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A BEHAVIORAL ANALYSIS OF MACROECONOMIC, FINANCIAL AND SOCIO-ECONOMIC VARIABLES BEFORE AND AFTER THE INTRODUCTION OF COMMON CURRENCY IN EUROPE

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ABSTRACT

This article extensively examines the consequences of the Euro's introduction as a common currency in Europe on diverse macroeconomic, financial, and socioeconomic aspects. By utilizing a GARCH model, it assesses the real effective exchange rate's volatility and its impact on economic growth in select European nations. The study also scrutinizes variable convergence across member states using cross-sectional standard deviations, drawing from monthly and annual data spanning 1970 to 2014. Results underscore a significant reduction in average inflation and exchange rate volatility post-Euro adoption, accompanied by diminished fluctuations in cross-country standard deviations. Fixed-effects analysis unveils a shift from a negative to a positive relationship between real effective exchange rate volatility and economic growth post-Euro. Overall, findings suggest widespread benefits for most participating member countries from the Euro's implementation.

Keywords: Words: *Exchange rate volatility, European Monetary Union, Optimum Currency Area, European Systems of Central Bank, Exchange Rate Mechanism*

INTRODUCTION

The idea of establishing a common currency among groups of nations has long been associated with the goal of enhancing economic integration and improving living standards (Mundell, 1961) This vision was conceptualized through the Optimum Currency Area (OCA) theory, notably introduced by the eminent monetary economist Robert Mundell. Building on this foundation, the European Monetary Union (EMU) was established on January 1, 1999, guided by the principles of the OCA theory. The EMU sought to unify the economies of its member states across three distinct stages of policy convergence. The scope of this integration encompasses 19 Eurozone nations and additional non-European Union countries.

Following more than fifty years of endeavor, the Euro emerged as the common currency within the EMU. Eleven countries, including Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain, transitioned from their respective national currencies to the Euro. The introduction of the Euro ushered in several anticipated advantages, including the mitigation of exchange rate volatility, a surge in trade activity among EMU members, reduced currency transaction costs, inflation moderation, and fortified economic and fiscal integration.

While previous studies have predominantly focused on assessing the stability and convergence of macroeconomic indicators

among EMU member countries, this research diverges by undertaking a comprehensive analysis of pre- and post-Euro adoption dynamics. Specifically, the study hones in on macroeconomic, financial, and socioeconomic variables. A central inquiry guiding this analysis revolves around the fundamental question of whether countries benefit from participating in the EMU or incur the cost of ceding their monetary autonomy.

A central theme of debate in the literature centers on the EMU's role in economic and monetary integration, a discourse often tied to unresolved questions within the theory of the optimum currency area. Drawing upon data spanning from 1970 to 2014, which encapsulates both 29 years preceding EMU entry and 15 years following, this study seeks to ascertain the net advantages or potential drawbacks of embracing a common currency.

Structured within a tripartite analysis framework, the study unfolds as follows: First, it examines the average performance of pivotal macroeconomic, financial, and socioeconomic indicators both before and after the Euro's introduction. Second, the study assesses alterations in cross-country standard deviations of these indicators, tracing shifts before and after EMU participation. Finally, the research delves into the influence of exchange rate volatility on economic growth in pre- and post-Euro eras.

The study meticulously examines the average growth of essential macroeconomic, financial, and socioeconomic indicators within Eurozone countries though descriptive statistics. Subsequently, it delves into an analysis of the dispersion of economic, financial, and socioeconomic indicators that occurs after the introduction of the shared currency by comparison of cross sectional standard deviation CSSD. Additionally, the study investigates the impact of exchange rate volatility on economic growth subsequent to the adoption of the common currency with the help of GARCH model.

2. Review of Literature

The Optimum Currency Area (OCA) framework, pioneered by (Mundell, 1961), has spurred extensive research into the implications of economic and monetary unions. This body of work, encompassing divergent outcomes, enriches our comprehension of the advantages and challenges inherent in such unions. This comprehensive literature review critically assesses key research traversing the OCA theory landscape, shedding light on its impact on monetary unions. (Bayomi, et al., 1997)delve into the fundamental implications of OCA theory, particularly its link to exchange rate performance. Contrary to common expectations, they find that most economies do not experience benefits from participating in monetary unions. A notable exception is France, where benefits are attributed more to political backing than purely economic factors.

