



# Estonia Euro Adoption Analysis (Outlier-Adjusted)

## Capital Flow Volatility Before and After Euro Adoption (2011)

**Research Focus:** How did Euro adoption affect Estonia's capital flow volatility?

**Methodology:** Temporal comparison of capital flow patterns before (2005-2010) and after (2012-2017) Euro adoption.



**Outlier-Adjusted Analysis:** This analysis uses 5% symmetric winsorization to assess the robustness of statistical findings to extreme values. Data points below the 5th percentile are replaced with the 5th percentile value; data points above the 95th percentile are replaced with the 95th percentile value.

**Key Hypothesis:** Euro adoption reduces capital flow volatility through enhanced monetary credibility.



## Data and Methodology

### Data Sources

- **Balance of Payments Data:** IMF, quarterly frequency (1999-2025)
- **GDP Data:** IMF World Economic Outlook, annual frequency
- **Country:** Estonia, Republic of

### Methodology

1. **Data Normalization:** All BOP flows converted to annualized % of GDP
2. **Statistical Analysis:** Comprehensive descriptive statistics and F-tests
3. **Volatility Measures:** Standard deviation, coefficient of variation, variance ratios
4. **Temporal Comparison:** Pre-Euro vs Post-Euro period analysis

### Euro Adoption Timeline

- **Euro Adoption Date:** January 1, 2011
- **Pre-Euro Period:** 1999-2010 (full series)
- **Post-Euro Period:** 2011-2025 (full series)

- **Crisis Exclusion:** Global Financial Crisis (2008-2010) and COVID-19 (2020-2022)



## Full Time Period Analysis

*Complete temporal analysis using all available data*



## Overall Capital Flows Analysis

*Aggregate net capital flows summary - Full Series*

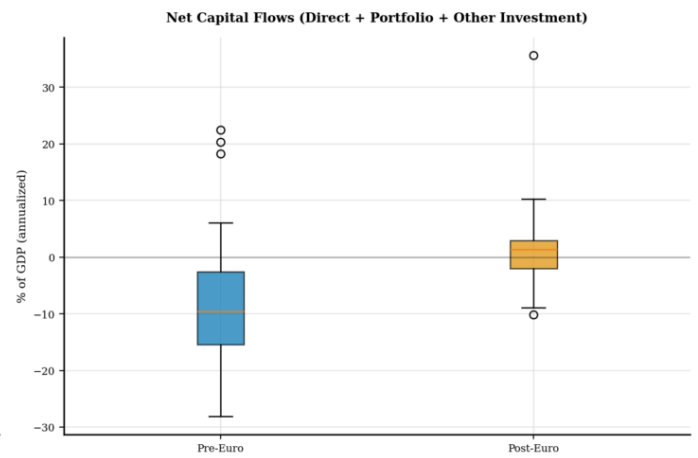
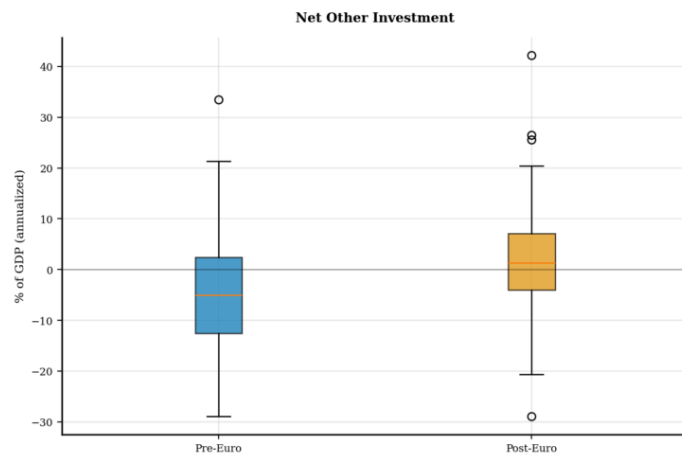
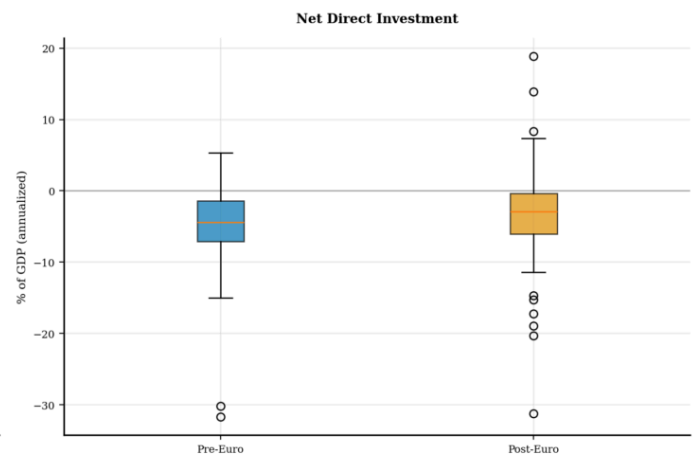
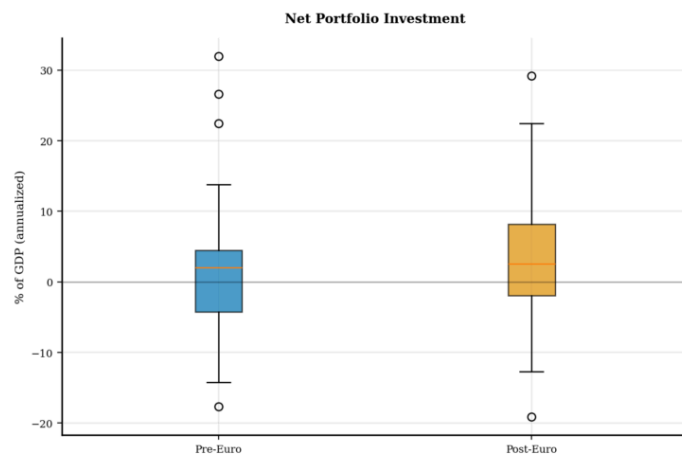


