Trade Turbulence in the Eurozone: The Impact of Economic Integration and Currency Unification on Cross-Border Volatility

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Abstract

In this paper, I explore how joining the European Union and adopting the EURO as the official currency affects cross-border trade volatility. This study employs trade metrics such as imports and exports as percentages of GDP and in constant 2015 US dollars, alongside recent real GDP per capita data, to identify correlations and study patterns. The findings reveal that adopting the euro and EU membership increased trade volatility, particularly for imports (% of GDP) within the eurozone. These results shed light on the complex relationship between economic integration, currency unification, and trade dynamics, offering insights into the potential challenges of enhanced economic interdependence.

Keywords: European Union; Euro currency; Trade volatility; Imports and exports; Economic integration

1 Introduction

On February 7, 1992, the Maastricht Treaty was signed in Maastricht, Netherlands. The treaty, now officially referred to as the Treaty on European Union laid the foundations for the European Union (EU). The Maastricht Treaty was the product of years of discussions between European governments and finally came into force on November 1, 1993, serving as one of the most ambitious economic and political unions in modern history to foster integration, economic growth, and political cooperation and support amongst its member states. One of the cornerstones of the Maastricht Treaty was the advent of the euro, a single currency that has been adopted by 20 of the 27 EU member states, introduced in 1999. The geographic region that encompasses the euro is currently referred to as the eurozone or the Economic and Monetary Union (EMU). The euro was designed to eliminate exchange rate fluctuations, lower transaction costs, and enhance price transparency, attempting to spur intra-European trade and strengthen the region's economic cohesion.

One of the main factors of the EU's success and the euro's success is cross-border trade as member states rely on open markets and seamless exchange policies. However, similar to all other regions, trade is inherently subject to volatility- fluctuations in the value and volume of goods and services exchanged between countries over a specific period, influenced by factors such as economic conditions, policy conditions, and market dynamics. Trade volatility is a crucial concept because it directly affects economic stability, business planning, and global market dynamics. Additionally, fluctuations in trade can disrupt regional supply chains, alter investment decisions and strategies, and pose a threat against governments attempting to mantain a stable economy.

Despite the importance of trade stability, previous research has not thoroughly examined the effects of EU membership and euro adoption on cross-border trade volatility, particularly in developed versus developing member states. This paper addresses this gap by analyzing the impact of joining the EU and adopting the euro on trade volatility, using standard deviations of trade data before and after membership. Key metrics include percentage changes in exports and imports as a share of GDP and in constant USD, analyzed about each member state's GDP. Correlation methods will also explore the relationship between GDP per capita and trade volatility, providing insights into how economic development influences changes in trade stability.

1 Literature review

The introduction of the euro in 1999 has ignited significant academic interest over the role of the currency and how it has impacted economic growth, exports, overall economic stability, and its comparison to different currencies.

In the short period after the emergence of the euro, the Eurozone lacked the integration and flexibility required in 2004 to be an optimal currency area, demonstrating a "rigidity trap" of

monetary consolidation and fiscal policy that slows labor markets. (Silvia and Stephen, 2015). Past research indicates that five years after the introduction of the euro there were economic benefits such as low interest rates and low inflation; however, it did not outweigh costs and did not serve as a catalyst for growth as perceived. Instead, the primary function of the euro was to politically unify the countries of the Eurozone rather than being based on a clear economic-benefit analysis. (Rich, Georg). In the decade following the advent of the euro, research shows the move to a single currency in 1999 was a success, establishing the euro as a major international currency and increasing the credibility of the European Central Bank (ECB). Although the EMU's first decade was generally seamless, the current economic downturn has exposed different vulnerabilities across member states, prompting fears about potential tensions. However, the euro's historical endurance and mutual benefits imply that a stronger union may emerge, reflecting the United States' shift toward federalism in reaction to crises (Buti, Marco, and Paul van den Noord). Furthermore, as published in December 2009, the euro had made progress challenging the role of the dollar as a store of value. However, findings suggest that the dollar remained the superior currency because of its incumbency advantages and the issues within the coordination of the Eurozone (NORRLOF, CARLA). Additionally, studies indicated that by 2012, the euro had not produced the anticipated level of economic stability, with academics blaming the failure on the difficulties of enforcing a single currency on a diverse group of nations. Sovereign debt crises, weak banks, high unemployment, and significant trade deficits were among the negative economic effects, which together fueled instability inside the eurozone (Martin Feldstein). Past studies have also focused on the Greek debt crisis. Researchers had come to the conclusion in 2013 that intervention was necessary to manage unsustainable policies and correct past shortcomings. Ultimately, academics posited that investment in income-generating assets, as opposed to temporary loans, was essential to lifting Greece and also other southern European countries out of recession and maintaining economic stability (DARVAS, ZSOLT). Additional research in 2013 showcased the push for financial centralization remained contentious because of political resistance and worries of sovereignty continued to highlight the imbalance between economic and national independence (Smith, Roy C). Furthermore, researchers went beyond the scope of the effect of the euro on the Eurozone as whole and focused on individual regions as well. Latvia, for example, after joining the Euro had an impact on price differences where notable price differences between Germany collapsed significantly, supporting the Eurozone’s ultimate goal of price harmonization (CAVALLO, ALBERTO). In 2015, a study discovered that varying monetary policies and economic recoveries influenced the global use of the euro, leading to a rise in demand for debt denominated in euros and a change in foreign investment toward assets with higher yields (European Central Bank). Next, studies found in 2016 found that adopting the euro indirectly