Economists (Dellas, et al., 2009) contribute significantly by addressing pivotal concerns within the OCA framework. They underscore the earlier proposition of the OCA concept by Friedman in 1960 and scrutinize the foundational assumptions underpinning Mundell's work. Their rigorous analysis reveals the limited real-world applicability of these assumptions, as they rely on partial equilibrium models. Consequently, they deem Mundell's work paradoxical.

(Broz, et al., 2005) conduct a comprehensive analysis drawing insights from (Mundell, 1961) , (Mickinnon, 1963) (Kenen, 2010). They dissect traditional and contemporary perspectives on OCA theory, emphasizing the enduring relevance of Mundell's ideas, especially within the European Monetary Union context. Their conclusion highlights the absence of a universal criterion for countries' participation in monetary unions, stressing the importance of context-sensitive considerations.

(Mongelli, et al., 2002) review the four phases of OCA theory, concluding that entering a currency union involves limited costs that can be mitigated by optimizing net benefits. This perspective underscores the need to strike a balance between costs and gains during monetary integration. (Horvath, et al., 2003) embark on a comprehensive cost-benefit analysis of fixed and flexible exchange rate regimes within the OCA framework. Their findings advocate for fixed exchange rate regimes in small, open economies with diverse factors of production and geographical integration.

(Mickinnon, 1963) enriches Mundell's concepts by clarifying the dual interpretation of factor mobility—within countries and industries. This distinction adds depth to the exploration of OCA principles. (Krugman, 2013) introduces a critical perspective, asserting that Euro integration is primarily driven by political motives, sidelining considerations of economic integration. He highlights that the validity of OCA theory hinges on its ability to elucidate constraints, cautioning against potential detrimental consequences if these constraints are overlooked.

Shifting focus to empirical studies on the European Monetary Union (EMU), this review underscores their impact on economic convergence. These studies span various aspects, including inflation, GDP, and monetary policy, unveiling the intricate dynamics of the EMU's effects on member nations. (Ashok, et al., 2006)scrutinize the European Monetary System (EMS) using yearly data from six EMU countries spanning 1973 to 1990. Their findings cast doubts on the extent of post-EMS harmonization, indicating a lack of significant convergence.

(Barbara, et al., 2012) delve into inflation rates across listed European countries, revealing multifaceted inflation determinants beyond monetary policy. Employing panel data analysis from January 1996 to December 1998, their study offers nuanced insights. (Lane, 2006) explores the intricate relationship between inflation, GDP, and trade share within selected EMU countries. Analyzing panel data from 1999 to 2004, Lane's study suggests a correlation between reduced inflation rates and an increased share of nondomestic equity, hinting at the potential impact of deeper economic integration on monetary policy uniformity across EMU nations.

In conclusion, these seminal research papers collectively deepen our understanding of OCA theory and its intricate dimensions within monetary unions. Despite divergent conclusions, they collectively illuminate the multifaceted nature of economic integration through the OCA framework. Additionally, they offer valuable insights into the European Monetary Union's complexities and its implications for economic convergence. This intricate body of research contributes to a more comprehensive understanding of economic integration dynamics in the context of monetary unions.

3. Methodology

3.1 t-test and F-test

$$t = \frac{\bar{X}_{i,PRE} - \bar{X}_{i,POST}}{\sqrt{\frac{S^2_{i,PRE}}{N_{PRE}} + \frac{S^2_{i,POST}}{N_{POST}}}} \quad \text{..... (3.1)}$$

Where, T is the test statistic that will be compared with the tabulated value, $\bar{X}_{i,PRE}$ is the average of desired variable X for country i before the introduction of common currency, $\bar{X}_{i,POST}$ is the average of desired variable X for country i after the introduction of common currency, $S^2_{i,PRE}$ is the variance of desired variable X for country i before the introduction of common currency, $S^2_{i,POST}$ is the variance of desired variable X for country i after the introduction of common currency in Europe. The test is carried out for all sixteen economic, financial and social variables for eleven European countries.

In the same way, to compare the volatility in the economic, financial and social variables before and after the introduction of common currency in Europe, simple F-test has been employed.

$$F = \frac{S^2_{i,PRE}}{S^2_{i,POST}} \quad \text{..... (3.2)}$$

Where, $S^2_{i,PRE}$ is the variance of the desired variable before the introduction of common currency in Europe, and $S^2_{i,POST}$ is the variance of the desired variable after the introduction of common currency in Europe.

