Discussion Paper No. 389

COVID-19 on Total Fertility Rates: A Comparative Study of High-Income Countries

Mikito Masuda
Komazawa University
Tsukasa Matsuura
Chuo University

August 2023

INSTITUTE OF ECONOMIC RESEARCH
Chuo University
Tokyo, Japan

COVID-19 on Total Fertility Rates:

A Comparative Study of High-Income Countries

Abstract

BACKGROUND: The COVID-19 pandemic has caused rapid changes in fertility rates in high-income countries. Interestingly, it significantly increased fertility in some countries, while significantly decreased fertility in others.

OBJECTIVE: We explored the countries' differences in the impact of COVID-19 on TFR.

METHODS: First, we analyzed the trends in fertility rates across high-income countries, dividing them into five groups: Japan and South Korea, Southern Europe, Western Europe and the United States, Northern Europe, and Central Europe. Second, we conducted an event study and difference-in-differences (DID) analyses, controlling for economic factors such as inflation and unemployment rates, to explain the observed differences.

RESULTS: The first analysis revealed substantial regional variations, with some regions experiencing a sharp increase in fertility rates after the COVID-19, whereas others experienced a sharp decline. The second set of analyses indicate that rising unemployment rates universally led to a decline in fertility rates across all. Additionally, the influence of inflation on fertility rates varies across regions, with no significant changes observed before or after the COVID-19 pandemic. Furthermore, significant regional disparities in the impact of the COVID-19 shock on fertility rates were found, even when controlling for unemployment and inflation rates, suggesting that economic factors alone cannot fully explain these variations.

CONCLUSIONS: While COVID-19 substantially affected fertility rates, the nature of this impact differed significantly across regions, implying the presence of non-economic factors.

Word: Total fertility rate; COVID-19, event study, DID

1. Introduction:

The rapid spread of the COVID-19 pandemic since February 2020 has had a profound impact on various aspects of society and the economy globally (Aassave et al. 2021). Numerous studies have examined the effects of COVID-19 on various socio-economic domains, including demographic changes such as fertility rates. Aassve et al. (2020)

divided the regions into three categories: high-income countries, urban areas in low-to middle-income countries, and rural areas in low-to middle-income countries, and predicted the trends in fertility rates resulting from the pandemic. These studies suggest that fertility rates would decline in high-income countries and increase in rural areas of low- to middle-income countries. However, to the best of our knowledge, only a few studies have specifically investigated how the impact of COVID-19 on fertility rates and subsequent trends vary across countries. Furthermore, these analyses did not examine causal relationships.

Figure 1 illustrates that even among high-income countries, the impact of COVID-19 on fertility rates varies significantly. The effects of the shock on fertility rates tend to manifest approximately 9-10 months after the initial outbreak. Notable fluctuations in fertility rates have been observed in many countries from November 2020 to January 2021. Interestingly, despite belonging to the same high-income category, some countries have experienced a substantial increase in fertility rates, whereas others have experienced a significant decline. Furthermore, when observing subsequent trends, many countries appear to converge toward pre-pandemic levels over a certain period; however, countries such as Japan and South Korea exhibited a continued decline in fertility rates after the COVID-19 period.

Therefore, the aim of this paper is as follows: We categorize countries based on the extent and direction of the shocks and subsequent changes in fertility rates caused by COVID-19. Subsequently, we demonstrate that the impact of COVID-19 on fertility rates varies across regional groups. We investigate the factors underlying these differences by focusing on socioeconomic variables. Through these examinations, this study aims to reveal that the changes in fertility rates resulting from COVID-19, including the direction of change and subsequent trends, differ significantly among regional groups and that these differences can be attributed to variations in socioeconomic factors.

Specifically, this analysis involves the following. First, 14 high-income countries are categorized into regional groups, considering their geographical and cultural proximity, to confirm the variations in the impact of COVID-19 on fertility rates across regional groups. Second, using event study analysis, we examined whether the immediate effects of COVID-19 on fertility rates and subsequent trends differ among regional groups. Third, using monthly data on unemployment and inflation rates, which are available for each regional group, we explore whether there are significant regional disparities in the impact of the COVID-19 shock on fertility rates, even when controlling for unemployment and inflation rates, and whether the influences of unemployment and inflation rates on fertility rates differ among regional groups before and after the COVID-19 shock by Difference in Difference (DID).

The implications of this analysis are twofold. By controlling for economic conditions and examining the variations in immediate effects and subsequent trends resulting from the COVID-19 shock, this study elucidates how variations in family systems and policies among countries contribute to diverse impacts on fertility rates. Furthermore, this study provides insights into whether the effects of COVID-19 on fertility rates represent temporary shocks or structural changes in each country.

2. Previous Studies

Few studies have focused on cross-country comparisons of the impact of COVID-19 on fertility rates, and no studies have delved into causal relationships in this field.

One study that has focused on cross-country comparisons is that of Nitsche et al. (2022), which examines the changes in variance in fertility rates between countries and within regions in countries before and after the COVID-19 shock. This study utilized monthly data from 241 NUTS2 regions in 28 European countries. The variance decomposition results revealed that the variance in fertility rates within countries decreased, while the variance between countries increased, indicating an intensified impact at the national level.

From a cross-country comparison perspective, several studies have explained the impact of

COVID-19 shock on births through socioeconomic factors. Based on monthly data from 24 European countries, Pomar et al. (2022) reveal that higher per capita income has a mitigating effect on the decrease in birth rates caused by the COVID-19 shock. Masuda (2022, 2023) suggests that countries with strong gender role divisions may experience a more pronounced decrease in fertility rates due to the pandemic, using monthly data from 14 advanced countries, same as in this study. Kitaki (2022), using monthly data from various countries, demonstrates that the expansion of the COVID crisis negatively affected fertility rates through a decrease in trust in others and an increase in poverty rates.

Although not specifically focused on cross-country comparisons, existing studies have analyzed the relationship between COVID-19 and births. Iwasawa et al. (2021) examine the impact of the COVID-19 shock on demographic trends in Japan by comparing the actual birth and marriage rates with their projections. Lappegard et al. (2022) investigate the positive effect of the COVID-19 shock on births in Norway and explore the factors affecting the fertility rate using individual-level data. Their results indicate that this positive effect primarily operates among women aged 28–35 years and women who already have children, who generally have higher birth rates, and are in economically and socially stable situations.

Furthermore, some studies have examined the influence of COVID-19 shock on birth intentions rather than on actual births.

Micro data from Poland (Sienicka et al. 2022), China (Chen et al. 2022), Italy (Micelli et al. 2020, Arpino et al. 2021), and Australia (Lazzari et al. 2023, Mooi-Reci et al. 2023), revealed that the COVID-19 shock had an impact on decision-making regarding childbirth, leading to the decision-making process to postpone or abandon childbearing.

In the field of analyzing the effect of COVID-19 on demographic changes other than the fertility rate, there are studies that focus on the impact of the COVID crisis on marriage and divorce. Komura and Ogawa (2022) utilize monthly data by prefecture in Japan, and Ghaznavi et al. (2022) analyze monthly data by region in Japan, demonstrating that the COVID-19 shock reduced the number of marriages and divorces. Jung and Lee (2023) utilize region-level monthly data from South Korea and reveal that the COVID-19 shock decreased marriage rates in various regions.