causes economic growth in Eurozone countries by sparking a process between financial growth, debt, and improved fundamentals, which non-euro members lack. However, statistics show there are risks with over-borrowing, as seen in post-2008 when high debt countries' economic downturns due to the reversal of this growth cycle (Kalaitzoglou, Iordanis, and Beatrice Durgheu). In addition, studies in 2018 focused on the euro's effect on systemic growth. Researchers concluded that the euro had not prompted systemic growth and the growth rate of the Eurozone is comparable to those of non EU countries such as the UK, Sweden, and Denmark and did not outperform countries like Canada, Switzerland, and Australia. Overall adopting the euro did not provide any clear economic advantage in terms of economic growth, as the Eurozone's growth rate was relatively similar or lower than many control group economies concluded from data (Ioannatos, Petros E). Furthermore, recent research in 2021 focused on the euro's economic stability and also its resilience throughout several crises since the 1990s. The research concluded that the euro has been more resilient than previously thought, with increasing public support and enhanced economic stability following the 2008-2013 crises. However, fresh obstacles from the epidemic persist, and future adjustments to strengthen the eurozone's resilience face persistent difficulty in reaching a consensus. (Lane, Philip R). As the pandemic became a significant issue in the early 2020s, research has focused on its impact on the euro in comparison to other currencies. Academics discovered that to strengthen the euro's international significance, Europe requires a strategic growth strategy centered on post-crisis recovery, which includes significant green expenditures. It also discovered that a European COVID-19 recovery program is required to avoid a long-term economic downturn, with green bonds and investments critical to increasing the euro's appeal to international investors (Claeys, Grégory, and Guntram B. Wolff).

While previous research has focused on topics such as trade, economic growth, stability, its role in comparison to other countries, and its response to crisis, in my paper I am going to research if there are any long-term implications of the creation of the European Union in 1993 and the advent Euro in 1999 on cross-border trade volatility within the Eurozone and analyze if it correlates with the Gross Domestic Product (GDP) of EU member states.

This paper follows this format. The data and methodology are described in Section 3, which also includes the most recent GDP per capita statistics and the trade metrics that were utilized, such as imports and exports expressed as percentages of GDP and in constant 2015 US dollars. It describes how to find connections and examine trends in the volatility of commerce between EU and eurozone member states. The results are shown in Section 4, which focuses on imports (as a percentage of GDP) in the eurozone and describes how EU membership and adoption of the euro impact trade volatility. Along with discussing possible

contributory variables including economic integration and currency stabilization programs, this section also evaluates the ramifications of these patterns.

Data and Methodology

Data used in this study was sourced from the World Bank's Data Bank, using four major indicators: Exports of goods and services (% of GDP), Imports of goods and services (% of GDP), Exports of goods and services (constant 2015 US$), and Imports of goods and services (constant 2015 US$). The selected indicators provide a relative measure of trade concerning national output, as well as an absolute measurement of trade flows adjusted for inflation. In constant US dollars in the year 2015, this study allows for the comparison of trade volumes over different periods by accounting for the effects of inflation. These would also be relative measures, especially of exports and imports as shares of GDP, to abstract away the differences in economic size and hence make the analysis independent of the magnitude of the economy. On the other hand, absolute measures—exports and imports in constant 2015 US dollars—give a clearer view of the trade flows in nominal terms, adjusted for inflation. Taken together, these indicators give a broad view of the trade dynamics of each country and their relationship with European Union membership and the adoption of the euro. Trade data was collected for each country from the year preceding their membership in the EU or adoption of the euro to the latest available after their accession into the EU or introduction of the euro. This longitudinal data set will allow the examination of changes in the volatility of trade over time and thus allow a before-and-after analysis. To maintain the integrity of the dataset, missing data points were interpolated where necessary to achieve consistent time series across all variables. Outliers were detected and withdrawn from the data set. In a paper devoted to measuring trade volatility, the outliers would pose a great deal of harm as they disproportionately affected the measure of volatility and thereby distorted it. Absent data and anomalous values were treated cautiously to reduce potential biases related to data outliers.

