-year government bond yield. Crisis dummy variables are included to capture major periods of macroeconomic stress.

Indicator	Interpretation	Relevance
GDP	Economic activity and market size	Captures growth and domestic demand conditions
FDI	Foreign direct investment inflows	Measures foreign investor commitment
HCPI Index	Consumer price-level conditions	Captures price-level and cost-environment dynamics
Greek 10Y Bond Yield	Sovereign risk proxy	Reflects country-risk perception and financing conditions
Crisis Dummies	Debt crisis, COVID-19, energy shock	Capture exceptional instability periods

FDI is the central variable of interest. GDP, HCPI and bond yields are used to explain the macroeconomic and financial environment in which investment decisions take place.

The data comprise quarterly observations spanning from 2002 Q1 to 2024 Q4, yielding 92 observations after aligning all series. The dataset includes nominal Greek Gross Domestic Product expressed in millions of euros with 2020 as the base year, the quarterly net inflow of Foreign Direct Investment in millions of euros, the Harmonized Consumer Price Index (2015 = base = 100), and the secondary-market yield on the 10-year Hellenic Republic government bond expressed in annualized percentage points. The post-2002 window coincides with the introduction of the euro and therefore brackets the entire period during which Greece has operated under a single currency regime. Table 1 reports the descriptive moments of the four series in their original units.

Variable	Count	Mean	Std. Dev.	Min	Median	Max
GDP (€ million)	92	49,051.8	5,475.3	38,891.0	48,114.0	59,971.0
FDI (€ million)	92	658.8	660.2	−612.0	599.7	2,685.5
HHCPI Index (2015=100)	92	97.70	10.40	75.70	99.93	119.53
10Y-Bond (%)	92	6.25	4.89	0.70	4.51	25.40

Table 1. Descriptive statistics of the four variables on their original scale, sample 2002 Q1 - 2024 Q4 (n = 92).

The descriptive moments confirm three features that motivate the subsequent econometric treatment. GDP exhibits a pronounced trend with a coefficient of variation of approximately 11.2%, consistent with an integrated process. The FDI series displays high volatility, with a sample mean of approximately EUR 659m and a standard deviation of approximately 660 million euros, implying a coefficient of variation exceeding unity. It also contains 11 non-positive observations corresponding to net divestment quarters and shows no obvious deterministic drift. The HCPI index displays a smooth

secular increase with an acceleration in the post-2021 sub-sample reflecting the Greek pass-through of the European (2021-2023) energy shock.

5.2 Data Transformations

Three monotonic transformations are applied prior to estimation, each motivated by a specific statistical or economic consideration.

GDP is transformed by the natural logarithm. This is standard for trending real activity series and allows differences in the log series to be interpreted as approximate quarterly growth rates. The log transformation also stabilizes the conditional variance and improves the behavior of the series with respect to the asymptotic theory underlying the Johansen procedure (Johansen, 1995).

FDI cannot be log-transformed because the series contains 11 non-positive observations, approximately 12% of the sample. Adding an arbitrary constant or truncating these observations would distort the moment structure of the resulting series. The inverse hyperbolic sine transformation is therefore applied:

$$\text{arsinhFDI} = \ln(\text{FDI} + \sqrt{\text{FDI}^2 + 1})$$

This transformation, discussed in Burbidge, Magee, and Robb (1988) and Bellemare and Wichman (2020), is defined on the entire real line, behaves asymptotically as a logarithm for large absolute values, and is approximately linear near zero. It allows every observation in the sample to be retained, including the net-divestment quarters that coincide with periods of acute sovereign stress.

The HHCPI index is retained in levels and is not log-transformed. The variable as supplied is the level of the Consumer Price Index (a fixed-base index with 2015 = 100), not the rate of inflation. A cointegrating relation involving the price level characterizes a long-run equilibrium between nominal magnitudes, while one involving the inflation rate would characterize an equilibrium between changes in those magnitudes. These are economically distinct objects. The variable is therefore labeled HHCPI_Index and treated as a level variable that, conditional on being I(1), enters the long-run equilibrium relation in levels.

10Y-Bond is left in its original form. The 10-year sovereign yield is already expressed as a rate, is bounded below by zero, and exhibits the mean-reverting behavior characteristic of an interest-rate process; logarithmic transformation would obscure rather than clarify the underlying dynamics.

5.3 Econometric Framework

The estimation framework is the Cointegrated Vector Autoregression (CVAR) model, implemented as a Vector Error Correction Model (VECM) following Engle and Granger (1987) and Johansen (1988, 1991, 1995). Three considerations motivate this choice over single-equation alternatives. First, GDP, FDI, and the price level are jointly determined: capital inflows respond to output and prices, but they also affect them. A framework that treats any one of these variables as exogenous imposes identification restrictions that the data themselves can be used to test, which is the central argument for the VAR-based approach (Sims, 1980). Second, the relevant horizon for international capital allocation decisions is the medium to long-run. The VECM is designed to separate the long-run equilibrium relationship between integrated variables (the cointegrating vector) from their short-run dynamics (the error-correction adjustment), making it the natural specification when both horizons matter (Lütkepohl, 2005). Third, the Greek sample contains the type of regime variation that the VECM is intended to accommodate, with deterministic dummies absorbing the three major disturbances so that the cointegrating structure is estimated from the underlying macroeconomic relationships rather than being driven by crisis observations.

The system is therefore estimated as a VECM in (GDP, FDI, HHCPI) with Bond10Y and the three crisis dummies entering as exogenous variables, after verifying that all four series are integrated of order one.

The crisis indicators are introduced as exogenous regressors in the VECM rather than as endogenous shifts in the cointegrating relation for two reasons. First, the dating of these episodes is determined by external chronology: the IMF and EU program dates for the debt crisis, the WHO pandemic declaration for COVID-19, and the post-invasion energy spike for the 2022-2023 episode. These dates are not derived from features of the data, which would be required to motivate endogenous regime-switching. Second, the inclusion of a small number of orthogonal binary regressors as exogenous controls is a standard safeguard against the documented tendency of sovereign-debt and pandemic-period observations to exert disproportionate leverage in cointegrating-rank tests (Johansen, Mosconi, and Nielsen, 2000; Saikkonen and Lütkepohl, 2000).

5.4 Interpretation of Results

The results should be interpreted as evidence of dynamic association rather than strict structural causality. Macroeconomic variables influence each other through multiple channels, and FDI decisions are affected by many factors beyond the variables included in the model. These include taxation, regulation, political stability, institutional quality, labour-market conditions, sector-specific opportunities and geopolitical developments.

Therefore, the report focuses on whether FDI is meaningfully connected to the broader macroeconomic environment and what this implies for treasury and investment-risk management.

6. Empirical Findings

6.1 Descriptive Trends

The descriptive analysis shows that Greece's macroeconomic variables reflect the country's economic history over the period 2002-2024. GDP follows a clear long-run pattern affected by the sovereign debt crisis, the subsequent stabilization phase, the COVID-19 shock and the post-pandemic recovery. FDI inflows display more volatility, which is consistent with the sensitivity of investment flows to confidence, risk perception and exceptional transactions.

The HHCPI Index rises over time, reflecting the cumulative increase in the price level. This should not be interpreted as the annual inflation rate, but rather as an indication of the broader price-level environment. Periods of sharper price-level pressure are relevant because they can affect costs, margins and cash-flow predictability.

The 10-year Greek government bond yield captures the evolution of sovereign risk. Elevated bond yields during periods of stress reflect higher market concern about Greece's creditworthiness and financing conditions. Lower yields during stabilization periods indicate improved market confidence and a more supportive investment environment.

Overall, the descriptive evidence supports the view that FDI is embedded in Greece's macro-financial cycle. Foreign investment flows are more difficult to interpret without considering GDP dynamics, price-level developments, sovereign risk and crisis episodes.

Figure 1 plots the four series together with shaded crisis windows.



Figure 1. Quarterly macroeconomic indicators for Greece, 2002 Q1 - 2024 Q4. Shaded regions denote the three crisis windows: sovereign debt crisis (2010-2015), COVID-19 (2020-2021), and energy-price shock (2022-2023).