While the aforementioned studies provide valuable information, there is currently no research analyzing the causal relationship in terms of international comparisons of the impact of COVID-19 on birth rates. In this study, we first identified the causal relationship between the impact of COVID-19 and fertility rate using cross-country data based on event study and DID analyses.

3. Model and Data

3.1 Trends in Fertility rates by Country and Region:

This section explains the model and data used for the estimation. Figure 1 shows the trends in the total fertility rates in high-income countries before and after the onset of the COVID-19 pandemic.

As previously mentioned, significant fluctuations in fertility rates were observed in many countries from November 2020 to January 2021. Considering the gestation period of approximately 10 months, it can be inferred that the shocks that affected fertility rates occurred between February and April 2020, when COVID-19 was prevalent worldwide, suggesting a substantial impact of the COVID-19 shock on fertility rates globally.

Interestingly, despite being high-income countries, there are significant variations in how COVID-19 has affected fertility rates. For example, France experienced a rapid decline, followed by a sharp increase, indicating a temporary dip before a subsequent rise, whereas South Korea showed a consistent decline with minimal fluctuations. By contrast, Portugal witnessed a significant decline, followed by a sharp increase, a period of stability, and subsequent upward trends.

This demonstrates that countries exhibit diverse responses to shocks caused by COVID-19 in terms of fertility rates. However, some common trends were observed to a certain extent across the regions. Therefore, we conducted an analysis by categorizing the 14 countries into five regional groups: Japan and South Korea, Southern Europe, Western Europe and the United States, Northern Europe, and Central Europe[1], considering their geographical and cultural proximity. The results are shown in Figure 2. Among these regional groups, Western Europe and the United States, Southern Europe, and Japan and South Korea experienced a sharp decline in fertility rates immediately after COVID-19,

[1] Southern Europe: Italy, Spain, and Portugal; Western Europe and the United States: France, the US, Netherlands, and Belgium; Central Europe: Germany and Austria; North Europe: Finland, Sweden, and Denmark.

while Northern Europe and Central Europe experienced a rapid increase in fertility rates after the shock. Hence, similarities were observed among the regional groups.

However, the regional differences in the impact of COVID-19 on fertility rates may be attributed to economic factors. For example, regional variations in the economic impact of COVID-19 may have influenced fertility rates. Nevertheless, the above analysis merely demonstrates the regional trends in fertility rates before and after COVID-19, and does not consider factors related to changes in the economic environment caused by the COVID-19 shock.

3.2 Estimation Model

Therefore, to account for economic factors, we utilize monthly data on inflation and unemployment rates available for each region. We control for unemployment and inflation rates and conducted an event study analysis to examine the effects of the COVID-19 shock on fertility rates ten months later using the following model:

$$Y_{i,t+10} = \sum_{j \in \{-m,..0,...m\}} \gamma_j \, D_{i,t-j} + \beta X_{i,t} + \alpha_i + \delta_t + u_{i,t}$$

In this study, we utilize a model to examine the effects of COVID-19 on the total fertility rate (TFR) across different regional groups. Variable *i* represents the regional groups, and *t* represents a month. The dependent variable $Y_{i,t+10}$, represents the TFR 10 months after the reference point, which was set as February 2020. We introduce the dummy variable $D_{i,t-j}$ to capture the impact of COVID-19 on the TFR in each regional group at various time points (*t-j* months from the shock point).

Additionally, we include economic variables $X_{i,t}$ namely the unemployment and inflation rates, to control for their potential influence on fertility rates. The individual effects of the regional groups are denoted as α_i, while δ_t represents the time effects. Terms $u_{i,t}$ represent the residual error components of the model.

By employing this framework, we can analyze how the TFR after 10-months changes before and after the COVID-19 shock, considering both regional and temporal variations. To explore the potential heterogeneity in the effects of COVID-19 on fertility rates across regions, we conducted an event study analysis followed by a DID analysis.

Furthermore, we examine whether the impact of economic variables such as unemployment and inflation rates on fertility rates varies across regional groups. Additionally, we investigate whether these economic variables have different effects on fertility rates before and after the COVID-19 shock. Estimating these relationships will provide valuable insights into the complex interplay among the COVID-19 pandemic, regional factors, and economic variables that shape fertility patterns.

$$Y_{i,t+10} = \gamma Region \times After_{i,t} + X_{i,t}\beta + \alpha_i + \delta_t + u_{i,t}$$

$$Y_{i,t+10} = \gamma Region_i \times After_{i,t} + X_{i,t}\beta + \theta Country_i \times \mathrm{X_{i,t}} + \alpha_i + \delta_t + u_{i,t}$$

$$Y_{i,t+10} = \gamma Region_i \times After_{i,t} + X_{i,t}\beta + \tau After_{i,t} \times \mathrm{X_{i,t}} + \alpha_i + \delta_t + u_{i,t}$$

In our estimation, we introduce the variable "*Region*" as a dummy variable representing four different regions, with Japan and South Korea as the reference category. The variable "After" is also included as an indicator variable after February 2020 as one to capture the pre- and post-shock periods. It is important to note that our analysis is based on a fixed effects model, allowing us to account for unobserved heterogeneity at the country level. To address potential correlations within countries, we employ clustered robust standard errors in our estimation.

3.3. Data

The data used in our analysis were based on monthly observations. For the TFR in Japan, we obtained the number of births[2] from the "Vital Statistics Survey" by the Ministry of Health, Labour and Welfare. We divided this by the female population data from the "Population Estimates" by the Statistics Bureau of the Ministry of Internal Affairs and Communications, multiplied it by 5 to account for the 5-year age groups (15-49), and further multiplied it by 12 to obtain an annual indicator. We then applied X-12-ARIMA for seasonal adjustment (without adjustment for weekdays or

[2] We use preliminary figures.

holidays).

For the TFR in countries other than Japan, we utilized a seasonally adjusted series from the Human Fertility Database, jointly provided by the Max Planck Institute for Demographic Research in Germany and the Vienna Institute of Demography in Austria[3]. We use data from January 2018 to January 2023.

Unemployment rate data were obtained from a database from the Organisation for Economic Co-operation and Development (OECD) and were seasonally adjusted. However, consumer price index (inflation rates)[4] data were sourced from the United Nations' Monthly Bulletin of Statistics Online database and were not seasonally adjusted. Nevertheless, as no clear seasonality was observed, we used the original series in our estimation.

Regarding the selection criteria for advanced countries other than Japan, we followed the criteria used by Masuda (2022, 2023), which include thirteen countries that are relatively similar to Japan in terms of economic development among advanced Western countries, as well as culturally similar countries like South Korea. We did not include countries for which data were not available until the second half of 2022.

4. Result

[3] It was updated in March 2023.
[4] It is an index where the year 2010 is set as 100.

4.1 Event Study

First, we estimated the models using an event study analysis. Figure 3 shows the results for Japan and South Korea. It can be observed that after the occurrence of the COVID-19 shock in February 2020, the TFR in both countries experienced a rapid decline starting from April and this significant decrease continued until February 2021. There was a slight tendency for recovery thereafter, but despite there being months in which the decline was not statistically significant, no month surpassed the level of February 2020. In other words, in Japan and South Korea, the TFR has consistently remained low since the COVID-19 shock.