3.2 Comparison of CSSD

Cross Sectional Standard Deviation (CSSD) is the standard deviation for eleven European countries, calculated for each year. We compare the CSSD of variables and examine that whether deviation of key indicators increases or decreases after joining EMU. (Busetti, et al., 2007) In order to compare dispersion in the growth rate of the variables across the member countries decreased before and after the joining of common currency we used following formula:

$$CSSD_t = \left[\sum_{i=1}^{11} \frac{(X_{i,t} - \bar{X}_t)}{n-1}\right]^{1/2} \quad \text{.....} \quad (3.3)$$

Where, $CSSD_t$ is the cross-sectional standard deviation calculated for time period t, $X_{i,t}$ is the desired variable of country i in time period t, $\bar{X}_t$ is the average of the desired variable calculated for time period t and i is used for the eleven European countries joined EMU.

Following the empirical models of (Barrell, et al., 2009) , (Jakob, 2016) and (Habib, et al., 2016), we constructed subsequent model. However, some independent variables are different from the model they have proposed. Equation 3.4 represents the impact of unconditional volatility in real effective exchange rate on GDP per capita. In the same way, equation 3.5 represents the impact of conditional volatility in real effective exchange rate on GDP per capita.

3.3 Econometric Model

$$LGDPPC_t = \alpha + \beta_1 LGDPPC_{t-1} + \beta_2 LKLR_t + \beta_3 TO_t + \beta_4 FDIR_t + \beta_5 VER_t + \beta_6 (D \times VER_t) + \varepsilon_t \quad \text{.....} \quad (3.4)$$

$$LGDPPC_t = \alpha + \beta_1 LGDPPC_{t-1} + \beta_2 LKLR_t + \beta_3 TO_t + \beta_4 FDIR_t + \beta_5 CVER_t + \beta_6 (D \times CVER_t) + \varepsilon_t \quad \text{.....} \quad (3.5)$$

Where, $LGDPPC_t$ is the logarithmic value of GDP per-capita at time period t, $LKLR_t$ is the logarithmic value of capital labor ratio at time period t, TO_t is the trade openness at time period t, $FDIR_t$ is the ratio of foreign direct invest to GDP at time period t, VER_t is the unconditional volatility in exchange rate at time period t measured through the standard deviation of the monthly exchange rates in the year t, and D is the dummy variable having value 1 if country joined the common currency and 0 otherwise. Equation 3.5 is regressed by using the measure of volatility in exchange measured through GARCH model. The variable $CVER_t$ represents the conditional volatility in exchange rate measured through GARCH model. The interaction term β_6 will indicates that if after joining the common currency exchange rate volatility has different impact on the logarithmic value of GDP.

The above-mentioned equations 3.4 and 3.5 are estimated for all countries separately who have joined Euro on January 1, 1999. Along with this we also estimated the equation by using the panel data. The equation that we will estimate is as follow:

$$LGDPPC_{it} = \alpha_i + \beta_1 LGDPPC_{i,t-1} + \beta_2 LKLR_{it} + \beta_3 TO_{it} + \beta_4 FDIR_{it} + \beta_5 CVER_{it} + \beta_6 (D \times CVER_{it}) + \varepsilon_{it} \quad \text{.....} \quad (3.6)$$

$$LGDPPC_{it} = \alpha_i + \beta_1 LGDPPC_{i,t-1} + \beta_2 LKLR_{it} + \beta_3 TO_{it} + \beta_4 FDIR_{it} + \beta_5 CVER_{it} + \beta_6 (D \times CVER_{it}) + \varepsilon_{it} \quad \text{.....} \quad (3.7)$$

Where, $LGDPPC_{it}$ is the logarithmic value of GDP per-capita of country i at time period t, $LKLR_{it}$ is the logarithmic value of capital labor ratio for country i at time period t, TO_{it} is the trade openness of country i at time period t, $FDIR_{it}$ is the ratio of foreign direct invest to GDP of country i at time period t, VER_{it} is the unconditional volatility in exchange rate of country i at time period t measured through the standard deviation of the monthly exchange rates in the year t, and D is the dummy variable having value 1 if country joined the common currency and 0 otherwise. Equation 3.7 is regressed by using the measure of volatility in exchange measured through GARCH model. The variable $CVER_{it}$ represents the conditional

volatility in exchange rate measured through GARCH model. The interaction term β_6 will indicate that if after joining the common currency exchange rate volatility has different impact on the logarithmic value of GDP.