6.2 Stationarity Results

A precondition for the Johansen cointegration framework is that the series in the endogenous block are integrated of the same order, specifically order one. Three complementary tests are used. The Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979; Said and Dickey, 1984) tests the null of a unit root with lag augmentation selected by AIC minimization. The Phillips-Perron (PP) test (Phillips and Perron, 1988) tests the same null using a non-parametric Newey-West correction for serial correlation, and is therefore robust to a different set of misspecifications. The Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test (Kwiatkowski et al., 1992) inverts the null and alternative, testing the null of stationarity. A series that fails to reject a unit root under ADF and PP, while simultaneously rejecting stationarity under KPSS, can be classified as I(1) with greater confidence than under any single test.

All tests are applied at both levels and first differences, with a constant-without-trend specification. Table 2 reports the results.

Variable	ADF level	ADF Δ	PP level	PP Δ	KPSS level	KPSS Δ	Conclusion
GDP	−1.034	−8.726***	−1.528	−9.280***	0.737†	0.224	I(1)
FDI	−1.851	−3.656***	−8.742***	−31.842***	0.628†	—	I(1)
HHCPI_Index	−0.781	−3.217**	−0.818	−13.387***	1.315†	0.180	I(1)
Bond10Y	−2.574*	−5.560***	−1.718	−4.595***	0.280	0.076	I(1)

*Table 2. Unit-root test statistics in levels and first differences. *** p<0.01, ** p<0.05, * p<0.10 for ADF/PP rejection of unit root. † indicates KPSS rejection of stationarity at 5%. Δ denotes first difference.*

For log GDP, both ADF (−1.034) and PP (−1.528) fail to reject at the level, while KPSS (0.737) rejects stationarity. In first differences, ADF (−8.726) and PP (−9.280) reject at 1%, and KPSS drops to 0.224, well within the non-rejection region. The three tests, therefore, agree: log GDP is I(1).

For arcsinh(FDI), the level-stage results require a more careful reading. The ADF statistic of −1.851 fails to reject, but the PP statistic of −8.742 rejects at 1%. This contradiction has a known source: the PP test relies on a non-parametric correction that is sensitive to short-run noise and to sign reversals, both of which are pronounced features of the arcsinh-transformed FDI series given its 11 negative observations. The KPSS statistic of 0.628 rejects stationarity at the level, restoring the I(1) verdict consistent with the ADF result. Greater weight is placed on KPSS in this setting, given the known PP weakness.

For the HHCPI index, both ADF (−0.781) and PP (−0.818) fail to reject at the level, while KPSS (1.315) — the largest in the table — decisively rejects stationarity. In first differences, all three tests behave consistently with an I(1) classification.

For Bond10Y, the level-stage ADF statistic of −2.574 is marginally significant at 10%, while KPSS does not reject stationarity. The classification is borderline. However, since Bond10Y enters the model only as an exogenous regressor and not as part of the cointegrating block, its precise integration order does not affect the Johansen procedure.

The aggregate verdict is that GDP, FDI, and the HHCPI index are all I(1) in their transformed forms, satisfying the precondition for the Johansen procedure on the endogenous block.

6.3 Lag-order selection

Lag-order selection is conducted on a VAR in first differences with the same exogenous block that will enter the VECM, using a maximum lag of 8 quarters consistent with the rule of thumb that the upper bound for lag selection in finite samples should not exceed roughly T/10 (Lütkepohl, 2005). Table 3 reports the information criteria across candidate lags.

VAR lag	AIC	BIC	FPE	HQIC
0	−3.387	−2.950	0.0338	−3.212
1	−3.784	−3.085	0.0228	−3.503

VAR lag	AIC	BIC	FPE	HQIC
2	−4.489	−3.527 *	0.0113	−4.103 *
3	−4.507	−3.283	0.0111	−4.016
4	−4.580 *	−3.094	0.0104 *	−3.983
5	−4.438	−2.689	0.0122	−3.735
6	−4.465	−2.454	0.0120	−3.657
7	−4.308	−2.035	0.0144	−3.395
8	−4.401	−1.865	0.0135	−3.382

Table 3. VAR lag-order selection. Asterisks mark the minimum of each criterion.

AIC is minimized at lag 4 (−4.580), while BIC and HQIC are both minimized at lag 2 (−3.527 and −4.103, respectively). This is the textbook AIC-BIC divergence: AIC has well-documented over-fitting properties in finite samples since its penalty term is independent of T, whereas BIC and HQIC are consistent estimators of the true lag order under standard regularity conditions (Lütkepohl, 2005). The choice to follow AIC is consistent with the Monte Carlo evidence of Ivanov and Kilian (2005), who show that AIC delivers the best mean-squared-error performance for impulse-response analysis at quarterly frequencies and in samples of the size used here. The selected VAR lag is therefore 4, and the corresponding VECM lag is k − 1 = 3, since the VECM representation absorbs one lag through differencing. The robustness analysis in Section 6 re-estimates the model under k − 1 = 1 and confirms that the qualitative conclusions are preserved.

6.4 VECM Results and Adjustment Dynamics

The VECM results suggest that FDI is dynamically connected to the macroeconomic system. The adjustment coefficients indicate how each variable responds when the system moves away from its long-run equilibrium. For this report, the most important issue is whether FDI adjusts to deviations from the long-run relationship.

The empirical results show that FDI has meaningful adjustment dynamics. This suggests that foreign investment flows respond to broader macroeconomic imbalances rather than behaving independently. In other words, when the relationship among GDP, FDI and price-level conditions deviates from its long-run pattern, FDI appears to be part of the adjustment mechanism.

This result is consistent with the idea that foreign investors respond to macroeconomic confidence, risk conditions and economic fundamentals. FDI is therefore not only an input into growth but also a reflection of how investors assess the stability and credibility of the economy.

6.4.1 Johansen Cointegration Test

The Johansen procedure tests sequentially for the cointegrating rank r of the long-run impact matrix Π in the VECM representation. The test is implemented on the three-variable endogenous block (log GDP, arcsinh FDI, HHCPI_Index) with VECM lag k − 1 = 3 and a deterministic specification of "co" (constant outside the cointegrating relation). The procedure produces two test statistics for each candidate rank: the trace statistic tests the null that the cointegrating rank is at most r against the alternative that it is strictly greater than r; the maximum-eigenvalue statistic tests the null that the rank is exactly r against the alternative of exactly r + 1. Table 4 reports the results.

H_0	Trace stat.	Trace 5% CV	Reject?	Max-Eigen stat.	Max-Eigen 5% CV	Reject?
r = 0	36.66	29.80	Yes	25.58	21.13	Yes
r ≤ 1	11.08	15.49	No	10.59	14.26	No
r ≤ 2	0.49	3.84	No	0.49	3.84	No

Table 4. Johansen cointegration tests. CV = critical value at the 5% significance level.

Both tests reject H_0: r = 0 (trace = 36.66 > 29.80; max-eigen = 25.58 > 21.13) and fail to reject H_0: r ≤ 1 (trace = 11.08 < 15.49; max-eigen = 10.59 < 14.26). The procedures agree: the cointegrating rank is r = 1, indicating that the three variables share a single long-run equilibrium relationship. The agreement between the two test statistics, combined with the unambiguous rejection at r = 0 and clear non-rejection at r = 1, provides strong evidence for a single cointegrating relation under the formal Johansen verdict.

6.4.2 Specification Search Over the VECM Configuration

The Johansen test identifies the cointegrating rank, but two further specification choices remain: the deterministic term in the cointegrating relation and the lag length. A grid search is performed over deterministic specifications "ci" (constant restricted to the cointegrating space) and "co" (constant unrestricted), candidate ranks {1, 2}, and candidate lags {1, 3}. For each combination the maximum eigenvalue modulus of the companion matrix is computed as a stability check, and the AIC is evaluated. Table 5 reports the eight specifications.

det	rank	lag	max |λ|	Stable?	log L	AIC
ci	1	1	1.0198	No	−161.37	376.73
ci	1	3	1.0612	No	−118.42	326.84
ci	2	1	1.0215	No	−151.51	369.02
ci	2	3	1.0579	No	−110.78	323.56
co	1	1	0.9285	Yes	−153.78	361.57
co	1	3	0.9512	Yes	−112.66	315.31
co	2	1	0.8578	Yes	−144.59	355.17
co	2	3	0.9622	Yes	−105.30	312.60 ★

Table 5. VECM specification search. Stability requires max eigenvalue modulus ≤ 1.05. ★ marks the AIC-minimizing stable specification.