Figure 4 illustrates the results for Southern Europe. A significant decrease in the TFR was observed in February 2020. Before February 2020, the TFR was significantly higher than in this month for most periods. Subsequently, there was a gradual recovery in the fertility rate, but until January 2021, there was no significant difference compared with February 2020. However, from that point onwards, the fertility rate showed an upward trend, indicating a recovery surpassing the pre-COVID-19 level. Figure 5 presents the results for Western Europe and the United States. While there was a temporary decline following the COVID-19 shock, the fertility rate remained higher than pre-COVID-19 levels for over a year. However, a downward trend was observed after May 2021.

Figure 6 shows the results for Northern Europe. Before February 2020, the TFR was significantly lower for several months. However, there was a sharp increase in the fertility rate from February to

March 2020. Subsequently, there was a declining trend, and approximately one year after the COVID-19 shock, the fertility rate became even lower than the pre-COVID-19 level. Figure 7 shows the results for Central Europe. There was a temporary increase immediately after the COVID-19 shock; however, approximately four months later, the fertility rate returned to a level similar to that before the shock, and no significant differences were observed thereafter.

By comparing the time series changes in the TFR shown in Figure 2 with the results of the event study analysis, focusing on the differences between regions before and after the COVID-19 shock by controlling for unemployment and inflation rates, several common points were identified. However, the following differences can be observed. First, by examining the regional trends of the TFRs in Figure 2, Northern Europe and Central Europe exhibit similar patterns, showing a trend of an increase in fertility rates for a few months following the COVID-19 shock, followed by a gradual decline. However, according to the event study analysis in Figure 6, Northern Europe experienced a sharp increase immediately after the shock, followed by a sustained decline, resulting in a level lower than that in the pre-COVID-19 period after approximately one year. In contrast, Central Europe did not exhibit a declining trend after an initial increase in Northern Europe.

Second, concerning Southern Europe, Figure 2 shows a sharp decline in fertility rates after the COVID-19 shock, followed by a recovery to a level similar to that before. However, the event study analysis in Figure 4 indicates that one year after the COVID-19 shock, there was a tendency for further increases in fertility rates, surpassing the pre-COVID-19 level. For Japan, South Korea, Western Europe, and the United States, there were no significant differences between the results in Figure 2 and the event study analysis. Japan and South Korea experienced a temporary decline in fertility rates due to the COVID-19 shock, followed by a slight recovery; however, a structural decline in fertility rates persisted before and after the shock. Western Europe and the United States witnessed a decline in fertility rates following the COVID-19 shock, followed by an increase, maintaining levels higher than before. However, after more than a year, a downward trend was observed, returning to previous levels.

From the event study analysis described above, it is evident that the COVID-19 shock had a significant impact on fertility rates. However, this impact varied greatly across regions. Furthermore, there are differences between fertility rate trends in each region and the results of the event study analysis. One of the causes for this difference could be the control for unemployment and inflation rates.

4.2 DID

Next, we use a difference-in-differences (DID) analysis that controls for unemployment and inflation rates to examine not only regional differences in the impact of the COVID-19 shock on fertility rates but also the effects of unemployment and inflation rates on fertility rates. In addition, we investigate whether the effects of unemployment and inflation on fertility rates differ across regions and whether these effects vary before and after the COVID-19 shock.

Table 1 presents the results of the study. Column (1) shows the results without controlling for the unemployment and inflation rates. Southern Europe, Western Europe, the United States, and Central Europe showed a significant increase in fertility rates after the COVID-19 shock compared to Japan and South Korea, while no significant difference was observed in Northern Europe. Column (2) presents the results for the controlled unemployment and inflation rates. The unemployment rate has a significantly negative effect, whereas the inflation rate is not significant. An increase in unemployment rate leads to a decrease in fertility rates. Columns (3) and (4) include the interaction terms between region and unemployment or inflation rates. The interaction term between region and unemployment is not significant, indicating that the effect of the unemployment rate on fertility rates does not vary across regions, as shown in Column (3). However, as Column (4) shows, the CPI has a significant negative effect, and the interaction term between the CPI and region is positively significant for Southern Europe, Western Europe, the United States, and Central Europe, while it is negatively significant for Northern Europe. Examining the marginal effects, an increase of 1% in the inflation rate leads to an increase of 0.011 in the TFR for Southern Europe, and a decrease of 0.003 0.002 0.024 0.01 for the United States and Western, Central Europe, Northern Europe, and Japan and South Korea, respectively. This indicates that the effects of inflation rate on fertility rates also vary across regions. Columns (5) and (6) show the interaction terms between the COVID-19 shock and unemployment or inflation rates. These terms were not significant, suggesting that the effects of unemployment and inflation on fertility rates did not change after the COVID-19 shock.

5. Conclusion

We observed significant changes in fertility rates in 14 advanced countries from November 2020 to January 2021. Considering a pregnancy period of approximately 10 months, it is inferred that COVID-19 has had a substantial impact on birth behavior, leading to significant regional variations in fertility rates immediately after the COVID-19 shock. Therefore, we divided the 14 countries into five regions–Japan, South Korea, Southern Europe, Western Europe, the United States, Northern Europe, and Central Europe–and examined the trends in fertility rates.

The results revealed that Central and Northern Europe experienced a sharp increase in fertility rates immediately after the COVID-19 shock, followed by a steep decline. By contrast, Southern Europe, Western Europe, the United States, Japan, and South Korea showed sharp declines in fertility rates immediately after the shock, followed by a rapid increase. Notably, Japan and South Korea experienced a subsequent decline, indicating the continuation of the pre-COVID-19 decreasing trend.

To further investigate these trends, we conducted an event study analysis by controlling for unemployment and inflation rates, and using fertility rates after a 10-month period as the dependent variable. Japan and South Korea experienced a rapid decline in fertility rates after the COVID-19 shock, with a slight recovery; however, overall, fertility rates remained lower than pre-COVID-19 levels. Conversely, Southern Europe showed a sharp decline after the shock, followed by a recovery trend, and fertility rates were even higher than the pre-COVID-19 levels. Western Europe and the United States experienced a temporary decline, followed by a slight increase, maintaining higher levels than before the shock. However, more than a year after the shock, fertility rates began to decline and return to their previous levels. Northern Europe experienced a sharp increase immediately after the COVID-19 shock, followed by a decline, and recent fertility rates fell below the pre-COVID-19 levels. Central Europe showed a sharp increase after the COVID-19 shock, followed by an immediate decline, reaching a level similar to pre-COVID-19.

To assess regional differences in fertility rate changes before and after the COVID-19 shock and the impact of inflation and unemployment rates on fertility rates, we conducted a DID analysis. The results indicate that unemployment rates had a consistently negative effect on fertility rates, irrespective of the region or pre/post COVID-19 periods. Inflation rates had a higher impact on fertility rates in Southern Europe, Western Europe, the United States, and Central Europe than in Japan and South Korea, whereas Northern Europe showed a lower impact. Moreover, even after controlling for unemployment and inflation rates, the COVID-19 shock's negative effect on fertility rates remains weaker in Western Europe and the United States, Southern Europe, and Central Europe than in Japan or South Korea. From a causal perspective, it can be interpreted that the COVID-19 shock had a more significant impact on fertility rates in Japan and South Korea.