$$\Delta X_t = \gamma X_{t-1} \sum_{j=1}^{p} (\delta_j \Delta X_{t-j}) + e_t$$

$$\Delta X_t = \alpha + \gamma X_{t-1} + \sum_{j=1}^{p} (\delta_j \Delta X_{t-j}) + e_t$$

$$\Delta X_t = \alpha + \beta t + \gamma X_{t-1} + \sum_{j=1}^{p} (\delta_j \Delta X_{t-j}) + e_t \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3.8)$$

We also employed tests developed by Im, Pesaran and Shin to check the unit root in the panel data. Unit root is tested through the following equation:

$$X_{it} = \rho_i X_{i,t-1} + \sum_{i=1}^{\rho t} \emptyset_{i,1} \Delta X_{i,t-1} + \alpha_i d_{it} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (3.9)$$

Here d_{it} is deterministic component, $\rho_i = 0$ indicates that y has unit root process for individual I while $\rho_i < 0$ indicates that X is stationary around the deterministic part.
Similarly, Hausman Test has also been used to distinguish among random effect model and fixed effect model in pooled regression.

3.4 Generalize Autoregressive Conditional Heteroscedasticity (GARCH) Model.
An important generalization of ARCH model is the GARCH model introduced by Bollerslev (1986). This model is weighted averages of previous square of residuals but here the weights are declining which never became zero.

4. Data
In empirical investigation, data of important economic, financial and socioeconomic variables has been studied. Our sample goes from 1960 to 2014.Annual data for unemployment, inflation rate, GDP per capita, GDP growth, and gross domestic savings, trade, population, conditional exchange rate volatility and unconditional exchange rate volatility has been used. The study employed monthly data from of industrial production, exports, imports, international reserves, gold reserves (in Euro valuation), nominal effective exchange rate and real effective exchange rate (1989M01-2014M04).
The data sources are International Financial Statistics (IFS), World Developmental Indicators (WDI), and European Central Bank (WCB). The data was taken for eleven European countries. These eleven countries are chosen for analysis because these countries join European Monetary Union on January 1, 1999. List of all those countries which included in this study and details of currencies before joining European Monetary Union is provided in table 4.1

3.4 Unit Root Tests
Before the estimation of above-mentioned equations, we tested unit roots by employing Augmented Dickey-Fuller (ADF) test for the time series data. Dickey and Fuller consider following three differential-forms of autoregressive equations to identify the occurrence of unit root.

Table 4.1 List of Countries with their currencies before Euro

Country Name	Currency code	Currency Before EMU
Austria	ATS	Schilling
Belgium	BEF	Belgian Franc
Finland	FIM	Finnish Markka
France	FF	French Franc
Germany	DM	Deutsche Mark

Ireland	IEP	Irish Punt
Italy	TRY	Lira
Luxembourg	LUF	Luxembourg Franc
Netherland	PTE	Escudo
Portugal	IPA	Dutch Guilder
Spain	ESP	Esp

Source: Author's own work

Table 4.2 List of Variables

Variable Name	Category	Abbreviation
Central Government Debt	Macroeconomic	DEBT
Consumer Price Index	Macroeconomic	CPI
Exports of Goods and Services (Constant)	Macroeconomic	EXPOC
GDP at market prices (constant 2010 US$)	Macroeconomic	GDPC
GDP per Capita (constant 2010 US$)	Macroeconomic	GDPPCC
Gross Fixed Capital Formation (% of GDP)	Macroeconomic	GFCGDP
GDP Growth	Macroeconomic	GGDP
Gross Domestic Saving	Macroeconomic	GDS
Imports of Goods and Services (Constant)	Macroeconomic	IMPOC
Industrial production	Macroeconomic	IP
Inflation	Macroeconomic	INF
Labor Force Total	Macroeconomic	LF
Unemployment	Macroeconomic	UNEMP
Trade (% of GDP)	Macroeconomic	TRA
Nominal Effective Exchange Rate	Financial	NEER
Real effective Exchange rate	Financial	REER
Foreign Direct Investment (% of GDP)	Financial	FDI
International Reserves	Financial	IR
Gold (Euro system Valuation)	Financial	GEU
Unemployment	Socioeconomic	UNEMP
Population	Socioeconomic	POP

Source: Author's own work.