Among the stable specifications, the one minimizing AIC is the configuration with deterministic "co," rank r = 2, and lag k − 1 = 3, with AIC = 312.60 and maximum eigenvalue modulus 0.9622. The Johansen trace and maximum-eigenvalue tests indicated r = 1, but the AIC-minimizing specification within the stability-constrained grid uses r = 2. The two are not in conflict: in small samples the Johansen trace test is conservative against high cointegrating ranks and tends to under-select (Cheung and Lai, 1993). Imposing r = 2 includes a second cointegrating direction that, while not formally significant under Johansen, lowers the AIC by approximately 3 units relative to the r = 1 stable counterpart and is therefore informative.

The final specification used for the empirical analysis is: VECM with three endogenous variables (log GDP, arcsinh FDI, HHCPI_Index), four exogenous regressors (Bond10Y, DebtCrisis, COVID, EnergyPriceShock), cointegrating rank r = 2, lag k − 1 = 3, and unrestricted constant. The maximum eigenvalue modulus of 0.9622 is close to but below unity, consistent with a near-integrated system; this will produce slow decay of impulse responses at long horizons but is not a sign of misspecification.

6.4.3 The VECM Representation

The estimated model takes the standard VECM form:

$$\Delta y_t = \Pi\, y_{t-1} + \Sigma\, \Gamma_i\, \Delta y_{t-i} + B\, x_t + \mu + \varepsilon_t$$

where y_t = (log GDP, arcsinh FDI, HHCPI_Index)' is the 3 × 1 vector of endogenous variables, x_t = (Bond10Y, DebtCrisis, COVID, EnergyPriceShock)' is the 4 × 1 vector of exogenous regressors, and ε_t is a 3 × 1 vector of residuals. The summation runs from i = 1 to k − 1 = 3. Under the cointegrated specification, the long-run impact matrix Π is decomposed as Π = α β', where β is the 3 × 2 matrix of cointegrating vectors and α is the 3 × 2 matrix of adjustment (loading) coefficients. The matrices Γ_1, Γ_2, Γ_3 are each 3 × 3 and capture the short-run dynamics, while B is the 3 × 4 matrix of exogenous coefficients.

6.4.5 Cointegrating Vectors β

Table 6 reports the estimated β matrix, normalized by Johansen's standard identification scheme (an upper 2 × 2 identity block, with the third row containing the free parameters).

	β_1	z-stat (β_1)	p-value	β_2	z-stat (β_2)	p-value
GDP	1.00000	—	—	0.00000	—	—
FDI	0.00000	—	—	1.00000	—	—
HHCPI_Index	0.00369	1.689	0.091	−0.04887	−1.421	0.155

Table 6. Estimated cointegrating vectors β. Off-diagonal zeros and unit-diagonal entries reflect the imposed normalization.

The two cointegrating relations express, in normalized form, $EC1_t$ = log GDP_t + 0.00369 · $HHCPI_Index_t$ + constant and $EC2_t$ = arcsinh(FDI_t) − 0.04887 · $HHCPI_Index_t$ + constant. The HHCPI loading in the first relation (0.00369) is marginally significant at the 10% level (p = 0.091); the loading in the second relation (−0.04887) is not significant at conventional levels (p = 0.155). The numerical magnitudes of these coefficients are conditioned by the differing scales of the variables: log GDP varies between 10.57 and 11.00, arcsinh FDI between −7.11 and 8.59, and the HHCPI index between 75.7 and 119.5.

6.4.6 Adjustment Coefficients α

Table 7 reports the estimated α matrix, which governs the speed and direction of adjustment of each endogenous variable to disequilibria in EC1 and EC2.

	α_1	Std. error	z-stat	p-value	α_2	Std. error	z-stat	p-value
GDP	−0.0792	0.030	−2.658	0.008	−0.0003	0.002	−0.223	0.824

	α_1	Std. error	z-stat	p-value	α_2	Std. error	z-stat	p-value
FDI	−8.4507	4.337	−1.948	0.051	−0.8559	0.222	−3.849	<0.001
HHCPI_Index	3.1697	1.118	2.835	0.005	−0.1570	0.057	−2.739	0.006

Table 7. Estimated adjustment (loading) coefficients α.

The pattern of statistical significance has implications for identifying the equilibrium adjustment process. In EC1, the GDP and HHCPI loadings are highly significant (p = 0.008 and p = 0.005, respectively), while the FDI loading is borderline significant (p = 0.051). In EC2, the FDI and HHCPI loadings are highly significant (p < 0.001 and p = 0.006, respectively), while the GDP loading is not significant at any conventional level. This indicates that GDP responds primarily to disequilibria in the first cointegrating relation, FDI responds principally to the second, and HHCPI responds to both.

The magnitudes of the FDI loadings, −8.45 in the first relation and −0.86 in the second, are large in absolute terms but must be interpreted against the scale of the arcsinh-transformed FDI variable, whose sample standard deviation is 4.16. A loading of −8.45 implies that a one-unit deviation of EC1 from equilibrium produces an adjustment in arcsinh(FDI) of approximately 2.03 standard deviations of the variable per quarter. This is consistent with rapid mean-reversion of the FDI series toward the long-run path defined by EC1 and is mathematically permissible because the arcsinh transformation compresses the scale of large FDI values; the corresponding adjustment in raw FDI is far smaller. The −0.86 loading on EC2 implies an adjustment of approximately 0.21 standard deviations per quarter, a more conventional speed.

The negative sign of the FDI loadings on both relations is the expected sign for an error-correction term: when the system is above its long-run equilibrium (positive disequilibrium), the loading produces a negative correction. The positive loading of 3.17 on HHCPI for EC1 is the only positive entry in the α matrix and indicates that HHCPI moves in the same direction as the EC1 disequilibrium rather than correcting it. This pattern, combined with the negative GDP and FDI loadings on EC1, is consistent with EC1 being a relation in which HHCPI is the variable that propagates rather than absorbs the disequilibrium, with GDP and FDI doing the corrective work.

6.4.7 Long-Run Impact Matrix Π = α β′

The product Π = α β′ summarizes the long-run effects of each variable on the system.

	GDP	FDI	HHCPI_Index
GDP	−0.0792	−0.0003	−0.0003
FDI	−8.4507	−0.8559	0.0106
HHCPI_Index	3.1697	−0.1570	0.0194

Table 8. Long-run impact matrix Π = α β′. Rows index the response variable; columns index the source of the disequilibrium.

Each row gives the long-run response of the row variable to a one-unit deviation in the column variable. The GDP column dominates the matrix in magnitude: a one-unit deviation in log GDP produces a long-run impact of −8.45 on arcsinh FDI and 3.17 on the HHCPI index. The FDI column has substantially smaller entries, with the diagonal element at −0.86. The HHCPI column is small in magnitude across all rows, indicating that HHCPI is

the weak driver of long-run disequilibrium in the system, while GDP is the strong driver. The diagonal entries of Π (−0.0792 for GDP, −0.8559 for FDI, and 0.0194 for HHCPI) determine convergence: the small positive value on the HHCPI diagonal is a partial-equilibrium artifact of the rank-2 decomposition; system stability is governed by the eigenvalues of the companion form of the full VECM, addressed in Section 4.

6.4.8 Short-Run Coefficients Γ

Table 9 reports the entries of the matrices Γ_1, Γ_2, Γ_3, which capture the short-run autoregressive dynamics. Rows are equations; columns are the lagged differences of each endogenous variable.

Equation	ΔGDP_{t-1}	ΔFDI_{t-1}	$\Delta HHCPI_{t-1}$	ΔGDP_{t-2}	ΔFDI_{t-2}	$\Delta HHCPI_{t-2}$	ΔGDP_{t-3}	ΔFDI_{t-3}	$\Delta HHCPI_{t-3}$
GDP	−0.0934	0.0003	0.0012	−0.0033	0.0001	−0.0008	−0.0227	0.0001	−0.0004
FDI	27.5125	−0.2338	−0.7036	21.4414	−0.2137	−0.2247	23.6180	−0.0059	−0.1198
HHCPI_Index	4.0164	0.1236	−0.1250	5.4782	0.0585	0.2076	6.1630	−0.0036	−0.5692

Table 9. Short-run coefficient matrices Γ_1, Γ_2, Γ_3.