In summary, this study demonstrates that the COVID-19 pandemic has had a profound shock to fertility rates worldwide, resulting in varying effects depending on the region. Furthermore, it highlights the significant influence of unemployment and inflation rates on fertility rates, with variations in the effects of inflation rates on fertility rates across different regions. However, this study has several limitations, as the regional differences in fertility rates caused by the COVID-19 shock were not entirely explained by controlling for unemployment and inflation rates alone. Understanding the mechanisms underlying the impact of the COVID-19 shock on fertility rates, including its directionality and whether the effects are temporary or permanent, remains a subject for further investigation.

Reference

Aassve, Arnstein, Nicolo` Cavalli, Letizia Mencarini, Samuel Plach and Livi M. Bacci (2020) “The COVID-19 pandemic and human fertility,” *Science*, Vol.369, ISSUE 6502, pp.370-371.

Aassve, Arnstein, Nicolo` Cavalli, Letizia Mencarini, Samuel Plach and Seth Sanders (2021) “Early assessment of the relationship between the COVID-19 pandemic and births in high income countries,” *PNAS*, Vol.118, No.36, pp.1-3.

Arpino, Bruno, Francesca Luppi and Alessandro Rosina (2021) “Changes in fertility plans during the COVID-19 pandemic in Italy: the role of occupation and income vulnerability,” *SocArXiv*, pp.1-

53.

Chen, Tinggui, Peixin Hou, TiantianWu and Jianjun Yang, (2022) ”The Impacts of the COVID-19 Pandemic on Fertility Intentions of Women with Childbearing Age in China,” *Behavioral Sciences*, Vol.12, No.335.

Ghaznavi, Cyrus, Takayuki Kawashima, Yuta Tanoue, Daisuke Yoneoka, Koji Makiyama, Haruka Sakamoto, Peter Ueda, Akifumi Eguchi and Shuhei Nomura (2022) “Changes in Marriage, Divorce and Births during the COVID-19 Pandemic in Japan,” *BMJ Global Health*, Vol.7, Issue 5, pp.1-11.

Iwasawa, Miho, Shiro Koike, Reiko Hayashi, Motomi Beppu and Yu Korekawa (2021) “The COVID-19 pandemic and demographic process: What we know and what will happen to future population,” *IPSS Working Paper Series*, No.51, pp.1-42. (In Japanese)

Jung, Myunggu and D.Susie Lee (2023) “Subnational variations in births and marriages during the COVID-19 pandemic in South Korea,” *Demographic Research*, Vol.48, Article 30, pp.867-882.

Kitaki, Hideaki (2022) “The Impact of COVID-19 on Birth Rates and its Socioeconomic Factors,” *NPI Economy and Society Study Group, Research Note,* pp.1-13. (In Japanese)

Komura, Mizuki and Hikaru Ogawa, (2022) “COVID-19, marriage, and divorce in Japan,” *Review of Economics of the Household*, Vol.20, No.3, pp.831–853.

Lappegård, Trude, Tom Kornstad, Lars Dommermuth and Axel Peter Kristensen, (2023)” Understanding the positive effects of the COVID-19 pandemic on women’s fertility in Norway,” *Population and Development Review,* In press, pp.1–25.

Lazzari, Ester, Anna Reimondos and Edith Gray, (2023) “Did the COVID-19 Pandemic Affect Fertility Desires in Australia? Understanding Why People Changed Their Attitudes towards Having a First or Additional Child,” *Population and Development Review*, In press, pp.1–34.

Masuda, Mikito (2022) “Demographic Changes in Japan and Their Responses during the COVID-19 Pandemic,” *NPI Economy and Society Study Group, Commentary* 11, pp.1-11. (In Japanese)

Masuda, Mikito (2023) “The Changes in Japan's Fertility Rates after the Coronavirus Pandemic: A Comparison with South Korea and Western Developed Countries,” *IERCU Discussion Paper* 384, pp.1-21. (In Japanese)

Micelli, Elisabetta, Gianmartin Cito, Andrea Cocci, Gaia Polloni, Giorgio Ivan Russo, Andrea Minervini, Marco Carini, Alessandro Natali and Maria Elisabetta Coccia (2020) “Desire for parenthood at the time of COVID-19 pandemic: an insight into the Italian situation”, *Journal of Psychosomatic Obstetrics & Gynecology*, Vol.41, No.3, pp.183–190.

Miller, Douglas L. (2023) “An Introductory Guide to Event Study Models,” *Journal of Economic Perspectives*, Vol.37, No.2, pp.203-230.

Mooi-Reci, Irma, Trong-Anh Trinh, Esperanza Vera-Toscano and Mark Wooden, (2023) “The impact of lockdowns during the COVID-19 pandemic on fertility intentions,” *Economics and Human Biology*, Vol.48, pp.1-9.

Nitsche, Natalie, Aiva Jasilioniene, Jessica Nisén, Peng Li, Maxi S. Kniffka, Jonas Schöley, Gunnar Andersson, Christos Bagavos, Ann Berrington, Ivan Čipin, Susana Clemente, Lars Dommermuth, Peter Fallesen, Dovile Galdauskaite, Dănuţ-Vasile Jemna, Mathias Lerch, Cadhla McDonnell,

Arno Muller, Karel Neels, Olga Pötzsch, Diego Ramiro, Bernhard Riederer, Saskia te Riele, Laura Szabó, Laurent Toulemon, Daniele Vignoli, Kryštof Zeman and Tina Žnidaršič (2022) “Pandemic babies? Fertility in the aftermath of the first COVID-19 wave across European regions,” *MPIDR Working Paper WP* 2022-027, pp.1-57.

Pomar, Le´o, Guillaume Favre1, Claire de Labrusse, Agathe Contier, Michel Boulvain and David Baud (2022) “Impact of the First Wave of the COVID-19 Pandemic on Birth Rates in Europe: a Time Series Analysis in 24 Countries,” *Human Reproduction*, Vol.37, No.12, pp.2921-2931.

Sienicka, Agnieszka, Agata Pisula, Katarzyna K. Pawlik, Joanna Kacperczyk-Bartnik, Pawel Bartnik, Agnieszka Dobrowolska-Redo and Ewa Romejko-Wolniewicz (2022) “The impact of COVID-

19 pandemic on reproductive intentions among the Polish population," *Ginekologia Polska*, Vol.93, No.5, pp.345-350.