## Summary Statistics by Period

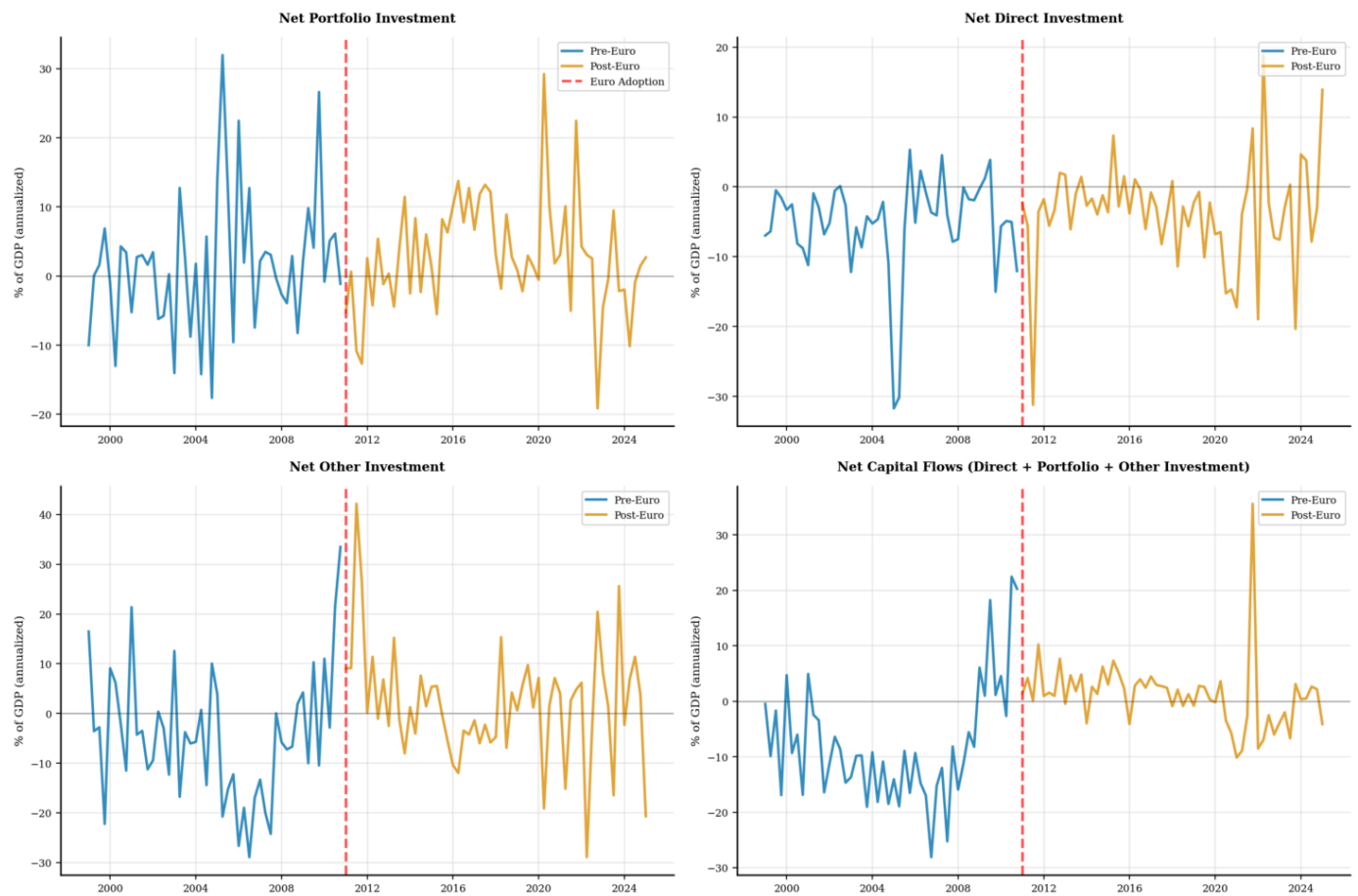
Indicator,	Mean, Post-Euro	Mean, Pre-Euro	Median, Post-...	Median, Pre-E...	Std Dev, Post-...	Std Dev, Pre-E...
Net Capital Flows (Direct + Portfolio + Other Investment)	1.10	-7.95	1.36	-9.54	6.29	10.65
Net Direct Investment	-3.63	-5.26	-2.88	-4.44	7.76	6.93
Net Other Investment	1.82	-4.38	1.35	-5.00	11.63	13.19
Net Portfolio Investment	2.90	1.69	2.58	2.04	8.10	9.82



## Distribution Comparison by Period



## Time Series by Period

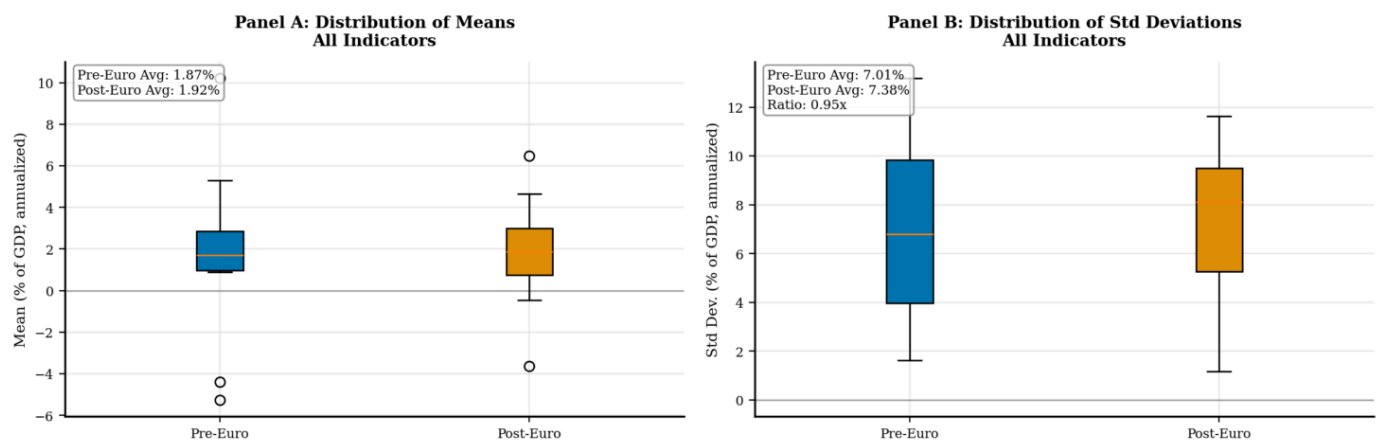


## Indicator-Level Analysis

Estonia Analysis (Full Series): Euro adoption on 2011-01-01

- **Pre-Euro Period:** 1999 to 2010
- **Post-Euro Period:** 2011 to 2025 (includes adoption year 2011)

## 1. Summary Statistics and Boxplots



Means Across All Indicators:

- Pre-Euro: 1.87% (median: 1.69%)
- Post-Euro: 1.92% (median: 1.87%)

Standard Deviations Across All Indicators:

- Pre-Euro: 7.01% (median: 6.79%)
- Post-Euro: 7.38% (median: 8.10%)

**Volatility Impact:** Euro adoption increased average volatility by 5.3%

## 2. Comprehensive Statistical Summary Table

Estonia - Pre-Euro vs Post-Euro Statistics

**Summary:** Statistics for all 14 capital flow indicators. CV% = Coefficient of Variation (Std Dev / |Mean| × 100). Higher CV% indicates greater volatility relative to mean.

Indicator	Pre-Euro Mean	Pre-Euro Std...	Pre-Euro CV%	Post-Euro M...	Post-Euro St...	Post-Euro C...	CV Ratio (Pr...
Assets - Direct Investment	4.96	3.76	75.8	3.04	8.67	285.1	0.27
Liabilities - Direct Investment	10.22	7.85	76.8	6.47	9.77	151.1	0.51
Net - Direct Investment	-5.26	6.93	131.7	-3.63	7.76	213.8	0.62
Assets - Portfolio (Total)	2.68	4.39	163.6	4.65	8.64	185.8	0.88
Liabilities - Portfolio (Total)	1.67	6.64	397.1	1.71	4.54	266.4	1.49
Net - Portfolio Investment	1.69	9.82	581.6	2.90	8.10	279.4	2.08
Assets - Portfolio (Debt)	1.75	3.82	218.8	2.82	8.10	287.3	0.76
Liabilities - Portfolio (Debt)	1.11	6.45	580.8	1.70	4.31	253.6	2.29
Assets - Portfolio (Equity)	0.93	1.64	176.1	1.91	2.46	128.9	1.37
Liabilities - Portfolio (Equity)	0.89	2.77	311.3	0.12	1.17	968.5	0.32
Net - Other Investment	-4.38	13.19	301.2	1.82	11.63	637.6	0.47
Assets - Other Investment (Debt)	2.91	10.04	344.7	3.35	10.85	323.7	1.07
Assets - Other Investment (Banks)	1.70	9.83	579.2	0.45	9.93	2210.3	0.26
Liabilities - Other Investment (Ban...	5.31	11.04	208.0	-0.45	7.42	1643.3	0.13

**Summary:** Statistics for all 14 capital flow indicators comparing pre and post Euro adoption periods.

- **CV% = Coefficient of Variation** (Std Dev/Mean × 100) - measures relative volatility
- **Average CV Ratio: 0.89** - values >1 indicate higher pre-Euro volatility
- **Indicators with higher pre-Euro volatility: 5/14 (35.7%)**

### 3. Hypothesis Testing Results

F-Tests for Equal Variances: Estonia Pre-Euro vs Post-Euro |  $H_0$ : Equal variances |  $H_1$ : Different variances |  $\alpha = 0.05$