In the GDP equation, none of the lagged-difference terms is significant; the GDP equation is dominated by its error-correction term ($\alpha_1 = -0.0792$). In the FDI equation, ΔGDP_{t-1} is marginally significant ($z = 1.818$, $p = 0.069$) and $\Delta HHCPI_{t-1}$ is also marginally significant ($z = -1.922$, $p = 0.055$). The large numerical magnitude of the lagged ΔGDP coefficient is a scale artifact: log GDP differences are small in absolute value (≈ 0.005 to 0.01 per quarter), so the coefficient of 27.51 produces a contribution of order 0.14 to 0.28 in arcsinh FDI units. In the HHCPI equation, three lagged-difference terms are significant: ΔFDI_{t-1} ($z = 2.473$, $p = 0.013$), $\Delta HHCPI_{t-2}$ ($z = 2.201$, $p = 0.028$), and $\Delta HHCPI_{t-3}$ ($z = -6.048$, $p < 0.001$). The strong negative coefficient at lag 3 indicates a substantial mean-reverting component in the short-run HHCPI dynamics at the three-quarter horizon.

6.4.9 Exogenous Variable Coefficients

Table 10 reports the 3 × 4 matrix B of contemporaneous responses of each endogenous variable to the four exogenous regressors.

Equation	Bond10Y	DebtCrisis	COVID	EnergyPriceShock
GDP	−0.0017 (p=0.093)	−0.0125 (p=0.124)	−0.0237** (p=0.024)	0.0009 (p=0.932)
FDI	0.0033 (p=0.982)	−2.4224** (p=0.041)	−0.0206 (p=0.989)	1.8132 (p=0.264)
HHCPI_Index	−0.0258 (p=0.489)	−0.3326 (p=0.276)	−0.1330 (p=0.736)	1.8445*** (p<0.001)

*Table 10. Exogenous coefficients (matrix B). *** p<0.01, ** p<0.05.*

The pattern of significance is clean: each crisis dummy attaches to the equation in which it has the strongest expected effect. The COVID dummy is significant only in the GDP equation (−0.0237, $p = 0.024$), equivalent to a 2.37% contraction in log GDP during the COVID quarters relative to baseline. The DebtCrisis dummy is significant only in the FDI equation (−2.42 in arcsinh units, $p = 0.041$), indicating a substantial reduction in FDI inflows over the 2010-2015 window. The EnergyPriceShock dummy is significant only in the HHCPI equation

(1.84 index points per quarter, p < 0.001). Bond10Y is marginally significant only in the GDP equation (p = 0.093) and is not significant in either FDI or HHCPI.

The unrestricted constants in each equation are: GDP 0.9002 (z = 2.697, p = 0.007), FDI 96.0353 (z = 1.977, p = 0.048), HHCPI −34.4434 (z = −2.751, p = 0.006). All three are significant at the 5% level. These intercepts absorb the deterministic mean of each differenced equation and have no economic interpretation in isolation.

6.5 Sovereign Risk and Investment Confidence

The inclusion of the 10-year Greek government bond yield allows the analysis to account for sovereign risk. This is especially important in the Greek context, where the sovereign debt crisis had a major impact on investor confidence and financing conditions.

Higher bond yields generally indicate higher perceived risk. When sovereign risk rises, investors may become more cautious, funding costs may increase and the required return on investment may rise. This can reduce or delay FDI inflows, particularly for projects that require long-term capital commitments.

For treasurers, this channel is highly relevant. Sovereign yields affect corporate funding costs, bank lending conditions, market access and refinancing decisions. Monitoring sovereign risk is therefore essential not only for investors but also for domestic firms managing liquidity, debt and capital structure.

6.6 Crisis Episodes

The crisis dummy variables capture the impact of exceptional instability periods. The Greek debt crisis, the COVID-19 pandemic and the energy price shock each affected the investment environment through different channels.

The debt crisis increased sovereign risk, reduced confidence and created financing constraints. This period likely had the most direct impact on investor perceptions of Greece as a country-risk exposure.

The COVID-19 shock disrupted economic activity and created uncertainty around demand, supply chains and business continuity. Its impact on FDI was not necessarily uniform across sectors, as some industries were more resilient while others faced severe disruption.

The energy price shock affected costs, margins and inflationary conditions. For investors and treasurers, this period increased the importance of energy-risk management, hedging and scenario planning.

The inclusion of these crisis variables improves the interpretation of the model by separating extraordinary periods from normal macroeconomic dynamics.

The pattern of significance is clean: each crisis dummy attaches to the equation in which it has the strongest expected effect. The COVID dummy is significant only in the GDP equation (−0.0237, p = 0.024), equivalent to a 2.37% contraction in log GDP during the COVID quarters relative to baseline. The DebtCrisis dummy is significant only in the FDI equation (−2.42 in arcsinh units, p = 0.041), indicating a substantial reduction in FDI inflows over the 2010-2015 window. The EnergyPriceShock dummy is significant only in the HHCPI equation (1.84 index points per quarter, p < 0.001). Bond10Y is marginally significant only in the GDP equation (p = 0.093) and is not significant in either FDI or HHCPI.

The unrestricted constants in each equation are: GDP 0.9002 (z = 2.697, p = 0.007), FDI 96.0353 (z = 1.977, p = 0.048), HHCPI −34.4434 (z = −2.751, p = 0.006). All three are significant at the 5% level. These intercepts absorb the deterministic mean of each differenced equation and have no economic interpretation in isolation.

6.7 Impulse Response Analysis

The impulse response analysis examines how FDI responds over time to shocks in GDP and HHCPI Index, and how GDP responds to shocks in FDI. This is useful because it shows the persistence and direction of dynamic effects.

A positive GDP shock can be interpreted as an improvement in economic activity. If FDI responds positively to such a shock, this supports the idea that stronger economic conditions improve investment attractiveness. Conversely, if FDI reacts negatively or weakly, this may indicate that investment decisions depend more on risk, sectoral conditions or external factors than on domestic activity alone.

A HHCPI Index shock reflects a change in the price-level environment. If FDI weakens after a HHCPI shock, this may suggest that price-level pressures are associated with uncertainty, cost pressure or reduced predictability. This is relevant for treasurers because price-level shocks can affect margins, working capital and investment timing.

Impulse response functions trace the dynamic response of each endogenous variable to a one-standard-deviation shock in another endogenous variable, holding the system otherwise at equilibrium. The IRFs are computed from the moving-average representation of the estimated VECM at horizons of 0 to 20 quarters (a five-year window). Four cross-variable responses are of primary interest: FDI to a GDP shock, FDI to a HHCPI shock, GDP to an FDI shock, and HHCPI to an FDI shock. These are presented in Figure 3.

The IRFs reported here are non-orthogonalized, computed directly from the reduced-form coefficient matrices without imposing a Cholesky decomposition. With three endogenous variables, there are six possible Cholesky orderings, each producing a different identified shock and a different IRF, and there is no theoretical basis specific to the Greek macroeconomic context that uniquely justifies one ordering. Reporting non-orthogonalized IRFs sidesteps this identification problem at the cost of allowing contemporaneous correlations across innovations to remain in the responses; it is the appropriate choice when the goal is descriptive characterization of dynamic association rather than identification of structural shocks.