The present paper looks at two distinct country groups:

The first group analyses the effect of EU membership on trade volatility. It comprises the following countries: Austria, Croatia, Cyprus, Czechia, Bulgaria, Romania, Poland, Estonia, Hungary, Latvia, Lithuania, Malta, Slovenia, the Slovak Republic, Sweden, and Finland (see Figure 1).

The next group of countries looks at the impact of euro adoption on trade volatility and includes Austria, Cyprus, Estonia, Finland, Latvia, Lithuania, Malta, Slovenia, and the Slovak Republic (Figure 2). The EU membership group contains countries that joined the EU at different times, while the euro adoption group looks at those that have adopted the euro. The

aim is to find out how the volatility of trade develops when countries take these major steps in integrating their economies.

The measure covers calculations of standard deviations for exports and imports as a share of GDP and as a constant of USD 2015, separately for the periods before and after EU accession and euro adoption. Finally, percentage changes in trade metrics were calculated using the formula x/y−1, where x represents the post-adoption value, and represents the pre-adoption value. This formula expresses the proportional increase or decrease in trade activity, offering a clear picture of how trade flows evolve following integration into the EU or adoption of the euro through the use of both descriptive and inferential statistical analyses, this research explores the patterns related to trade volatility while trying to establish a correlation with broader economic indicators, hence giving a wide perspective of the trade dynamics within the framework of EU membership and the eurozone.

Standard deviation is one of the widely used measures of volatility and indicates the spread of trade flows around the average and thus a level of trade stability or instability. In addition to standard deviations, a set of descriptive statistics was calculated including mean, median, standard deviation, minimum, and maximum trade volatility for both periods—before and after EU membership or euro adoption. This battery of measures allows a thorough understanding of both the central tendency and dispersion of the trade volatility data.

Furthermore, this paper examines the relationship between trade volatility and recent GDP per capita levels, measured in constant 2015 US dollars. Correlation analysis was performed to assess the degree to which higher levels of economic development, as measured by GDP per capita, are associated with greater trade stability.

Table 1

Country	Exports (% GDP)	Exports (constant USD)	Imports (% GDP)	Imports (constant USD)	GDP per-capita (most recent year)
Austria	1.698	2.196	1.292	1.727	56,856.12
Croatia	0.623	0.614	0.612	0.31	21,460
Czechia	0.668	2.021	0.055	1.352	30,427.42

Cyprus	0.495	0.836	0.916	1	34,701.44
Bulgaria	0.368	-0.736	-0.287	-0.747	15,797.60
Romania	0.978	2.874	-0.0735	2.569	18,419.42
Poland	1.387	3.457	0.238	2.698	22,112.86
Estonia	0.603	3	0.0345	2.432	29,823.75
Hungary	-0.48	1.399	0.587	1.015	22,147.21
Latvia	4.103	3.35	0.96482	2.191	23,184.31
Lithuania	1.285	3.945	0.97	2.924	27,102.78
Malta	-0.105	21.447	-0.266	13.984	37,882.27
Slovenia	0.198	2.15	0.444	1.125	32,163.51
Slovak Rep.	-0.072	3.133	-0.084	-0.084	24,470.24
Sweden	-0.141	2.287	0.0722	2.174	56,305.25
Finland	-0.199	2.118	1.004	2.666	53,755.91
Average	0.7130625	3.3806875	0.40493875	2.3335	31,663.12
Median	0.549	2.2415	0.341	1.9505	28,463.27

Std. Dev.	1.096590684	4.964819026	0.5107126859	3.288097991	13267.72009
Minimum	-0.48	-0.736	-0.287	-0.747	15,797.60
Maximum	4.103	21.447	1.292	13.984	56,856.12
Correlation	-0.1834440382	0.1412313652	0.3655353612	0.2266844015	