5. Results and Results Discussion

The establishment of the European Monetary Union (EMU) in 1992 was a natural progression from the European Monetary System (EMS), as European countries continued their commitment to economic integration. The primary goals were to foster a united Europe, facilitate enhanced cooperation, bolster trade flows, and mitigate economic disparities among nations. By creating a common currency and unified monetary policy, the EMU aimed to deepen unity and stability, symbolizing a shared commitment to a cohesive and prosperous European identity.

5.1 Comparison of Variables before and after the introduction of common currency

The analysis focuses on the impact of joining the European Monetary Union (EMU) on various macroeconomic, financial, and socioeconomic variables for countries that adopted the common currency on January 1, 1999.

The study employs a range of statistical tests and descriptive measures to investigate the changes in these variables before and after the introduction of the Euro. Initially, the study examines the changes in the mean and standard deviations of selected variables before and after joining the EMU. By comparing average growth rates, the researchers aim to discern any patterns in how these variables behave post-Euro adoption. Additionally, the study

investigates the dispersion of these variables through standard deviations.

The analysis starts by employing the F-test to determine whether a t-test with equal variances or unequal variances should be used. The results of the F-test indicate that the variances of variables before and after the common currency introduction are not the same, prompting the use of t-tests with unequal variances.

The study examines various variables, starting with industrial production. Descriptive statistics reveal that, on average, the growth rate of industrial production is higher before 1999 compared to after for most countries, except Ireland. Standard deviation analysis indicates increased industrial production variation for some countries, including Austria, Belgium, and Italy, while others, like Finland and France, exhibit decreased variation after joining the EMU.

Next, inflation rates are analyzed. On average, inflation decreases for all countries after joining the EMU. Standard deviation analysis shows that inflation variability is higher before joining the common currency and decreases post-adoption, indicating greater stability in inflation rates.

The study then focuses on export growth rates. On average, exports decrease for the chosen European countries after joining the EMU. However, their standard deviation also decreases, indicating more stable export performance following Euro adoption.

A similar pattern emerges for import growth rates. Average imports are higher before 1999, decreasing after joining the common currency. Standard deviation analysis shows that import growth rate variability is higher before the EMU and decreases after joining, reflecting increased stability in trade.

Growth rate of GDP is another key variable studied. Average GDP growth rates are higher before joining the EMU, while they decrease after. Variation in GDP growth rate varies by country, with some showing higher standard deviations before EMU and others after. This implies that the outcomes of joining the EMU differ among countries.

Gross domestic saving growth rates are also assessed. Some countries experience increased saving growth rates after joining the EMU, while others experience decreases. The standard deviation of growth rate of domestic saving decreases after joining the EMU for most countries, indicating greater stability in saving rates.

Government debt is a critical factor, and results reveal varied outcomes. For some countries, like Austria and Germany, government debt increases post-1999, while for others, such as Luxembourg and Portugal, it decreases. Standard deviation analysis indicates reduced government debt variation after the EMU for most countries.

Trade is another vital area studied. Standard trade of almost all countries improves significantly after joining the EMU. The standard deviation of trade decreases for most member states, indicating increased stability in trade.

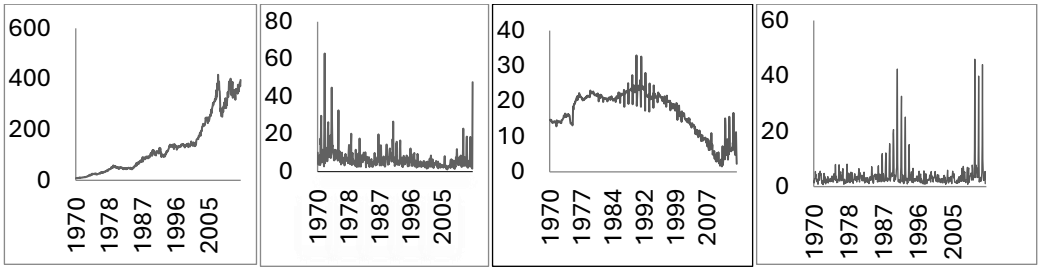
GDP per capita growth rates show a consistent pattern of decrease after joining the EMU. Standard deviation analysis shows variation in GDP per capita growth rates increases for some countries before Euro adoption, but decreases after, indicating greater stability.