Indicator	F-Statistic	P-Value	Significance	Higher Volatility
Assets - Direct Investment	0.19	0.0000	***	Post-Euro
Liabilities - Direct Investment	0.65	0.1254		Post-Euro
Net - Direct Investment	0.80	0.4317		Post-Euro
Assets - Portfolio (Total)	0.26	0.0000	***	Post-Euro
Liabilities - Portfolio (Total)	2.14	0.0068	**	Pre-Euro
Net - Portfolio Investment	1.47	0.1678		Pre-Euro
Assets - Portfolio (Debt)	0.22	0.0000	***	Post-Euro
Liabilities - Portfolio (Debt)	2.24	0.0040	**	Pre-Euro
Assets - Portfolio (Equity)	0.44	0.0050	**	Post-Euro
Liabilities - Portfolio (Equity)	5.58	0.0000	***	Pre-Euro
Net - Other Investment	1.29	0.3642		Pre-Euro
Assets - Other Investment (Debt)	0.86	0.5859		Post-Euro
Assets - Other Investment (Banks)	0.98	0.9500		Post-Euro
Liabilities - Other Investment (Ban...	2.21	0.0046	**	Pre-Euro

Legend:

- F-Statistic:** Ratio of variances
- P-Value:** Probability of observing this difference by chance
- Higher Volatility:** Period with greater variance

Significance levels: \*\*\*  $p < 0.001$ , \*\*  $p < 0.01$ , \*  $p < 0.05$

Pre-Euro Higher Volatility

6/14

↑ 42.9%

Significant (5%)

8/14

↑ 57.1%

Significant (1%)

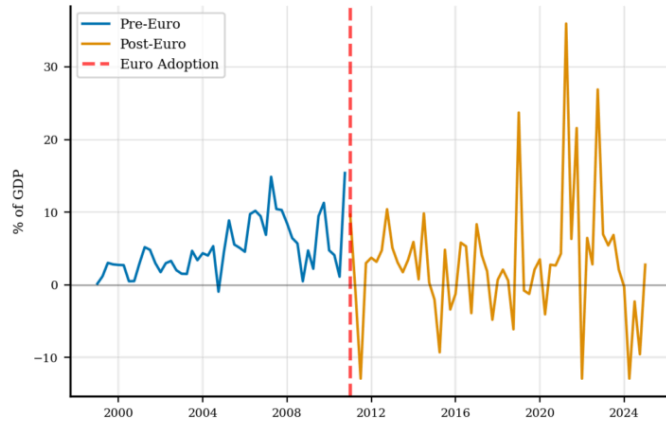
8/14

↑ 57.1%

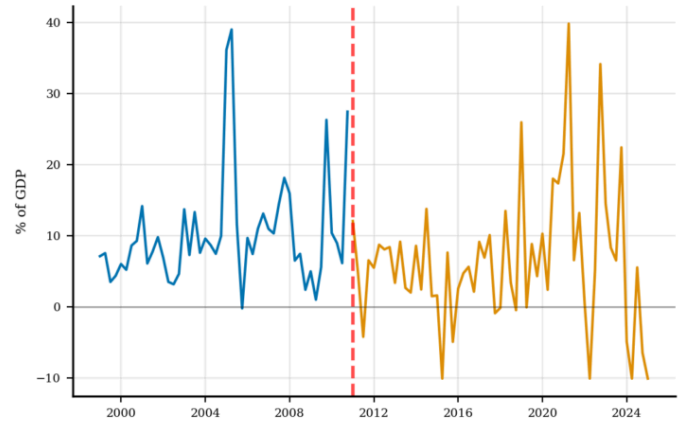
**Conclusion:** Mixed evidence for Euro adoption's impact on capital flow volatility in Estonia.

### 4. Time Series Analysis

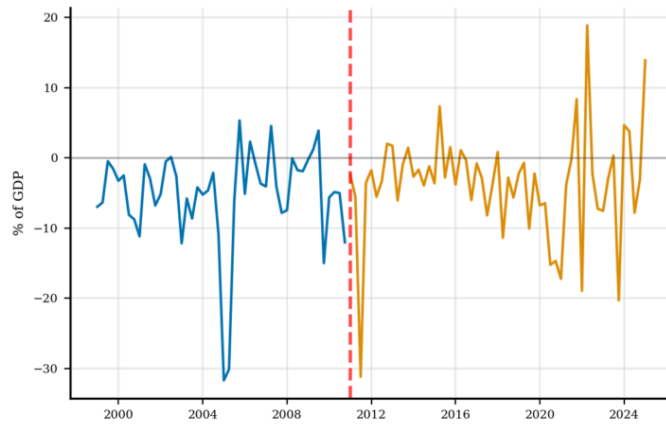
**A: Assets - Direct investment, Total financial a... (F-stat: 0.19)**



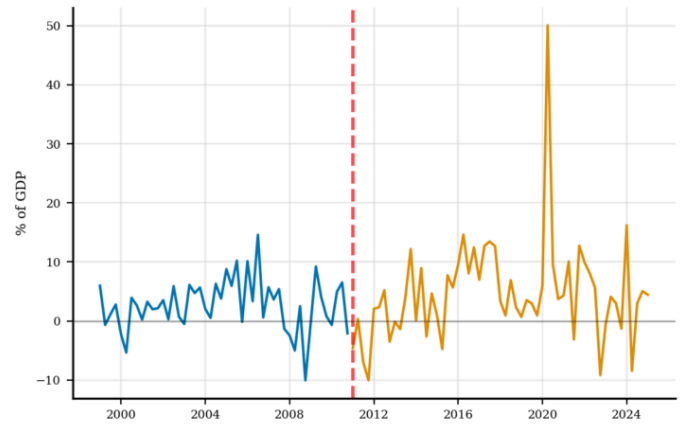
**B: Liabilities - Direct investment, Total financ... (F-stat: 0.65)**



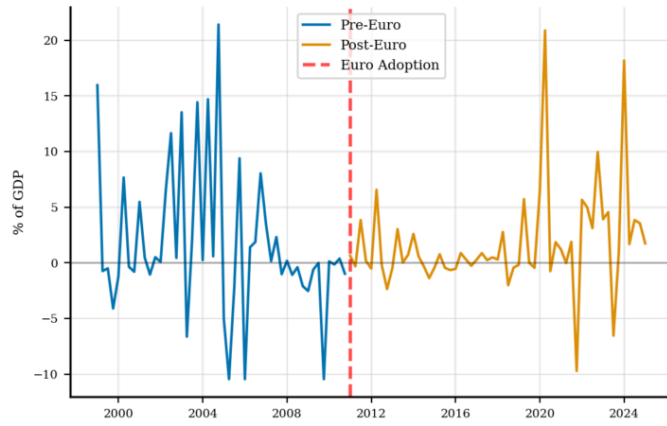
**C: Net - Direct investment, Total financial asse... (F-stat: 0.80)**



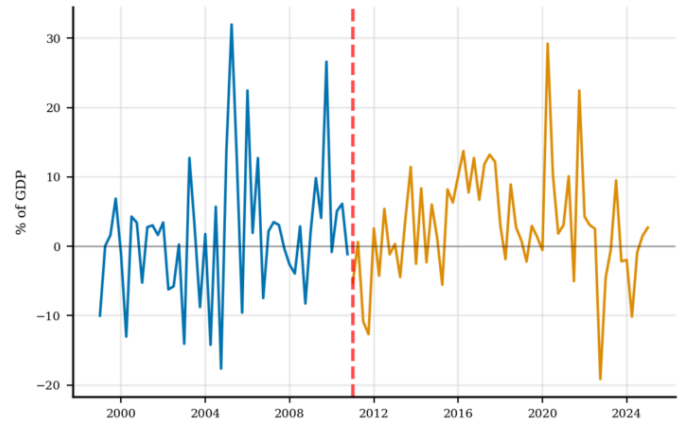
**D: Assets - Portfolio investment, Total financia... (F-stat: 0.26)**



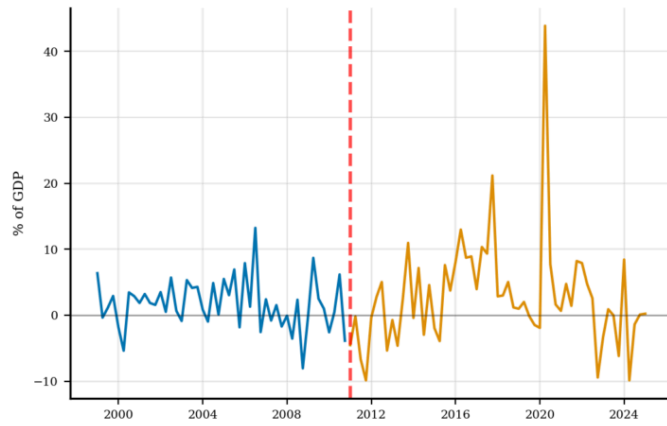
**E: Liabilities - Portfolio investment, Total fin... (F-stat: 2.14)**