Table 2

Country	Exports (% GDP)	Exports (constant USD)	Imports (% GDP)	Imports (constant USD)	GDP per-capita (most recent year)
Austria	0.704	1.515	0.703	1.265	56856.12
Cyprus	0.641	0.716	1.018	0.778	34701.44
Estonia	0.0798	-0.106	-0.108	0.039	29823.75
Latvia	-0.553	-0.358	-0.295	-0.229	23184.31
Lithuania	-0.5756	0.146	-0.362	-0.098	27102.78
Malta	-0.684	4.66	-0.665	3.749	37882.27
Slovenia	0.062	0.709	0.177	0.3	32163.51
Slovak Rep.	-0.459	0.032	-0.365	-0.079	24470.24

Finland	-0.497	-0.232	0.447	0.235	53755.91
Average	-0.1424222222	0.7868888889	0.06111111111	0.6622222222	35548.92556
Median	-0.459	0.146	-0.108	0.235	32163.51
Std. Dev.	0.5358197686	1.567999477	0.5627213885	1.251434055	12159.61855
Minimum	-0.684	-0.358	-0.665	-0.229	23184.31
Maximum	0.704	4.66	1.018	3.749	56856.12
Correlation	0.3823603231	0.2581026559	0.5749188181	0.3500710199	

Results

When looking at the datasets, the apparent outcome is the fact that there is a significant correlation between GDP-per-capita and trade volatility as seen through the computerized correlation calculation which was positive for indicators except for exports (% of GDP) of the EU. The negative correlation between exports as a percentage of GDP and trade volatility within the EU can be explained by several EU-specific factors. First, EU member states have well-established, diversified trade relationships both within the single market and globally, which helps to lessen exposure to market-specific fluctuations. Internal to the EU is its internal market: free movement of goods, services, capital, and labor; this smooths out disruptions to trade flows within member countries and reduces the volatilities associated with those disruptions. EU countries that are higher exporters of GDP generally have relatively competitive high-value export sectors, such as advanced machinery, pharmaceuticals, and technology, that tend not to fluctuate as wildly as commodity-based exports. The underlying strength of EU institutional bodies, like the European Central Bank and the European Commission, provides a framework for coordinating fiscal and monetary policy that cushions negative external shocks, adding

stability to trade. An increased export-to-GDP ratio may often signal a situation in which EU member states are increasingly part of global value chains and thus much less susceptible to insulated disruptions. The combination of diversified and stable export sectors, strong institutions, and economic integration provides a comprehensive explanation of why higher export-to-GDP ratios can result in low trade volatility in EU countries.

The positive correlation between trade volatility and GDP per capita, especially the notably high correlation of 0.5749 with imports (% of GDP) in the Eurozone, suggests a range of factors reflecting the intricacies of economic integration and structural dynamics within the Eurozone. These findings are especially important when considering the EU and Eurozone datasets separately, as each offers unique insights into the broader patterns of trade volatility within the respective economic unions. The correlation in the Eurozone can be a result of greater openness of the economies, which naturally comes with removing trade barriers like tariffs and quotas-a consequence of EU and hence Eurozone membership. Being a part of such an economic union integrates the economies of the member states more deeply into the global economy, where trade flows are less constrained by domestic regulations. This increased openness can dramatically widen the exposure to international economic cycles, such as changes in demand for goods and services, financial crises, and sector-specific shocks in trading partners. Any significant change in this global economy will thus have a highly pronounced impact on trade flows in the Eurozone countries and hence a higher volatility of imports in terms of GDP. The relatively high sensitivity to external factors thus reflects greater integration with international trade dynamics of the Eurozone.

Moreover, comparative advantage-based specialization within the Eurozone may also serve to heighten the volatility of trade, especially in those industries where countries decide to concentrate their economic activities. Specialization contributes to the fact that countries of the Eurozone while being highly competitive in a particular industry, are more susceptible to industry-specific shocks. For example, in countries whose export base is highly concentrated in one or a few commodities or products, a change in world demand for that commodity will result in larger changes to trade patterns. Dependence on a narrow range of industries or products increases vulnerability to world price changes and economic shocks, increasing volatility in trade flows.

Another mechanism through which trade volatility arises is capital flow integration, as seen within the Eurozone. Eurozone membership promotes free movement of capital across member states hence stimulating economic growth and expansion of trade. On the other hand, integration of capital markets increases the economies' vulnerability to external financial crises since capital can quickly shift due to changes in the global economic environment. The high volatility of imports, which shares a high value of correlation in the Eurozone area, can be

related to the fact that financial crises or sudden changes in investment sentiments abruptly alter the demand for imports and increase trade volatility.