Overall, the study's results indicate that growth rates for most variables decline after joining the EMU. Additionally, variation in growth rates decreases after the common currency's introduction, highlighting greater stability in macroeconomic variables. The analysis provides insights into the effects of the EMU on various aspects of member countries' economies, shedding light on both common trends and unique country-specific outcomes.

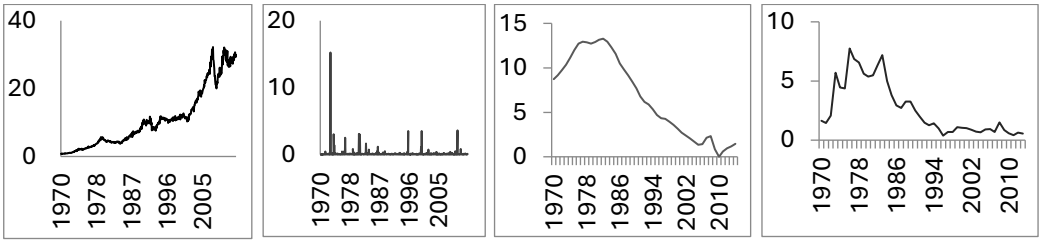
5.2 Comparison of Convergence of Variables

Figure 5.1: CSSD of Macroeconomic Variables of Euro-Zone Countries

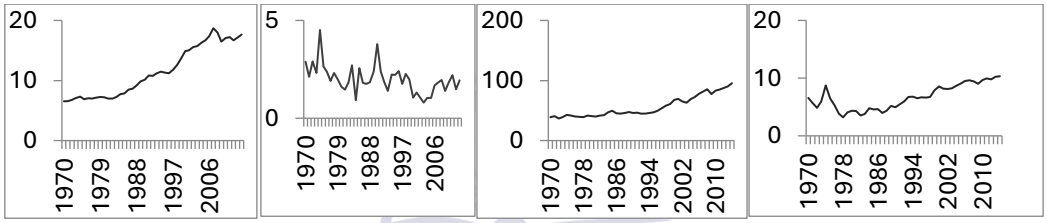
a. CSSD of Exports b. CSSD of Gr. Exports c. CSSD of IP (Index) d. CSSD of Gr. IP



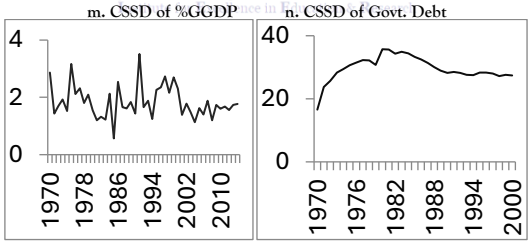
e. CSSD of Imports f. CSSD of Gr. Imports g. CSSD of CPI h. CSSD of Inflation