Fig 1. The Trend of TFR by Countries

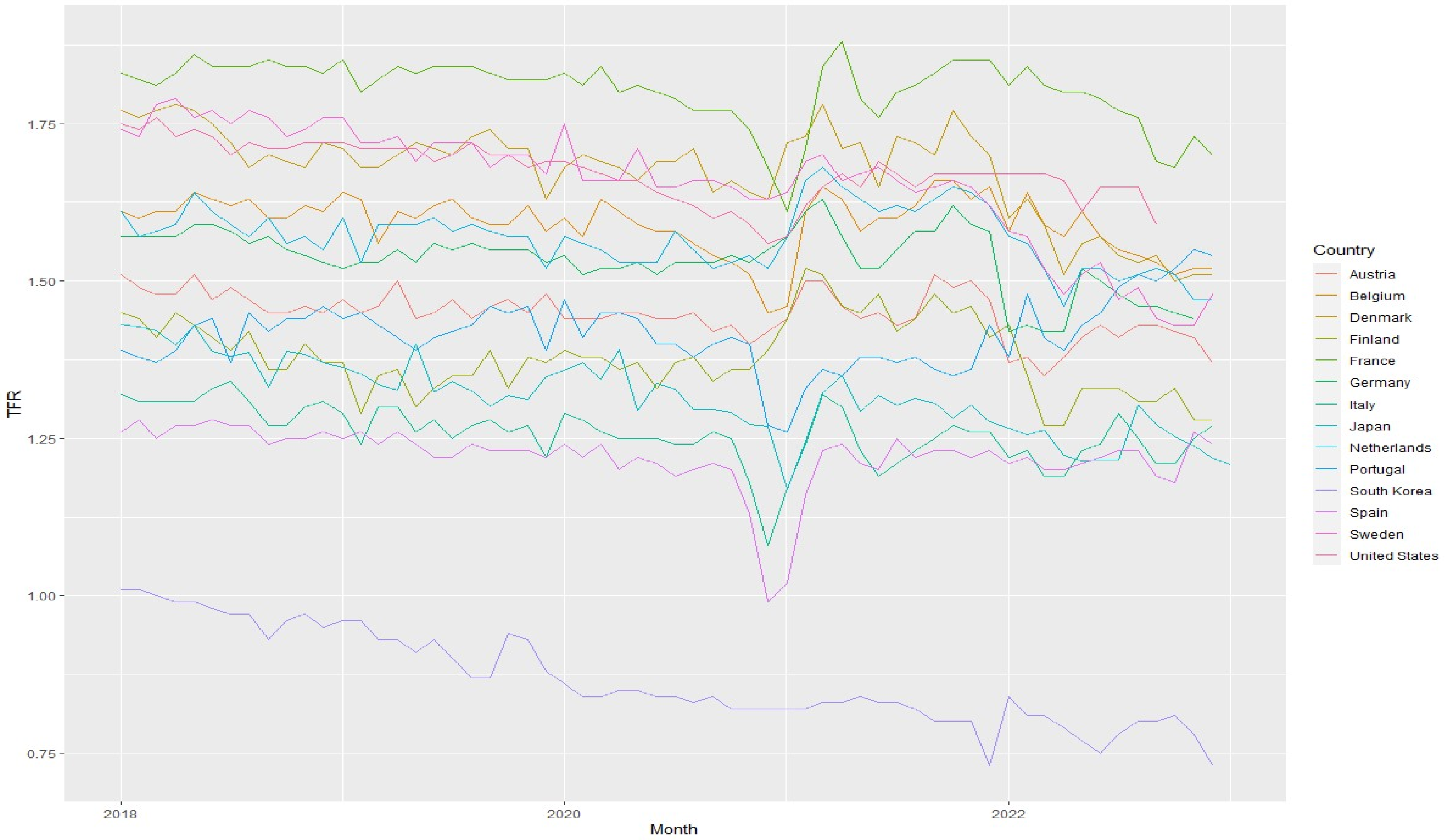

Fig 2. The Trend of TFR by Regime

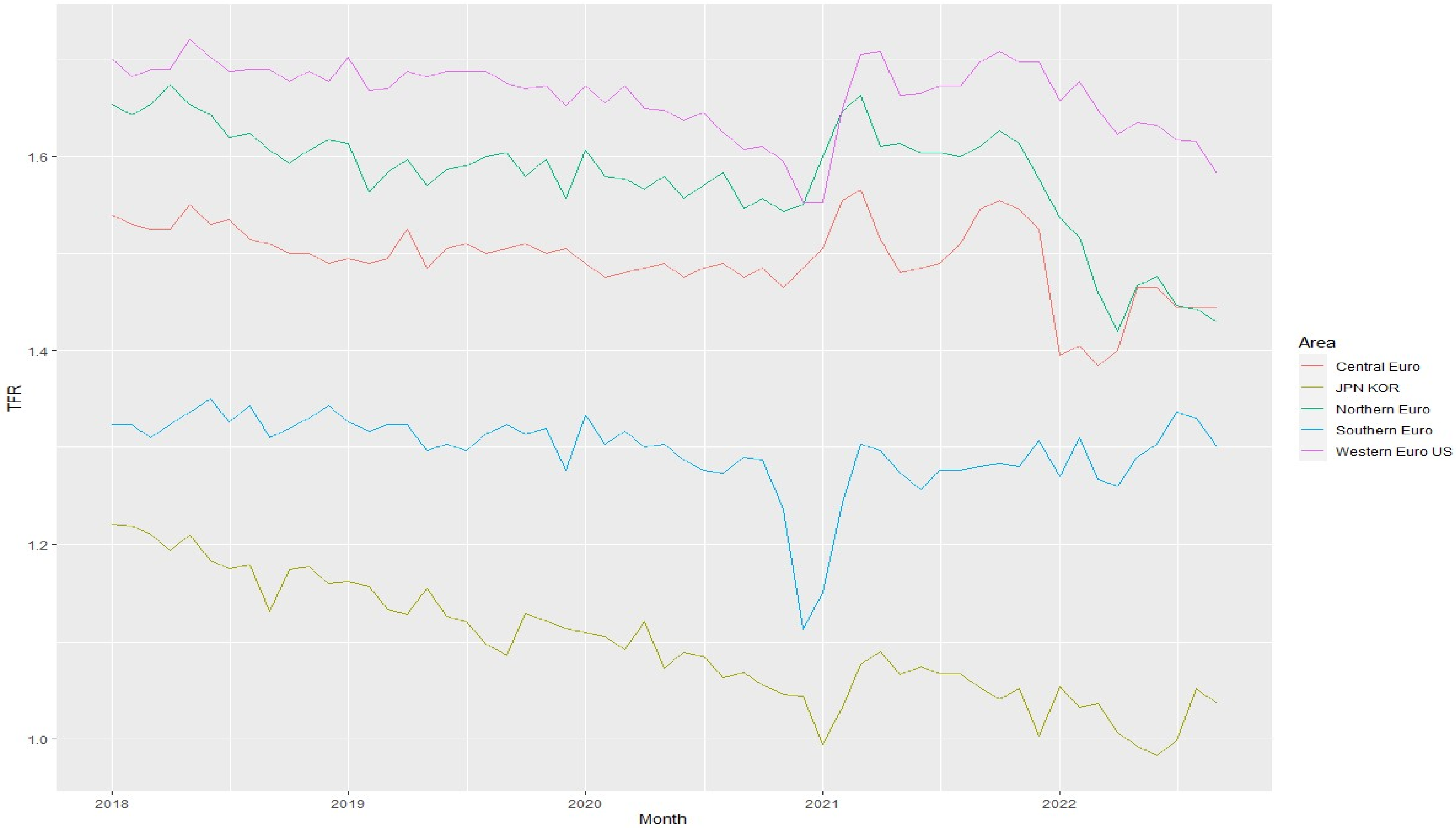

Fig 3. Event Study Analysis: Japan and Korea

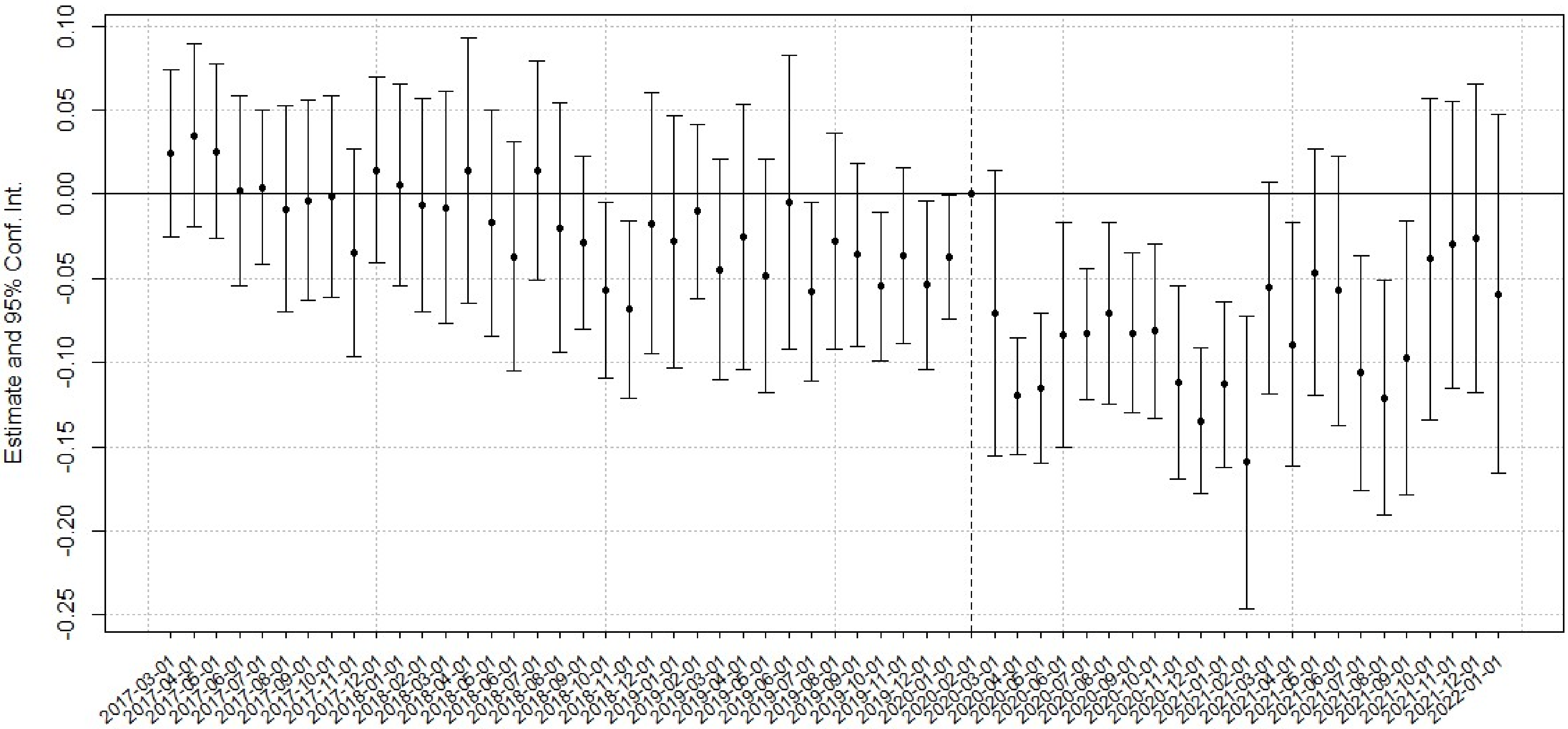

Fig 4. Event Study Analysis: Southern Europe

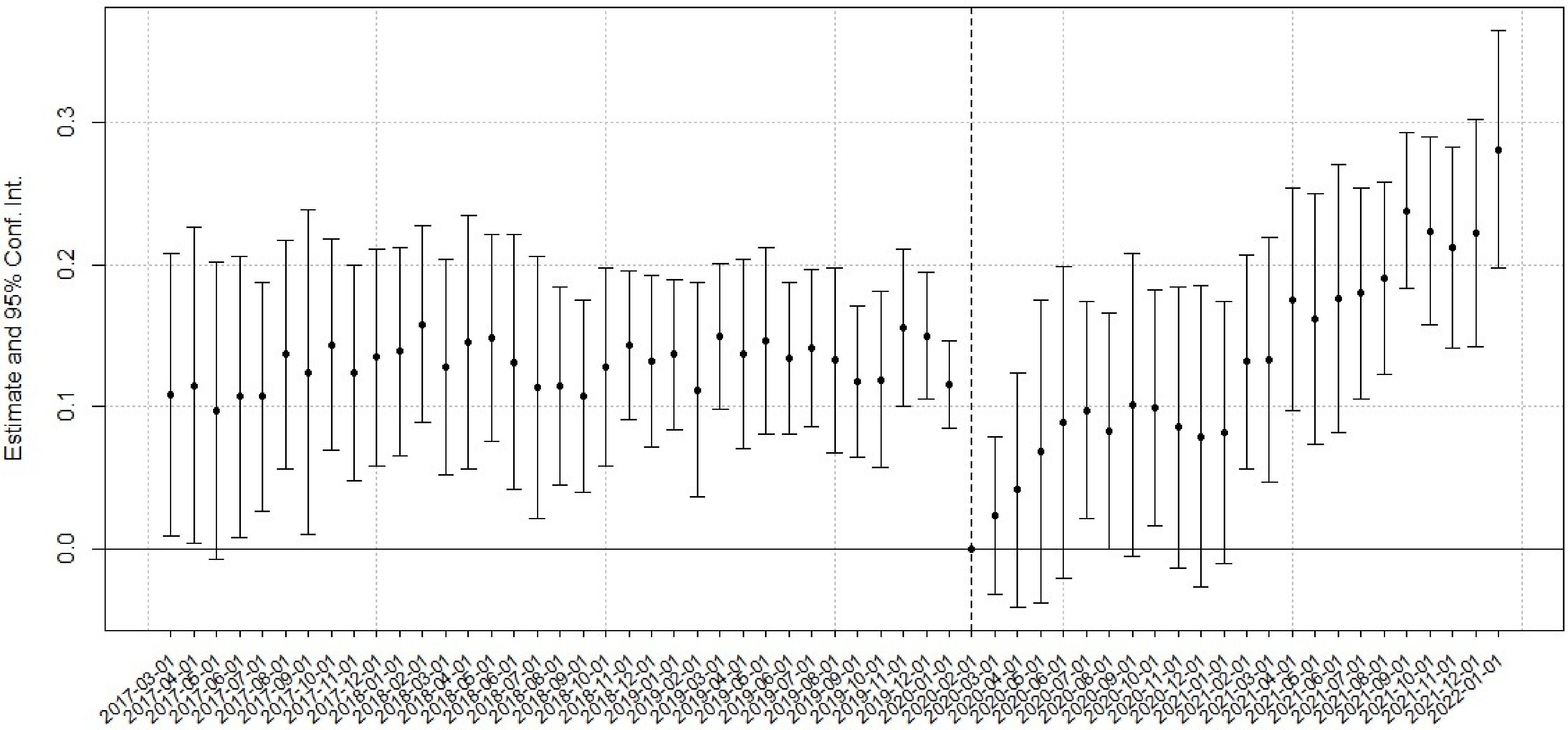

Fig 5. Event Study Analysis: Western Europe and USA

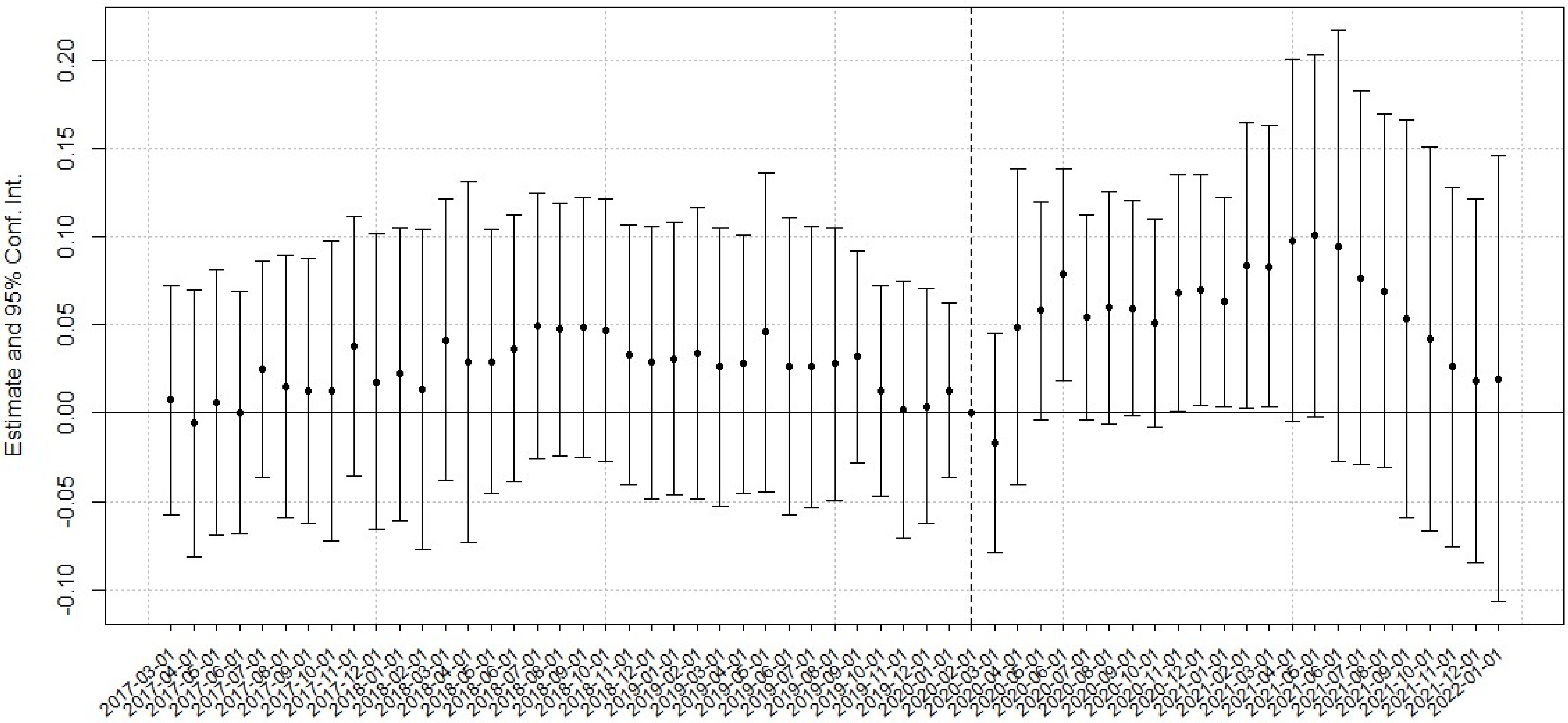

Fig 6. Event Study Analysis: Northern Europe

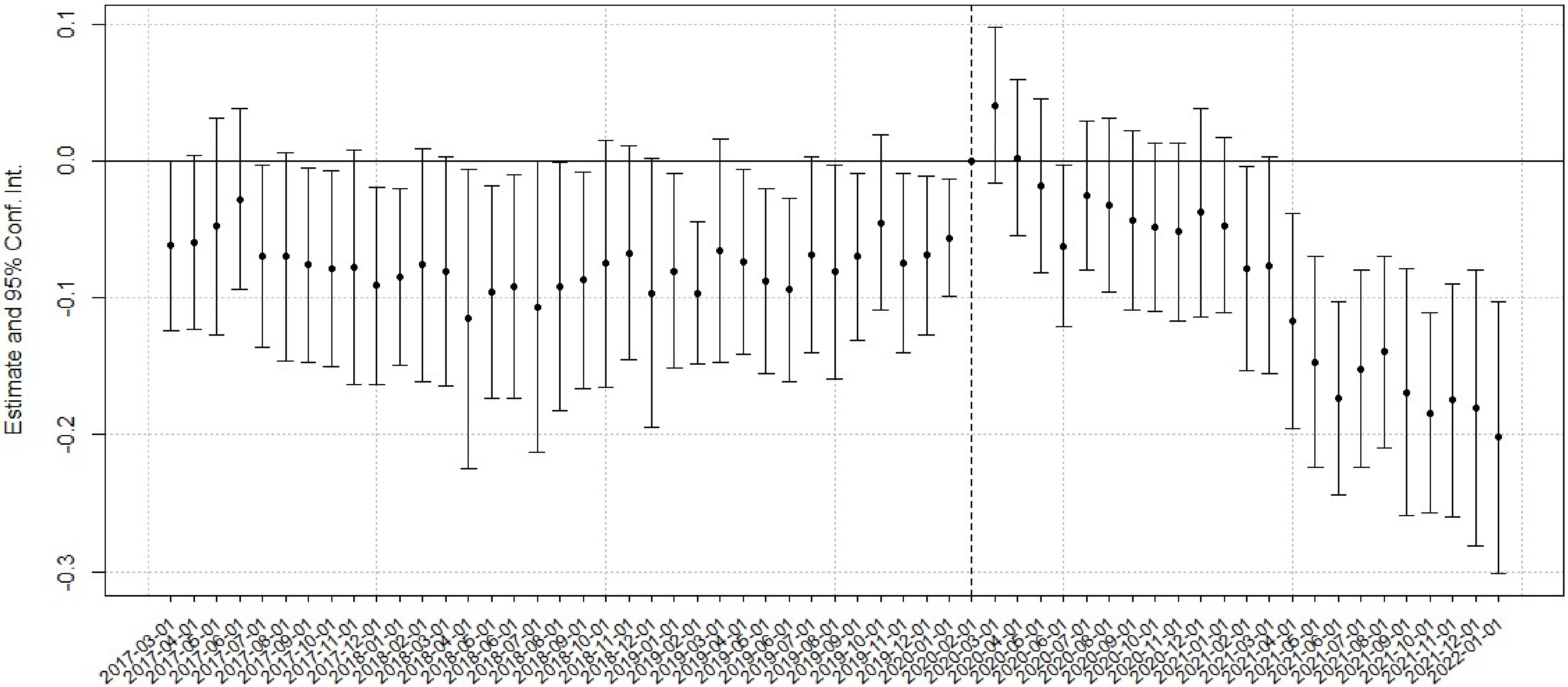

Fig 7. Event Study Analysis: Central Europe

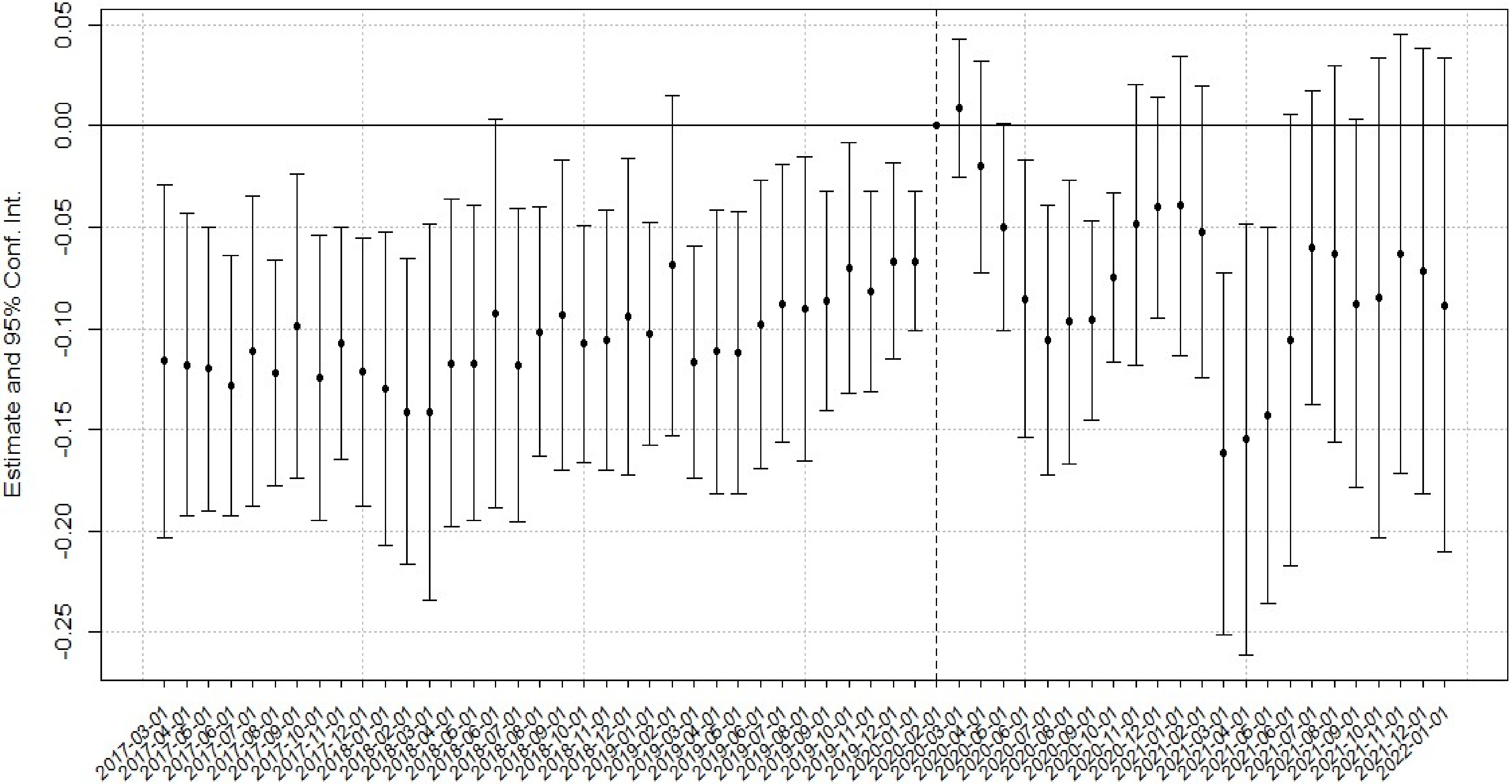