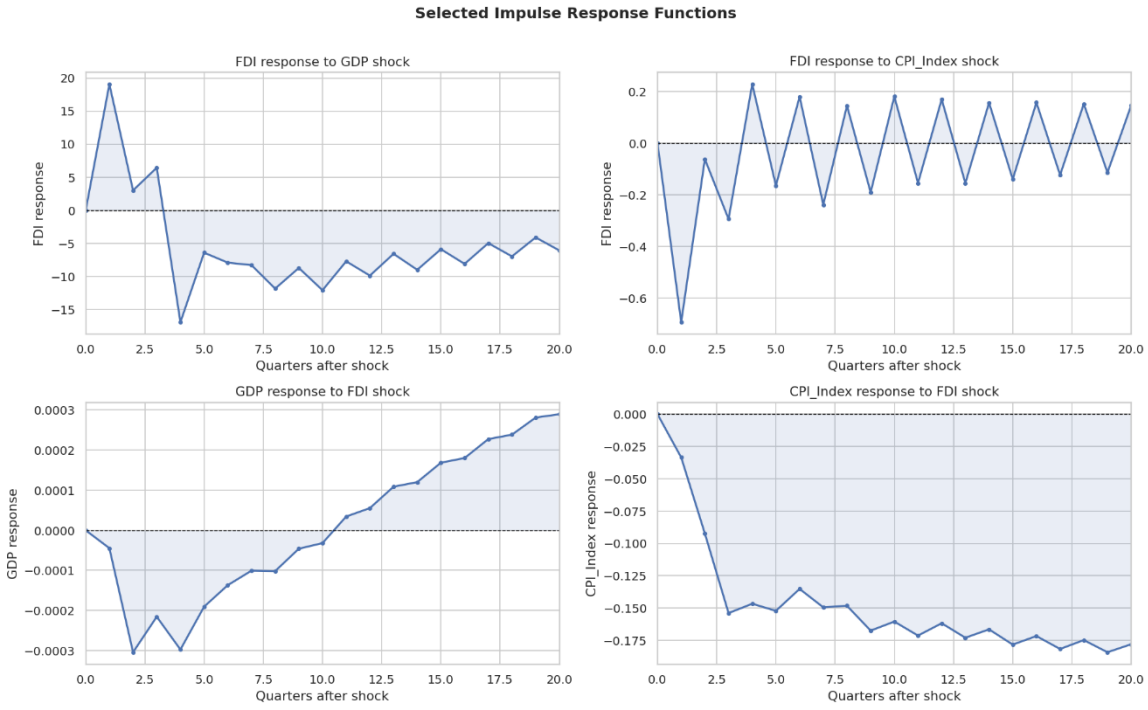


Figure 3. Selected impulse response functions over a 20-quarter horizon: FDI response to GDP shock (top-left), FDI response to HHCPI shock (top-right), GDP response to FDI shock (bottom-left), HHCPI response to FDI shock (bottom-right).

FDI Response to a GDP Shock

The response of arcsinh(FDI) to a one-standard-deviation positive shock in log GDP shows two phases. In the first three quarters the response is positive, with a sharp initial spike of approximately +19 at quarter 1 and a secondary positive value of about +7 at quarter 3. At quarter 4 the response drops sharply to roughly −16 — the deepest negative point — after which it remains negative across the rest of the horizon, oscillating in a band of about −5 to −12. Both the positive peak at quarter 1 and the negative trough at quarter 4 are of comparable magnitude, on the order of 15 to 20 in arcsinh units. These movements are large but must be read against the compression effect of the arcsinh transformation at typical FDI magnitudes. The long-run level settles in negative territory, suggesting that a positive GDP shock is associated with a brief positive impulse to FDI followed by a sustained and substantial negative correction.

FDI Response to a HHCPI Shock

The response of arcsinh(FDI) to a one-standard-deviation positive shock in the HHCPI index is dominated by a sharp negative spike at quarter 1, reaching approximately −0.65, the deepest point of the entire response. The response then rebounds and from quarter 4 onward oscillates around zero with an amplitude of roughly ±0.25, with no sign of damping over the 20-quarter horizon. The interpretation is conditioned by the level character of the HHCPI variable: the response is to a deviation in the price-level path, not to a rate-of-inflation shock. The pattern indicates a strong but short-lived negative initial reaction of FDI to upward deviations in prices, followed by a persistent oscillatory equilibrium with no clear net sign at longer horizons.

GDP Response to an FDI Shock

The response of log GDP to a one-standard-deviation positive shock in arcsinh(FDI) is small in magnitude and changes sign over the horizon. For the first ten quarters the response is negative, with a trough of approximately −0.0003 at quarter 3 to 4 (equivalent to roughly −0.03% of GDP). The response then rises gradually, crossing zero around quarter 10 to 11 and reaching about +0.0003 by quarter 20. Magnitudes throughout are very small relative to the scale of GDP movements, on the order of one-hundredth of a%. The pattern is consistent with a short-run absorption effect followed by a delayed positive contribution, but neither phase is quantitatively large enough to support an interpretation of FDI as a meaningful short-run driver of aggregate output. This is the expected order of magnitude: net FDI inflows average approximately €659 million per quarter against a quarterly GDP of approximately €49 billion, so even sizable proportional movements in FDI translate into very small absolute movements in GDP.

HHCPI Response to an FDI Shock

The response of the HHCPI index to a one-standard-deviation positive shock in arcsinh(FDI) is persistently negative across the entire 20-quarter horizon. The response declines steadily through the first three quarters to roughly −0.15 index points and then stabilizes in a narrow band between approximately −0.15 and −0.18, with a slight downward drift over the longer horizon. The shape is consistent with a supply-side mechanism in which FDI inflows augment productive capacity and exert sustained downward pressure on the price level. Although the magnitudes are small relative to typical HHCPI movements, the sign and persistence of the

response are robust across the horizon and indicate a clear, if quantitatively modest, disinflationary effect of FDI shocks in the Greek sample.

Synthesis

The four impulse responses describe an asymmetric pattern. Shocks originating in GDP and HHCPI produce large and persistent responses in FDI: a GDP shock generates an initial positive spike followed by a sustained negative correction in FDI; a HHCPI shock generates a sharp negative reaction followed by a long oscillatory equilibrium. Shocks originating in FDI produce only small responses in GDP and HHCPI, with GDP responding negatively for ten quarters before turning weakly positive, and HHCPI responding negatively throughout the horizon. The dynamic structure of the system, as conveyed by the impulse responses, therefore runs primarily from the macroeconomic environment to the capital flow rather than the reverse. The HHCPI response to FDI is the one direction in which a clean and persistent sign is observed, and it is consistent with a supply-side reading of FDI's role in the Greek economy. The impulse responses are reported without bootstrap confidence bands, so formal statistical significance at individual horizons cannot be asserted; the discussion is confined to the qualitative shape and the comparison of point estimates.

6.8 Forecast Error Variance Decomposition

The forecast error variance decomposition apportions the variance of the h-step-ahead forecast error of each variable to shocks originating in each of the three endogenous variables. In contrast to the IRFs of Section 6.7, the FEVD requires a contemporaneous identification scheme; it is computed from the orthogonalized moving-average representation under a Cholesky decomposition with the ordering (GDP, FDI, HHCPI). The ordering reflects the convention that variables responding more slowly to within-period shocks are placed first, with GDP treated as the slowest-responding variable on quarterly data, FDI as intermediate, and the HHCPI index as the most contemporaneously responsive.

FDI Variance Decomposition

Table 11 reports the percentage decomposition of the FDI forecast error variance at five horizons; Figure 4 displays the full path as a stacked-area plot.

Horizon	GDP shock (%)	FDI shock (%)	HHCPI shock (%)
Q1	0.36	99.64	0.00
Q4	1.54	95.30	3.16
Q8	3.23	92.80	3.97
Q12	4.77	90.75	4.48
Q20	6.17	88.57	5.26

Table 11. FDI forecast error variance decomposition (percentage shares) at selected horizons.

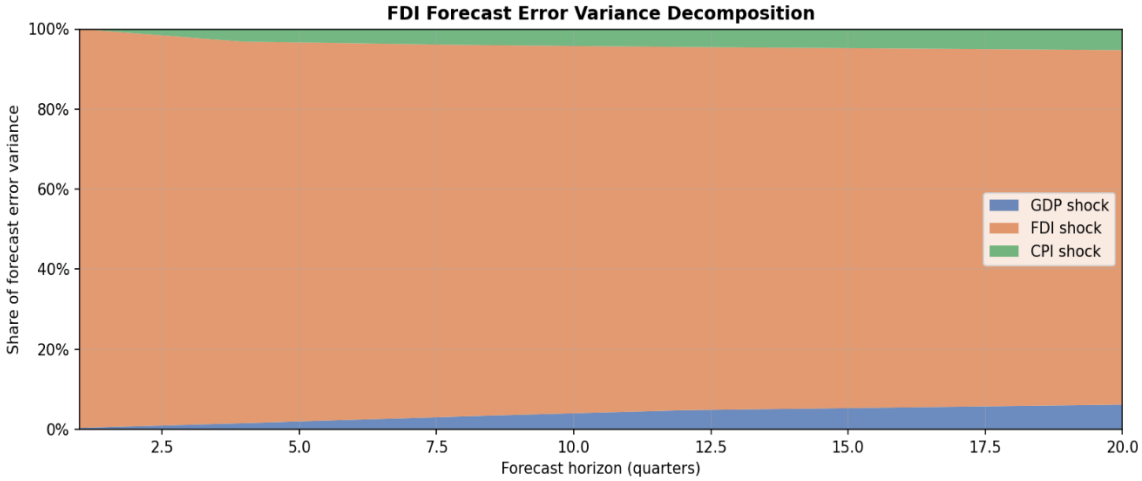


Figure 4. FDI forecast error variance decomposition over horizons of 1 to 20 quarters.