i. CSSD of GDP/Capital j. CSSD of GGDP/Capital k. Trade (% GDP) l. CSSD of CDS



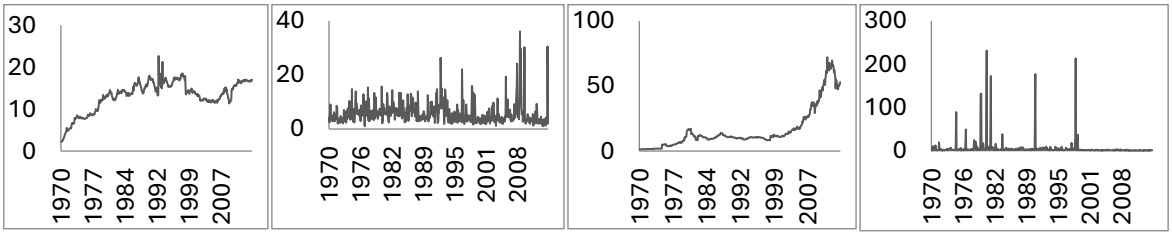
m. CSSD of %GGDP n. CSSD of Govt. Debt



Source: Author's own calculations

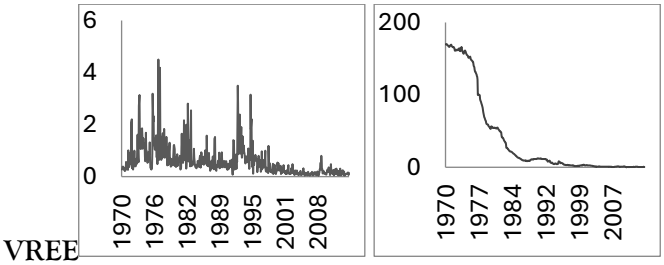
Figure 5.2: CSSD of Financial Variables of Euro-Zone Countries

a. CSSD of IR b. CSSD of GIR c. CSSD of Gold in Euro d. CSSD of Gr. Gold in Euro

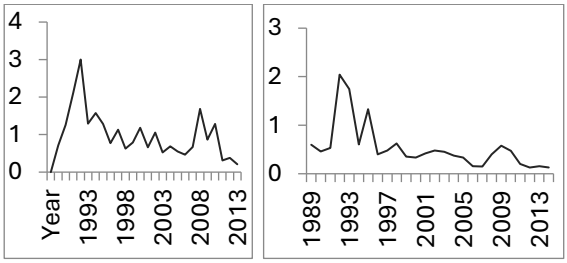


Source: Author's own calculation

e. CSSD of NEER f. CSSD of GNEER g. CSSD of CVREER h. CSSD of



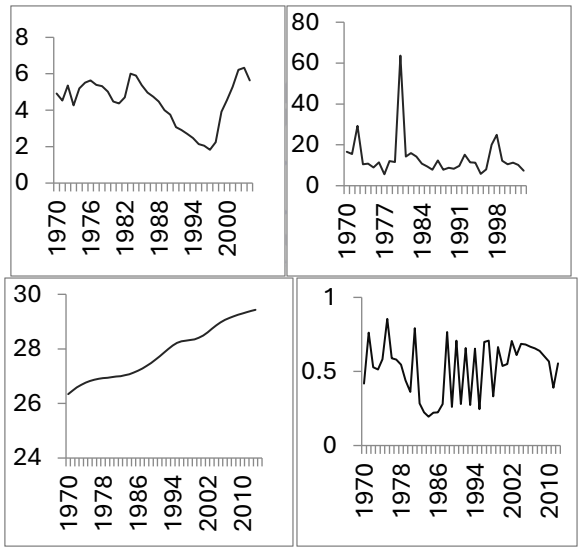
VREE



Source: Author's own calculations

Figure 5.3: CSSD of Socioeconomic Variables of Euro-Zone Countries

CSSD of UNM b. CSSD of GUNM c. CSSD of POP d. CSSD of GPOP



Source: Author's own calculations

6.Summary and Conclusion

In 1992, the European Monetary Union (EMU) was established with the aim of integrating European economies and achieving objectives such as exchange rate stability, price level uniformity, and enhanced economic coordination. This initiative brought about advantages like reduced currency transaction costs, lowered exchange rate risks, and increased price transparency. However, there were also costs involved, including loss of monetary independence and coordination challenges. To understand the implications, macroeconomic and financial variables were examined using hypothesis testing.

The results of the analysis indicate a general increase in trade among member countries after adopting the common currency. However, the behavior of other macroeconomic variables varied among the member countries. Notably, countries like Germany and France experienced greater increases in these indicators, while Ireland, Portugal, and Spain saw comparatively lower increases. The examination of cross-

sectional standard deviation (CSSD) revealed a consistent decline in variability across various macroeconomic, financial, and socioeconomic variables after the common currency introduction. Exchange rate volatility and inflation also decreased notably for member countries.

Overall, the study has significant policy implications not only for the EMU but also for other potential currency unions. It underscores the importance of aligning relative prices when establishing a common currency and highlights that the benefits and costs of such a union are not uniform across all member countries. These findings provide valuable guidelines for both developed and developing economies considering joining a common monetary policy. It's crucial for countries interested in joining or leaving a monetary union to assess their own unique costs and benefits, as the outcomes of a common currency endeavor can differ widely based on specific circumstances.

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