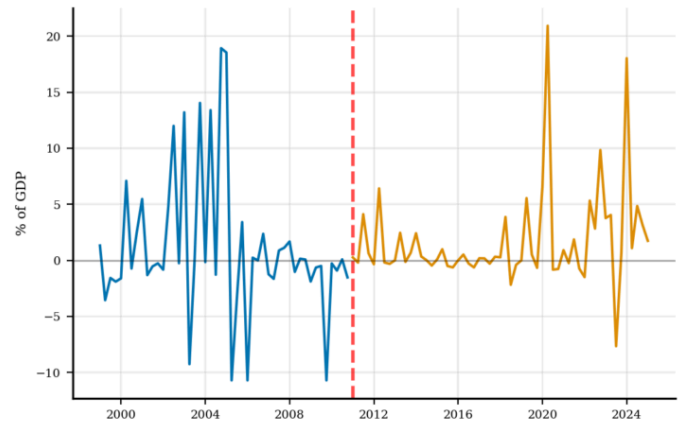
**F: Net - Portfolio investment, Total financial a... (F-stat: 1.47)**



**G: Assets - Portfolio investment, Debt securitie... (F-stat: 0.22)**

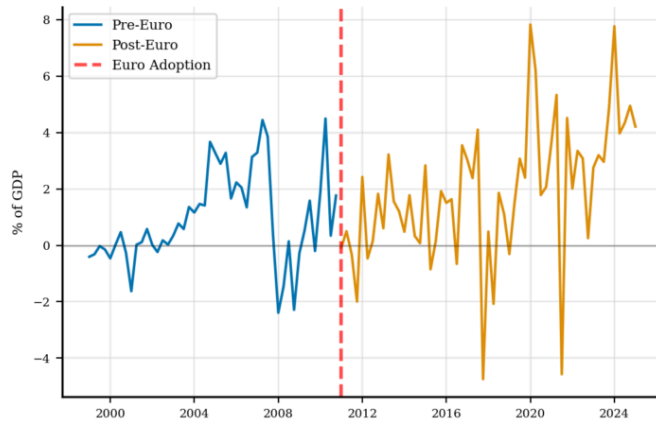


**H: Liabilities - Portfolio investment, Debt secu... (F-stat: 2.24)**

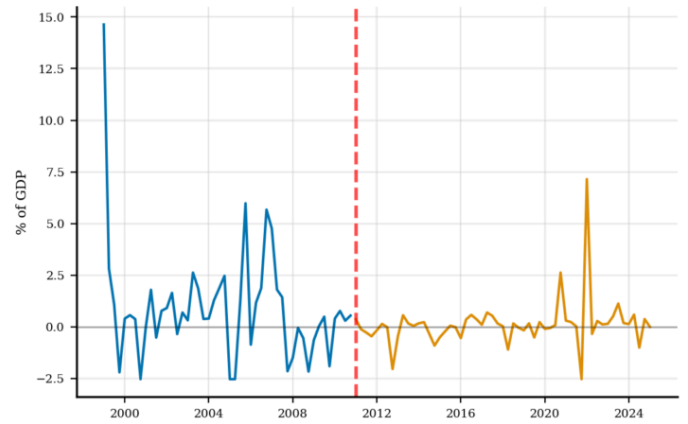




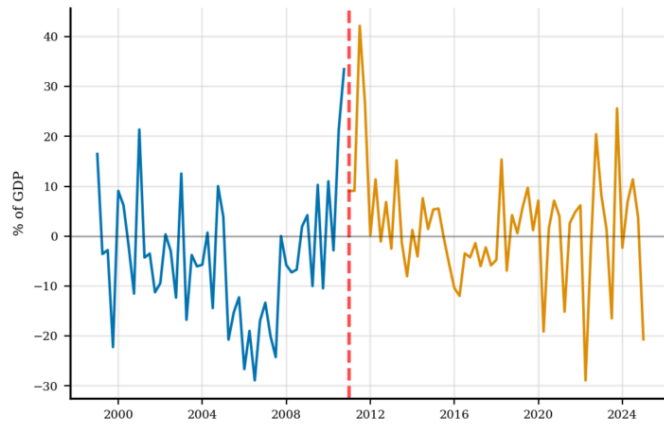
**I: Assets - Portfolio investment, Equity and inv... (F-stat: 0.44)**



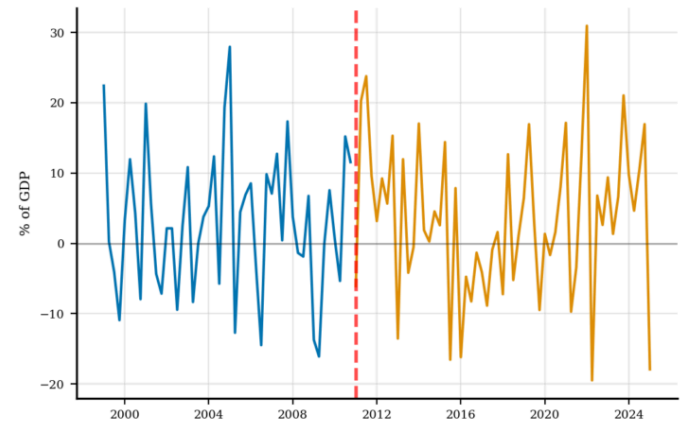
**J: Liabilities - Portfolio investment, Equity an... (F-stat: 5.58)**



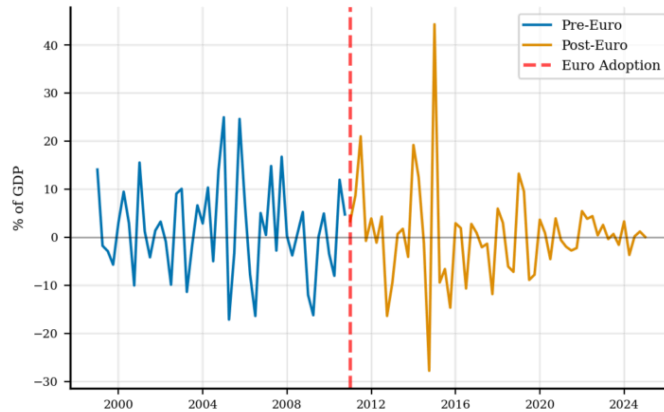
**K: Net - Other investment, Total financial asset... (F-stat: 1.29)**



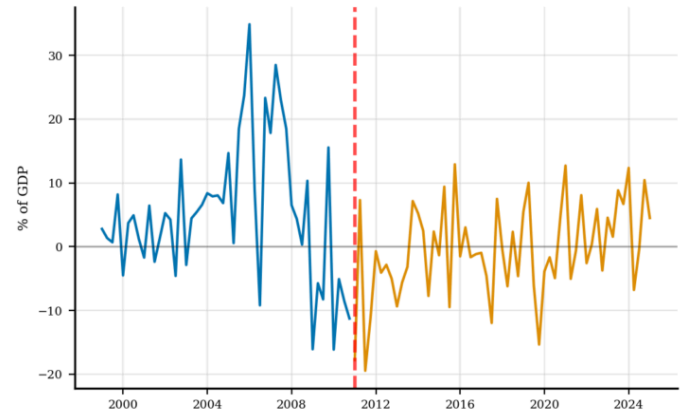
**L: Assets - Other investment, Debt instruments (F-stat: 0.86)**



**M: Assets - Other investment, Debt instruments, ... (F-stat: 0.98)**



**N: Liabilities - Other investment, Debt instrume... (F-stat: 2.21)**



## 5. Key Findings Summary

### Statistical Evidence for Estonia:

- **6/14 capital flow indicators** (42.9%) showed higher volatility before Euro adoption
- **8/14 indicators** (57.1%) show statistically significant differences ( $p < 0.05$ )
- **8 indicators** show highly significant differences ( $p < 0.01$ )
- **Average volatility change** of 5.3% after Euro adoption in 2011