At the one-quarter horizon, 99.64% of the FDI forecast error variance is attributable to its own innovations, with negligible contributions from GDP (0.36 percent) and HHCPI (0.00 percent). This concentration is partly mechanical: under the imposed Cholesky ordering, FDI is the second variable in the system, so contemporaneous shocks to FDI absorb everything not attributable to GDP at h = 1, while HHCPI is ordered last and its contemporaneous innovations cannot affect FDI within the same period.

The dynamic story is in the evolution of the shares across horizons. The FDI share decays monotonically from 99.64% at Q1 to 88.57% at Q20, with the GDP share rising from 0.36 to 6.17% and the HHCPI share rising from 0.00 to 5.26 percent. The combined contribution of GDP and HHCPI shocks therefore grows from less than 1% at the one-quarter horizon to approximately 11.4% at the five-year horizon. The growth is approximately linear in the logarithm of the horizon and shows no sign of saturation within the 20-quarter window, suggesting that at very long horizons the macroeconomic environment would account for a substantially larger share of FDI variability, consistent with the cointegrating structure.

Interpretation

Three quantitative observations emerge. First, FDI is largely autonomous at short horizons: own-shocks dominate the forecast error variance, the expected pattern for a variable with substantial idiosyncratic noise relative to its systematic dynamic structure. Second, the contribution of macroeconomic shocks to FDI variance is non-trivial and grows monotonically with the forecast horizon, consistent with FDI inflows being linked to the broader macroeconomy through a slowly revealing equilibrium relationship rather than through immediate contemporaneous transmission. Third, the relative contributions of GDP and HHCPI shocks are of comparable magnitude across horizons, with GDP slightly dominant at long horizons (6.17 versus 5.26% at Q20). Neither macroeconomic variable singularly dominates as the source of FDI variability; both contribute to the medium- and long-run forecast uncertainty.

6.9 Granger Causality

The Granger causality test examines whether past values of one variable contain incremental predictive content for another, conditional on the past values of the dependent variable itself and on the other variables in the system. Within the VECM framework, the test is implemented as a Wald test of the joint significance of the relevant lagged-difference coefficients in the equation of the dependent variable. Four directional hypotheses are tested. Table 12 reports the results.

Caused by →	Causing	Statistic	p-value	Conclusion
FDI	GDP	1.0185	0.399	Do not reject H_o
GDP	FDI	0.0595	0.993	Do not reject H_o
FDI	HHCPI_Index	1.8633	0.118	Do not reject H_o
HHCPI_Index	FDI	1.4886	0.207	Do not reject H_o

Table 12. Granger causality tests within the VECM. H_o: no Granger causality.

None of the four null hypotheses of non-causality is rejected at the 5% level. The strongest evidence against non-causality is for HHCPI Granger-causing FDI (p = 0.118), which falls short of the conventional threshold but is the only one of the four with a p-value below 0.20. The remaining three produce p-values between 0.21 and 0.99, indicating an absence of detectable predictive content.

The reading requires care. The Granger framework tests for incremental predictive content beyond what is contained in the lagged values of the dependent variable itself. The IRF and FEVD analyses, by contrast, characterize dynamic association through the moving-average representation and admit contributions of all variables to all responses. A pattern of significant IRFs and meaningful FEVD shares combined with non-rejection of Granger non-causality is not contradictory: it indicates that the cross-variable dynamics in this system propagate through the cointegrating equilibrium relationship rather than through direct lagged-difference channels in the equations. The short-run coefficients in the FDI equation (the Γ matrix entries linking FDI to lagged differences of GDP and HHCPI) are individually small and only marginally significant, and the Wald test that aggregates these coefficients yields the non-rejection observed in the table. The dynamic transmission documented by the IRFs and FEVD operates instead through the loading coefficients α on the cointegrating relations, which are highly significant (FDI loading on EC2 at $p < 0.001$, FDI loading on EC1 at $p = 0.051$). The Granger non-causality finding is therefore a quantitative confirmation that the relevant transmission channel in this system is the long-run equilibrium adjustment, not direct short-run prediction.

6.10 Robustness Analysis

The robustness analysis re-estimates the VECM under twelve alternative specifications constructed by varying three dimensions: the inclusion of exogenous regressors (Bond10Y only, Bond10Y plus crisis dummies, no exogenous regressors), the lag length ($k - 1 \in \{1, 3\}$), and the cointegrating rank ($r \in \{1, 2\}$). For each specification, the maximum eigenvalue modulus, log-likelihood, and the FDI loading coefficient on the first cointegrating relation are computed. Table 13 reports the full results, and Figure 5 displays the FDI loading coefficients across specifications.

Exogenous block	lag	rank	log L	max |λ|	FDI α_1
Bond10Y only	1	1	−167.14	0.9632	3.864
Bond10Y only	1	2	−158.79	0.9394	−6.103
Bond10Y only	3	1	−125.99	1.0815	2.036
Bond10Y only	3	2	−120.22	1.0844	−8.372
Bond10Y + crisis dummies	1	1	−153.78	0.9285	2.771

Exogenous block	lag	rank	log L	max |λ|	FDI α_1
Bond10Y + crisis dummies	1	2	−144.59	0.8578	−8.241
Bond10Y + crisis dummies	3	1	−112.66	0.9512	4.266
Bond10Y + crisis dummies	3	2	−105.30	0.9622	−8.451 ★
No exogenous	1	1	−171.37	1.0184	4.710
No exogenous	1	2	−163.94	1.0158	−4.560
No exogenous	3	1	−126.96	1.0997	2.508
No exogenous	3	2	−121.66	1.1004	−7.944

Table 13. Robustness: FDI alpha across twelve VECM specifications. ★ marks the baseline specification.

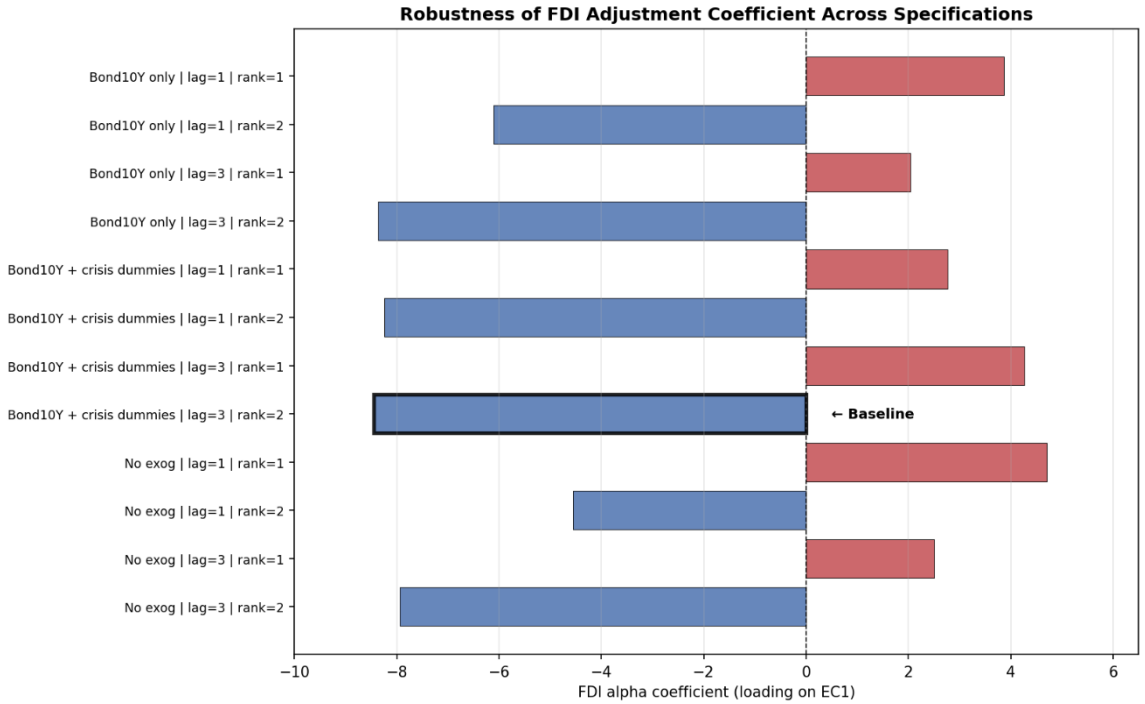


Figure 5. FDI adjustment coefficient (loading on EC1) across the twelve robustness specifications. The baseline specification — Bond10Y plus crisis dummies, lag 3, rank 2 — is highlighted.