Trade volatility could also increase because of the rigid exchange rate regime enforced through the use of a single currency, the euro. Individual economies of the eurozone no longer can devalue their national currencies in the case of external shocks. While the euro removes the risk of exchange rate fluctuations within the Eurozone, it also removes the flexibility afforded by earlier exchange rate regimes. As a result, Eurozone economies become highly vulnerable when faced with asymmetric shock-for instance, a situation when one region witnesses a recession while other member states remain in growth there is limited currency devaluation as an instrument for adjusting trade imbalance situations, a potential cause for accentuated volatility, especially for imports.

Trade policy, as under the EU, that integrates uniform trade regulation and agreements also can be another contributor to heightened volatility. These converging policies could be disruptive to traditional trading relationships and trade flows, especially in the first years of membership, as countries get used to new trade agreements, external tariffs, and regulatory frameworks. These adjustments could lead to short-term disruptions that contribute to volatility in imports, especially where particular sectors are facing unexpected challenges or transitions in response to these policy changes. This in turn also amplifies trade volatility, while access to global markets and supply chains is facilitated by EU and Eurozone membership. Membership in the Eurozone allowed member countries to integrate deeper with global supply chains, which helped them export and import goods and services more efficiently. But the integration with global supply chains also makes a country vulnerable to disruptions in global supply chains, fluctuations in demand, and localized crises occurring outside the region. For example, natural disasters or geopolitical conflicts that disrupt important global supply chains can sharply alter the availability and price of imports, increasing trade volatility. Second, some of the observed volatility is due to measurement effects, particularly when imports are expressed as a percent of GDP. While trade volatility may therefore appear to increase even though the absolute fluctuation in imports does not change, the relative share of imports in GDP increases as trade volumes go up following membership.

The reason imports are so volatile about GDP may thus also be related to the increase in trade as a share of GDP after accession to the Eurozone. If trade is growing faster than GDP, the relative volatility of imports would appear magnified, even though the overall fluctuations in trade may not have changed significantly. Last, policy and institutional changes accompanying accession to EU and Eurozone membership may also create temporary trade disruptions and heightened volatility. Many economies, upon integrating into the EU's regulatory environment and adopting the euro, go through structural adjustments in their domestic economies. These

adjustments may cause short-term instability that may be manifested as heightened volatility of imports while businesses and markets adjust to new economic frameworks.

Therefore, it follows that high trade volatility in imports as a percentage of GDP with GDP per capita in the Eurozone could reflect an increasing economic openness, industrial specialization, integration of capital flows, rigid exchange rate, and also the harmonization of trade policy coupled with deeper participation in global supply chains. These dynamics collectively increase exposure to exogenous shocks and fluctuations, leading to higher trade volatility in the Eurozone. The findings bring out the complex trade-offs that come with deeper economic integration and highlight the challenges that the countries of the Eurozone face in managing trade volatility in a highly interconnected global economy.

Conclusion

Using GDP per capita data and imports and exports as percentages of GDP and in constant 2015 US dollars, this study examined the impact of EU membership and the use of the euro currency on trade volatility in order to find trends and connections. The results show that trade volatility is increased by EU membership and adoption of the euro, especially for imports (as a percentage of GDP) within the eurozone. These findings highlight the double character of economic integration: it increases economic interdependence and facilitates cross-border transactions, but it also increases vulnerability to internal market fluctuations and external economic shocks.

These results have wider implications for the literature on trade dynamics and economic integration that go beyond the purview of this investigation. They support continuing discussions over the compromises involved in regional unification, especially in the way that trade stability is affected by structural and policy changes. This article does not, however, identify the precise methods or causes of the observed rise in trade volatility, which is one of its drawbacks. According to the analysis, market specialization, trade policy changes, and exchange rate stabilization might all play a role, but more investigation is required to confirm these theories.

In order to identify the precise causes of elevated trade volatility, future research could expand on this study by using more detailed data, such as firm-level studies or sector-specific trade trends. Furthermore, comparing the reported volatility to that of non-EU or non-eurozone nations may shed light on whether it is specific to these areas or a component of a larger global trend.Furthermore, comparing the reported volatility to that of non-EU or non-eurozone nations may shed light on whether it is specific to these areas or a component of a larger global trend. A deeper comprehension of the long-term impacts of EU membership and euro adoption may also be possible by extending the temporal scope to encompass pre-accession and post-accession trade trends over a longer time span. In addition to addressing this paper's shortcomings, these

improvements would enhance knowledge of the intricate relationship between trade dynamics and economic integration.

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