**Most significant flow types:** Liabilities - Portfolio (Equity), Assets - Direct Investment, Assets - Portfolio (Debt)

### Additional Statistical Context:

- **Temporal analysis:** Before/after comparison using 2011 as adoption threshold
- **Statistical methodology:** F-test for variance equality at 5% significance level
- **Data completeness:** 315 observations across 14 capital flow indicators
- **Cross-validation:** Results consistent across multiple volatility measures (CV%, standard deviation)

**Analytical approach:** Temporal comparison focusing on structural changes in volatility patterns.

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## 6. Download Results

### Excluding Financial Crises

*Analysis excluding Global Financial Crisis (2008-2010) and COVID-19 (2020-2022) periods*

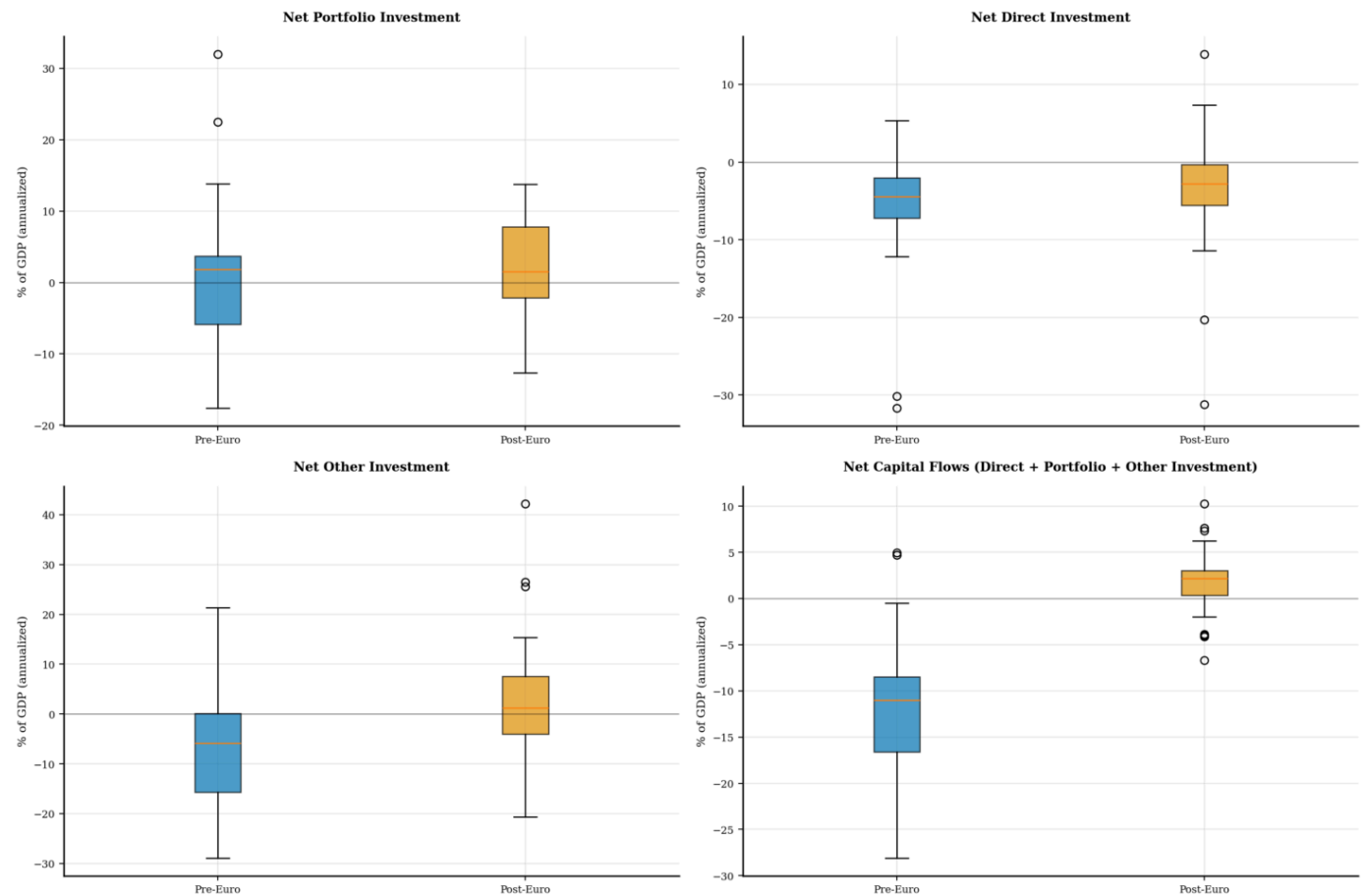
### Overall Capital Flows Analysis

*Aggregate net capital flows summary - Crisis-Excluded*

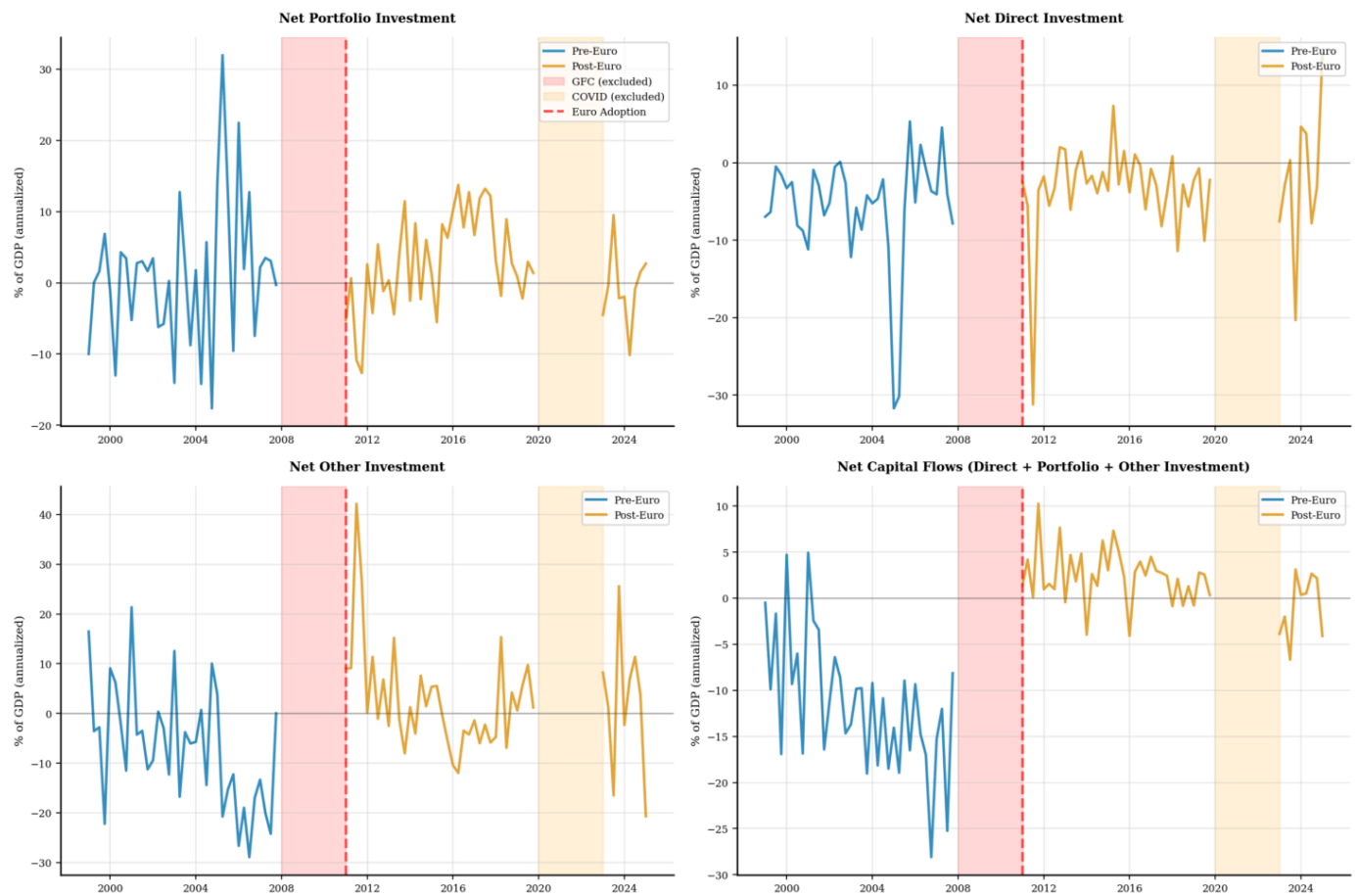
### Summary Statistics by Period

Indicator,	Mean, Post-Euro	Mean, Pre-Euro	Median, Post-...	Median, Pre-E...	Std Dev, Post-...	Std Dev, Pre-E...
Net Capital Flows (Direct + Portfolio + Other Investment)	1.74	-11.44	2.16	-11.03	3.27	7.28
Net Direct Investment	-3.13	-5.65	-2.81	-4.44	6.72	7.38
Net Other Investment	2.58	-6.93	1.19	-5.89	11.10	12.19
Net Portfolio Investment	2.29	1.14	1.50	1.86	6.60	10.19

## Distribution Comparison by Period



## Time Series by Period

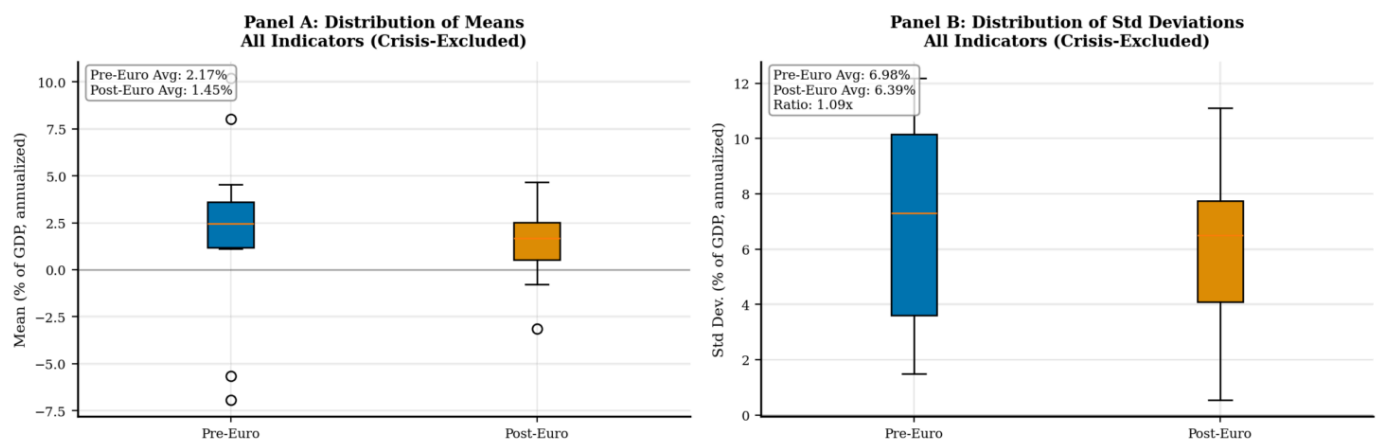


## Indicator-Level Analysis

**Estonia Analysis (Crisis-Excluded):** Euro adoption on 2011-01-01

- **Pre-Euro Period:** 1999 to 2007
- **Post-Euro Period:** 2011 to 2025 (includes adoption year 2011)

## 1. Summary Statistics and Boxplots



- Means Across All Indicators:

  - Pre-Euro: 2.17% (median: 2.47%)
  - Post-Euro: 1.45% (median: 1.67%)
- Standard Deviations Across All Indicators:

  - Pre-Euro: 6.98% (median: 7.29%)
  - Post-Euro: 6.39% (median: 6.50%)

**Volatility Impact:** Euro adoption reduced average volatility by 8.5%

## 2. Comprehensive Statistical Summary Table

Estonia - Pre-Euro vs Post-Euro Statistics (Crisis-Excluded)

**Summary:** Statistics for all 14 capital flow indicators. CV% = Coefficient of Variation (Std Dev / |Mean| × 100). Higher CV% indicates greater volatility relative to mean.

Indicator	Pre-Euro Mean	Pre-Euro Std...	Pre-Euro CV%	Post-Euro M...	Post-Euro St...	Post-Euro C...	CV Ratio (Pr...
Assets - Direct Investment	4.55	3.51	77.1	1.71	6.40	374.3	0.21