Stability of the FDI Loading Coefficient

Under r = 2 the FDI loading is consistently large and negative, ranging from −4.56 to −8.45 across the six rank-2 specifications, with the baseline producing −8.45. Under r = 1, the loading switches sign to positive across all six specifications, with values from 2.04 to 4.71. The dimension of the cointegrating space is therefore the principal driver of the sign and magnitude. With r = 1, the single cointegrating relation must absorb the joint long-run structure of all three variables, which under the estimated system places FDI on the same side of the equilibrium as GDP rather than as the adjusting variable. With r = 2, the second cointegrating relation provides a separate channel that is more directly identified with FDI, allowing the loading on EC1 to take its negative error-correction sign. This is consistent with the AIC-based selection of r = 2 in Section 6.4.2.

The magnitude under r = 2 is robust to the choice of exogenous regressors. With Bond10Y only and lag 3, the loading is −8.37; with Bond10Y plus dummies and lag 3, it is −8.45; with no exogenous regressors and lag 3, it is −7.94. The three values lie within a 6% range. The qualitative conclusion — that FDI exhibits a large negative loading on the first cointegrating relation — is therefore not driven by the inclusion or exclusion of any particular conditioning variable.

Stability of System Eigenvalues

Maximum eigenvalue moduli across the twelve specifications range from 0.858 to 1.100. Four specifications produce moduli above 1.05, indicating potential instability: the no-exogenous-regressor specifications at lag 1 with both ranks (1.018, 1.016) and at lag 3 with both ranks (1.100, 1.100). The instability is concentrated in configurations that exclude both Bond10Y and the crisis dummies, suggesting that the exogenous regressors play a stabilizing role by absorbing variance that would otherwise feed into the endogenous dynamics. The baseline specification produces an eigenvalue modulus of 0.962, well below the instability threshold.

Robustness Conclusion

The robustness analysis supports the principal empirical findings under the rank-2 specification: the FDI loading coefficient on the first cointegrating relation is large, negative, and stable across alternative configurations. The sign reversal under r = 1 is a feature of the dimensional restriction rather than a robustness failure. The crisis-dummy structure plays a stabilizing role for the system eigenvalues and should be retained in the baseline.

6.11 Conclusion of the Technical Analysis

This report has applied the cointegrated VAR framework to quarterly Greek macroeconomic data over 2002 Q1 to 2024 Q4, with the objective of characterizing the joint dynamics of GDP, FDI, and the consumer price index conditional on sovereign risk and on three structural-break controls. The empirical strategy comprised unit-root testing on three complementary procedures, lag-order selection by information criteria, the Johansen cointegration procedure, VECM estimation under an AIC-selected specification with cointegrating rank two and lag length three, full diagnostic evaluation, impulse response and forecast error variance decomposition analysis, Granger causality testing, and robustness checks across twelve alternative specifications.

The principal quantitative findings are: the three endogenous variables are integrated of order one; the system contains at least one and plausibly two cointegrating relations; FDI is the principal error-correcting variable, with loading coefficients of −8.45 on the first cointegrating relation and −0.86 on the second; the dynamic transmission is asymmetric, running predominantly from GDP and HHCPI to FDI rather than the reverse; macroeconomic shocks account for a non-trivial and rising share of FDI forecast error variance, reaching approximately 11% at the five-year horizon; and the qualitative findings on FDI adjustment are robust to the inclusion or exclusion of conditioning variables under the rank-2 specification.

7. Treasury Implications

7.1 Country Risk Monitoring

The findings highlight the importance of country-risk monitoring for treasury professionals. Sovereign risk affects funding conditions, investor confidence, bank liquidity and corporate borrowing costs (Kouretas, 2019; Kizys & Tzimas, 2021). The 10-year Greek government bond yield is therefore not only a government-finance indicator but also a relevant treasury signal.

Treasurers should incorporate sovereign spreads, credit-rating developments, bond-yield movements and market volatility into their risk dashboards. These indicators can help firms assess refinancing risk, debt-pricing conditions and the timing of capital-market transactions (Deloitte Finance, 2020; Kouretas, 2019).

7.2 Funding and Capital Structure

Macroeconomic stability influences the cost and availability of funding. When the investment environment improves and sovereign risk declines, firms may benefit from lower funding spreads and better access to longer-term financing. Conversely, instability can increase borrowing costs and reduce market access (Kouretas, 2019; Kizys & Tzimas, 2021).

Corporate treasurers should therefore align funding strategies with macro-financial conditions. This includes decisions on fixed versus floating-rate debt, maturity profiles, refinancing windows, bank diversification and capital-market access (Deloitte Finance, 2020).

7.3 Liquidity and Cash-Flow Planning

Price-level pressures and crisis episodes can affect working capital, supplier terms, inventory costs and receivables. A less stable macroeconomic environment requires stronger liquidity buffers and more frequent stress testing (Deloitte Finance, 2020; Daboe et al., 2022).

Treasurers should assess how shocks to GDP, prices and financing costs could affect operating cash flows. This is particularly relevant for companies exposed to energy costs, imported inputs, floating-rate debt or cyclical demand (Deloitte Finance, 2020; Daboe et al., 2022).

7.4 Hedging and Risk Management

The report's findings support the need for active hedging and scenario analysis. Price-level shocks, interest-rate volatility and sovereign-risk movements can affect corporate balance sheets and cash flows (Kizys & Tzimas, 2021; Deloitte Finance, 2020).

Relevant treasury tools include interest-rate hedging, foreign-exchange hedging, energy-price hedging, inflation-linked contract clauses and liquidity stress testing. The objective is not to eliminate all risk, but to reduce exposure to shocks that could disrupt funding, margins or investment plans (Deloitte Finance, 2020).

7.5 Strategic Investment Decisions

FDI trends can serve as a signal for broader investment confidence. Strong and persistent FDI inflows may indicate improving country perception, better financing conditions and stronger growth expectations. Weak or volatile FDI may indicate uncertainty or sector-specific fragility (Crnogorac-Kremenović et al., 2020; Ereppo & Yavuz, 2023).

Corporate treasurers and CFOs can use FDI developments as part of strategic planning. This includes decisions on capital expenditure, M&A, supply-chain location, regional treasury structures and long-term financing (Crnogorac-Kremenović et al., 2020; Ereppo & Yavuz, 2023).

8. Policy and Market Recommendations

8.1 Recommendations for Policymakers

To sustain FDI momentum, Greece should continue to strengthen macroeconomic credibility and institutional predictability. Foreign investors value stability, transparency and consistency. Policy uncertainty can increase required returns and delay investment decisions (Cesinger et al., 2022; Harlow, 2017).

Key priorities include:

- Maintaining fiscal credibility and debt sustainability (European Commission, 2022; Paraskevas, 2018).
- Ensuring a stable and predictable tax framework (Bhutiani, 2017).
- Accelerating licensing, permitting and judicial procedures (European Commission, 2022).
- Strengthening institutional efficiency and regulatory consistency (European Commission, 2022; Cesinger et al., 2022).
- Supporting infrastructure, digital transformation and energy transition (Hellenic Republic Ministry of Coordination and Government, 2021).
- Reducing administrative uncertainty for long-term investors (European Commission, 2022).
- Encouraging productive, export-oriented and innovation-driven FDI (World Bank, 2020; Harlow, 2017).

The objective should not be merely to increase the volume of FDI, but to improve its quality and long-term contribution to productivity, employment and resilience (World Bank, 2020; Paraskevas, 2018).