Table 1 The Impact of Covid-19 on TFR

	(1)	(2)	(3)	(4)	(5)	(6)
After:Southern_Euro	0.069 ***	0.059 ***	0.049 **	0.021 *	0.070 **	0.058 *
	(0.013)	(0.013)	(0.014)	(0.007)	(0.023)	(0.020)
After:Western Euro_US	0.071 ***	0.080 ***	0.076 ***	0.069 **	0.084 ***	0.072 **
	(0.015)	(0.018)	(0.017)	(0.020)	(0.016)	(0.023)
After:Northern_Euro	0.036	0.046	0.046	0.098 **	0.051	0.046
	(0.039)	(0.034)	(0.033)	(0.030)	(0.031)	(0.036)
After:Central_Euro	0.073 ***	0.080 ***	0.086 ***	0.064 ***	0.081 ***	0.073 **
	(0.010)	(0.013)	(0.014)	(0.007)	(0.013)	(0.019)
CPI		-0.002	-0.002	-0.010 *	-0.002	-0.005
		(0.002)	(0.002)	(0.004)	(0.002)	(0.003)
Unemployment		-0.012 *	-0.024	-0.007 *	-0.011 *	-0.013 *
		(0.004)	(0.017)	(0.003)	(0.005)	(0.004)
Southern_Euro:Unemp			0.000			
			(0.020)			
Western Euro_US:Unemp			0.016			
			(0.015)			
Northern_Euro:Unemp			0.009			
			(0.018)			
Central:Unemp			-0.002			
			(0.012)			
Southern_Euro:CPI				0.021 **		
				(0.005)		
Western Euro_US:CPI				0.007 **		
				(0.002)		
Northern_Euro:CPI				-0.014 ***		
				(0.002)		
Central_Euro:CPI				0.008 *		
				(0.003)		
After:Unemp					-0.001	
					(0.002)	
After:CPI						0.002
						(0.002)
Monthly Dummy	yes	yes	yes	yes	yes	yes
N	837	837	837	837	837	837
R2	0.971	0.973	0.973	0.978	0.973	0.973
logLik	1486.590	1509.685	1519.809	1602.217	1510.163	1513.459
AIC	-2817.180	-2859.370	-2871.618	-3036.435	-2858.326	-2864.917

*** p < 0.001; ** p < 0.01; * p < 0.05.

Reference: Japan and Korea

Clustered standard error within parentheses

中央大学経済研究所
(INSTITUTE OF ECONOMIC RESEARCH, CHUO UNIVERSITY)
代表者　林　光洋　 (Director: Mitsuhiro Hayashi)
〒192-0393　東京都八王子市東中野　742-1
(742-1 Higashi-nakano, Hachioji, Tokyo 192-0393　JAPAN)
TEL: 042-674-3271　　+81 42 674 3271
FAX: 042-674-3278　　+81 42 674 3278
E-mail: keizaiken-grp@g.chuo-u.ac.jp
URL: https://www.chuo-u.ac.jp/research/institutes/economic/