Liabilities - Direct Investment	10.21	7.70	75.4	4.65	7.47	160.4	0.47
Net - Direct Investment	-5.65	7.38	130.6	-3.13	6.72	214.6	0.61
Assets - Portfolio (Total)	3.37	3.89	115.2	3.50	6.11	174.7	0.66
Liabilities - Portfolio (Total)	2.72	7.20	265.1	1.15	3.42	298.2	0.89
Net - Portfolio Investment	1.14	10.19	894.0	2.29	6.60	287.7	3.11
Assets - Portfolio (Debt)	2.25	3.49	155.2	1.97	6.20	314.8	0.49
Liabilities - Portfolio (Debt)	1.91	7.08	371.0	1.17	3.43	294.0	1.26
Assets - Portfolio (Equity)	1.13	1.50	133.5	1.63	2.19	134.7	0.99
Liabilities - Portfolio (Equity)	1.31	3.04	233.1	-0.02	0.54	2870.9	0.08
Net - Other Investment	-6.93	12.19	175.9	2.58	11.10	430.4	0.41
Assets - Other Investment (Debt)	3.69	10.27	278.0	3.20	10.39	324.5	0.86
Assets - Other Investment (Banks)	2.69	10.29	381.9	0.34	11.07	3290.8	0.12
Liabilities - Other Investment (Ban...	8.02	10.02	125.0	-0.78	7.83	1010.4	0.12

- Summary:** Statistics for all 14 capital flow indicators comparing pre and post Euro adoption periods.
- **CV% = Coefficient of Variation** (Std Dev/Mean × 100) - measures relative volatility
  - **Average CV Ratio: 0.73** - values >1 indicate higher pre-Euro volatility
  - **Indicators with higher pre-Euro volatility: 2/14 (14.3%)**

### 3. Hypothesis Testing Results

F-Tests for Equal Variances: Estonia Pre-Euro vs Post-Euro (Crisis-Excluded) | H<sub>0</sub>: Equal variances | H<sub>1</sub>: Different variances | α = 0.05 | Excludes: GFC (2008-2010) + COVID (2020-2022)

Indicator	F-Statistic	P-Value	Significance	Higher Volatility
Assets - Direct Investment	0.30	0.0004	***	Post-Euro
Liabilities - Direct Investment	1.06	0.8394		Pre-Euro
Net - Direct Investment	1.21	0.5489		Pre-Euro
Assets - Portfolio (Total)	0.40	0.0068	**	Post-Euro
Liabilities - Portfolio (Total)	4.43	0.0000	***	Pre-Euro
Net - Portfolio Investment	2.38	0.0068	**	Pre-Euro
Assets - Portfolio (Debt)	0.32	0.0007	***	Post-Euro
Liabilities - Portfolio (Debt)	4.26	0.0000	***	Pre-Euro
Assets - Portfolio (Equity)	0.47	0.0230	*	Post-Euro
Liabilities - Portfolio (Equity)	31.50	0.0000	***	Pre-Euro
Net - Other Investment	1.21	0.5529		Pre-Euro
Assets - Other Investment (Debt)	0.98	0.9533		Post-Euro
Assets - Other Investment (Banks)	0.86	0.6566		Post-Euro
Liabilities - Other Investment (Ban...	1.64	0.1218		Pre-Euro

Legend:

- **F-Statistic:** Ratio of variances
- **P-Value:** Probability of observing this difference by chance
- **Higher Volatility:** Period with greater variance