8.2 Recommendations for Financial Institutions

Financial institutions can support FDI by improving access to financing, developing risk-sharing products and strengthening the link between foreign investors and domestic firms (Stein & Hallahan, 2018; Harlow, 2017).

Banks and capital-market participants should focus on:

- Long-term project financing.
- Green and transition finance.
- Supply-chain finance.
- Export-oriented corporate financing.
- Risk-management solutions for interest rates, FX and energy prices.

- Financing structures that support infrastructure and strategic investment.

A deeper and more diversified financial system can improve Greece's ability to attract and retain productive foreign capital (Stein & Hallahan, 2018; World Bank, 2020).

8.3 Recommendations for Corporate Treasurers and CFOs

Treasurers and CFOs should integrate macroeconomic indicators into treasury planning. FDI, GDP, bond yields and price-level indicators can all provide useful signals for funding, liquidity and risk management (PwC Greece, 2018).

Recommended practices include:

- Building treasury dashboards that monitor sovereign yields, spreads, inflation indicators and FDI trends.
- Running stress tests based on interest-rate, country-risk and price-level shocks.
- Diversifying funding sources across banks, capital markets and alternative instruments.
- Maintaining adequate liquidity buffers during periods of macro uncertainty.
- Reviewing hedging policies regularly.
- Aligning capital expenditure plans with macro-financial conditions.

For treasury teams, macroeconomic stability is not just a background condition. It is a direct driver of funding capacity, risk exposure and strategic flexibility (PwC Greece, 2018; Stein & Hallahan, 2018).

8.4 Considerations for Foreign Investors

Foreign investors should evaluate Greece through both macroeconomic and sector-specific lenses. Greece offers opportunities in energy, tourism, logistics, infrastructure, real estate, technology and services. However, investment decisions should account for sovereign risk, regulatory conditions, price-level dynamics and external shocks (Cesinger et al., 2022; Harlow, 2017).

A disciplined investment approach should include:

- Assessment of country-risk indicators.
- Sector-level demand analysis.
- Financing-cost scenarios.
- Regulatory and tax-risk evaluation.
- Stress testing for energy, inflation and interest-rate shocks.
- Evaluation of exit and refinancing conditions.

Investors with a long-term horizon may benefit from Greece's improving macroeconomic profile, but risk management remains essential (European Commission, 2022; Hellenic Republic Ministry of Coordination and Government, 2021).

9. Strategic Outlook for Greece

Greece has moved from a period of crisis stabilization toward a new phase of investment repositioning. The key challenge is to transform improved confidence into sustained, productive and diversified investment (Aires & Sommer, 2022; Agur, Celasun & Liu, 2022).

The medium-term outlook depends on several positive factors: continued fiscal credibility, improved infrastructure, energy-transition opportunities, stronger tourism, logistics development, digitalization and the country's strategic location in Southeastern Europe and the Eastern Mediterranean (Aires & Sommer, 2022; Bain & Company, 2022).

However, risks remain. Persistent inflationary pressures, geopolitical uncertainty, high interest rates, slow reform implementation, climate risks and external demand shocks could weaken investor confidence (Fitch Ratings, 2023; Agur, Celasun & Liu, 2022). Greece's ability to maintain macroeconomic stability will therefore remain central to its FDI prospects (Fitch Ratings, 2023).

A scenario-based view can be summarized as follows:

Scenario	Description	Implication for FDI
Upside	Strong growth, lower sovereign risk, reform continuity	Higher and more diversified FDI inflows
Baseline	Gradual stabilization, moderate growth, selective reforms	Stable but selective FDI
Downside	Renewed shocks, higher yields, policy uncertainty	Delayed or weaker FDI inflows

The baseline outlook is that Greece remains attractive but selective as an investment destination (Aires & Sommer, 2022; Bain & Company, 2022). The upside case depends on reform continuity and institutional reliability. The downside case would be triggered by renewed macroeconomic stress or deterioration in policy credibility (Fitch Ratings, 2023; Agur, Celasun & Liu, 2022).

10. Limitations

The findings should be interpreted with appropriate caution. The report uses aggregate macroeconomic data, which cannot fully capture sectoral differences in FDI. Investment in real estate, energy, infrastructure, tourism, logistics or technology may respond to different economic drivers and risk factors.

The HCPI Index is used as a price-level indicator rather than as a direct measure of inflation. Consequently, the results should be interpreted as reflecting relationships between FDI and broader price-level conditions rather than the direct impact of inflation rates on investment decisions.

The 10-year government bond yield serves as a proxy for sovereign risk and market confidence. Although widely used in macro-financial analysis, it does not capture all dimensions of country risk. Institutional quality, political stability, regulatory effectiveness, taxation, governance structures and geopolitical developments may also influence foreign investment decisions.

The Greek economy experienced several major structural disruptions during the period under examination, including the sovereign debt crisis, the COVID-19 pandemic and the energy-price shock. While crisis dummy

variables were incorporated into the analysis, these events may have introduced structural changes that are difficult to capture fully within a single econometric framework.

In addition, foreign direct investment decisions are influenced by a broad range of factors beyond the variables included in the model. Sector-specific opportunities, labour-market conditions, technological developments, international capital-market conditions and investor sentiment may affect investment behaviour but are not explicitly modelled in the present study.

The diagnostic tests indicate some evidence of residual autocorrelation and non-normality, suggesting that the model may not fully capture all dimensions of the underlying data-generating process. Although robustness checks support the overall conclusions, the estimated relationships should be interpreted as indicative rather than definitive.

Finally, the econometric results provide evidence of dynamic relationships, long-run equilibrium linkages and adjustment mechanisms rather than strict structural causality. Therefore, the findings should be interpreted as demonstrating how FDI interacts with Greece's macroeconomic environment rather than establishing direct cause-and-effect relationships.

11. Conclusion

This report examined the relationship between FDI and macroeconomic stability in Greece from a treasury and investment-risk perspective over the period 2002-2024. Using a time-series framework that incorporated GDP, the Consumer Price Index, sovereign risk indicators and major crisis episodes, the analysis explored how FDI interacts with Greece's broader macroeconomic environment.

The empirical findings indicate that FDI is meaningfully connected to key macroeconomic conditions in Greece. The evidence supports the existence of a long-run equilibrium relationship between FDI, economic activity and price-level conditions, suggesting that foreign investment flows do not evolve independently of the country's macroeconomic fundamentals. The results further indicate that FDI participates in the adjustment process when the system deviates from its long-run equilibrium, highlighting the dynamic interaction between investment behaviour and macroeconomic conditions.

The analysis also demonstrates the importance of sovereign risk and crisis periods in shaping the investment environment. Episodes such as the sovereign debt crisis, the COVID-19 pandemic and the energy-price shock altered financing conditions, investor confidence and risk perceptions. These findings reinforce the view that foreign investment decisions are closely linked to broader macro-financial stability and the ability of the economy to absorb and manage external shocks.

At the same time, the results suggest that the relationship between FDI and macroeconomic variables is complex. While the evidence supports dynamic associations and long-run linkages, it does not provide strong evidence of direct short-run predictive causality. This finding indicates that foreign investment decisions are influenced not only by macroeconomic conditions but also by institutional, regulatory, political and sector-specific factors that extend beyond the scope of the present model.

From a treasury perspective, the findings have important practical implications. Macroeconomic stability influences funding costs, liquidity management, refinancing conditions, risk exposure and long-term investment planning. Sovereign risk indicators, price-level developments and FDI trends can therefore provide valuable information for treasury professionals, CFOs, financial institutions and investors when assessing financial risk and strategic opportunities.

For policymakers, the results highlight the importance of maintaining a stable and predictable economic environment. Fiscal credibility, institutional effectiveness, regulatory consistency and resilience to external

shocks remain essential conditions for sustaining investor confidence and supporting productive long-term investment.

Overall, the findings suggest that FDI should be viewed not only as a source of external capital but also as an indicator of international confidence in Greece's economic prospects. The evidence points to a close interaction between foreign investment and macroeconomic stability, while emphasizing that sustainable investment attraction ultimately depends on a broader combination of economic performance, institutional quality and policy credibility. Future research may further enhance understanding of these relationships by incorporating institutional, governance and sector-specific variables that were beyond the scope of the present study.

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