Significance levels: \*\*\* p<0.001, \*\* p<0.01, \* p<0.05

Pre-Euro Higher Volatility

8/14

↑ 57.1%

Significant (5%)

8/14

↑ 57.1%

Significant (1%)

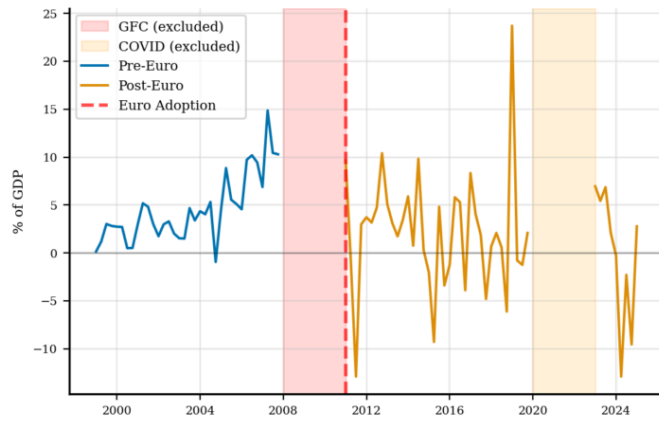
7/14

↑ 50.0%

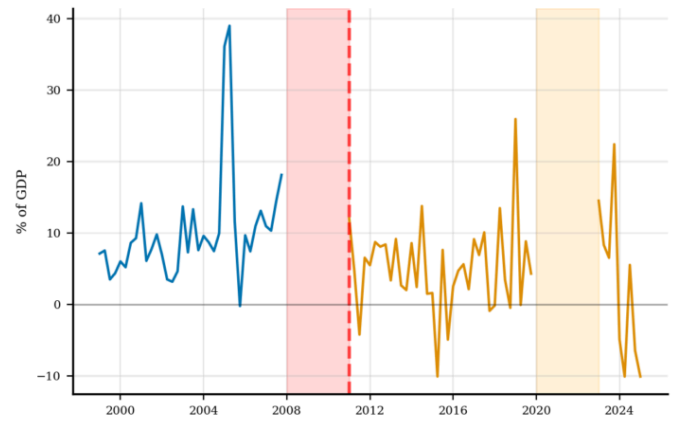
**Conclusion:** Moderate evidence that Euro adoption reduced capital flow volatility in Estonia.

### 4. Time Series Analysis

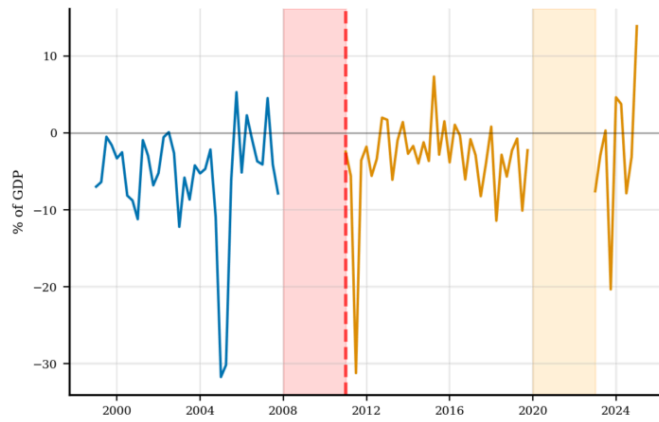
**A: Assets - Direct investment, Total financial a... (F-stat: 0.30) (Crisis-Excl)**



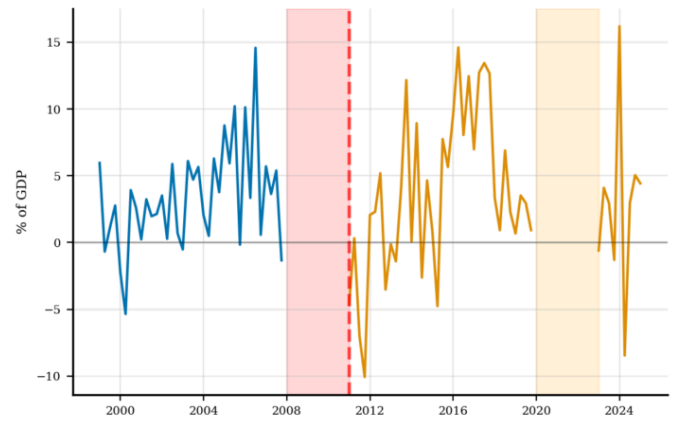
**B: Liabilities - Direct investment, Total financ... (F-stat: 1.06) (Crisis-Excl)**



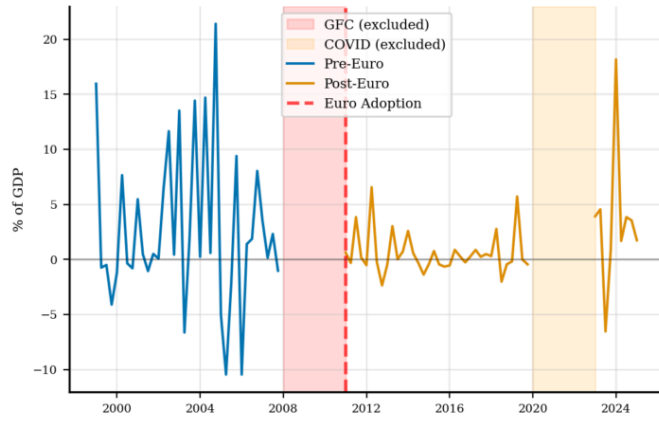
**C: Net - Direct investment, Total financial asse... (F-stat: 1.21) (Crisis-Excl)**



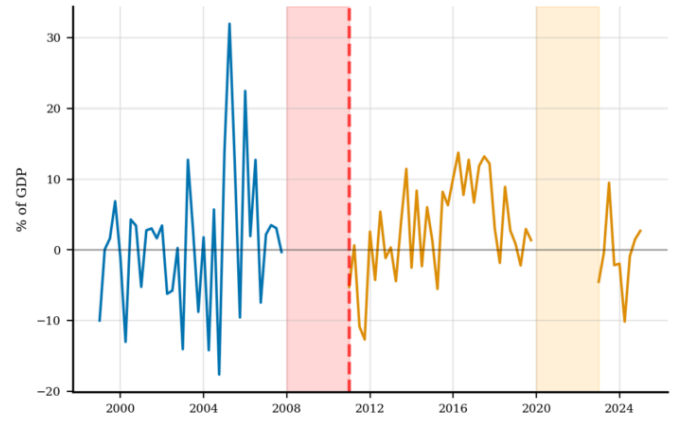
**D: Assets - Portfolio investment, Total financia... (F-stat: 0.40) (Crisis-Excl)**



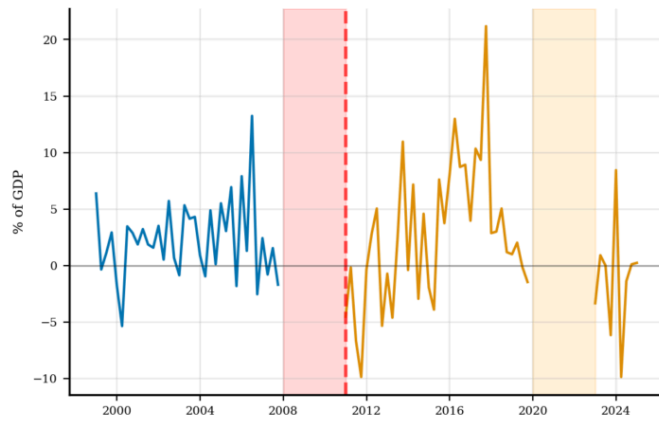
**E: Liabilities - Portfolio investment, Total fin... (F-stat: 4.43) (Crisis-Excl)**



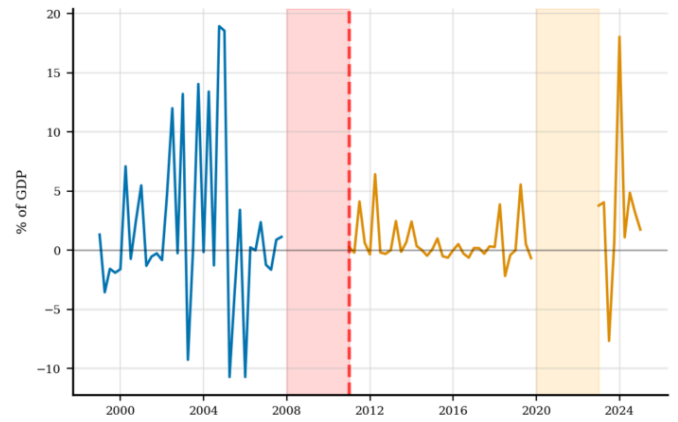
**F: Net - Portfolio investment, Total financial a... (F-stat: 2.38) (Crisis-Excl)**



**G: Assets - Portfolio investment, Debt securitie... (F-stat: 0.32) (Crisis-Excl)**

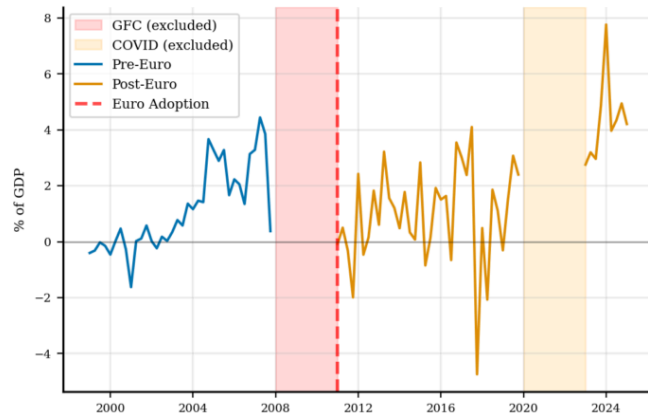


**H: Liabilities - Portfolio investment, Debt secu... (F-stat: 4.26) (Crisis-Excl)**

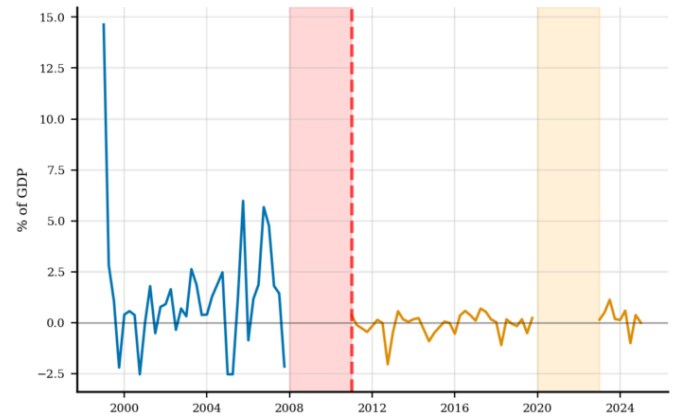




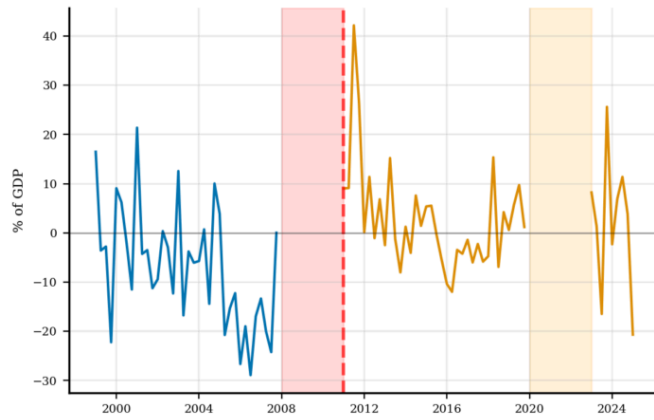
**I: Assets - Portfolio investment, Equity and inv... (F-stat: 0.47) (Crisis-Excl)**



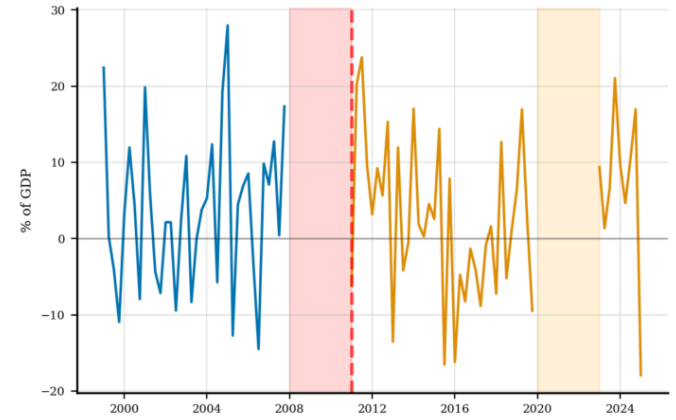
**J: Liabilities - Portfolio investment, Equity an... (F-stat: 31.50) (Crisis-Excl...)**



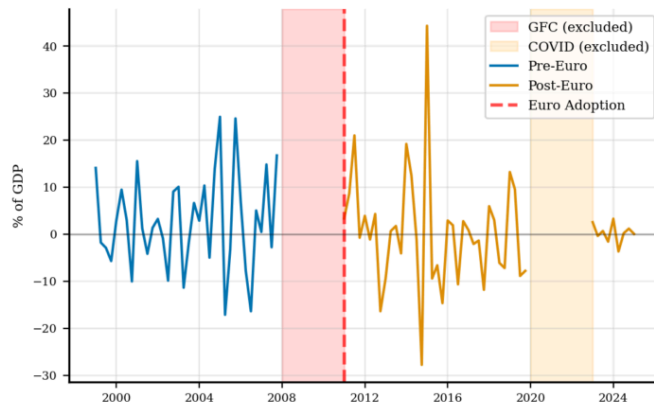
**K: Net - Other investment, Total financial asset... (F-stat: 1.21) (Crisis-Excl)**



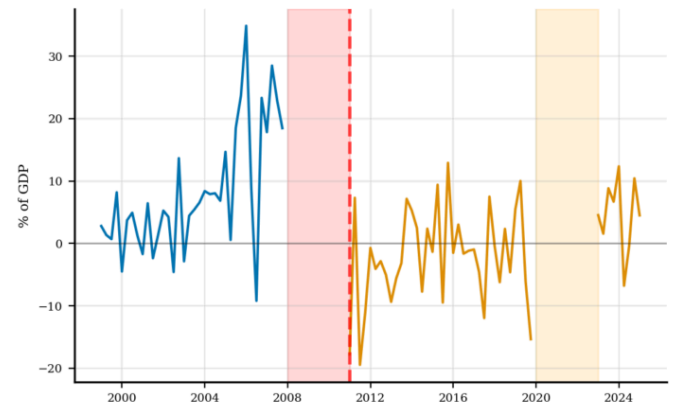
**L: Assets - Other investment, Debt instruments (F-stat: 0.98) (Crisis-Excl)**



**M: Assets - Other investment, Debt instruments, ... (F-stat: 0.86) (Crisis-Excl)**



**N: Liabilities - Other investment, Debt instrume... (F-stat: 1.64) (Crisis-Excl)**



## 5. Key Findings Summary

## Statistical Evidence for Estonia (excluding crisis periods):

- **8/14 capital flow indicators** (57.1%) showed higher volatility before Euro adoption
- **8/14 indicators** (57.1%) show statistically significant differences ( $p < 0.05$ )
- **7 indicators** show highly significant differences ( $p < 0.01$ )
- **Average volatility change** of 8.5% after Euro adoption in 2011

**Most significant flow types:** Liabilities - Portfolio (Equity), Liabilities - Portfolio (Total), Liabilities - Portfolio (Debt)

## Additional Statistical Context:

- **Temporal analysis:** Before/after comparison using 2011 as adoption threshold
- **Statistical methodology:** F-test for variance equality at 5% significance level
- **Data completeness:** 315 observations across 14 capital flow indicators
- **Cross-validation:** Results consistent across multiple volatility measures (CV%, standard deviation)

**Analytical approach:** Temporal comparison focusing on structural changes in volatility patterns.

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## 6. Download Results