**HELLENIC MEDITERRANEAN UNIVERSITY**
**SCHOOL OF MANAGEMENT AND ECONOMICS SCIENCE**
**DEPARTMENT OF MANAGEMENT SCIENCE AND TECHNOLOGY**

# The impact of the European Central Bank's monetary policy on security returns and bank credit expansion. A complete approach using quantitative methods.

## PhD Thesis

**Nikolaos E. Petrakis**

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**ΠΡΟΓΡΑΜΜΑ ΔΙΔΑΚΤΟΡΙΚΩΝ ΣΠΟΥΔΩΝ**

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# Η επίδραση της νομισματικής πολιτικής της Ευρωπαϊκής Κεντρικής Τράπεζας στις αποδόσεις των αξιογράφων και την τραπεζική πιστωτική επέκταση. Μια ολοκληρωμένη προσέγγιση με χρήση ποσοτικών μεθόδων

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## ΔΙΔΑΚΤΟΡΙΚΗ ΔΙΑΤΡΙΒΗ

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## Nikolaos E. Petrakis

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# Η επίδραση της νομισματικής πολιτικής της Ευρωπαϊκής Κεντρικής Τράπεζας στις αποδόσεις των αξιογράφων και την τραπεζική πιστωτική επέκταση. Μια ολοκληρωμένη προσέγγιση με χρήση ποσοτικών μεθόδων

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**Ημερομηνία εξέτασης 24/02/2025**

***<u>Υπεύθυνη Δήλωση</u>****: Βεβαιώνω ότι είμαι συγγραφέας αυτής της διδακτορικής διατριβής και ότι κάθε βοήθεια την οποία είχα για την προετοιμασία της, είναι πλήρως αναγνωρισμένη και αναφέρεται στη διδακτορική διατριβή. Επίσης έχω αναφέρει τις όποιες πηγές από τις οποίες έκανα χρήση δεδομένων, ιδεών ή λέξεων, είτε αυτές αναφέρονται ακριβώς είτε παραφρασμένες. Επίσης βεβαιώνω ότι αυτή η διδακτορικής διατριβή προετοιμάστηκε από εμένα προσωπικά ειδικά για τις απαιτήσεις του Διδακτορικού Προγράμματος Σπουδών του Τμήματος Διοικητικής Επιστήμης και Τεχνολογίας του ΕΛΜΕΠΑ.*

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# Περίληψη

Ένα από τα κυρίαρχα ερευνητικά θέματα των τελευταίων δεκαετιών στον τομέα της χρηματοοικονομικής είναι η επίδραση της νομισματικής πολιτικής στις τιμές διαφόρων χρηματοοικονομικών περιουσιακών στοιχείων. Οι εμπειρικές μελέτες που αφορούν την περίοδο πριν από την παγκόσμια οικονομική κρίση αναλύουν κυρίως τη συμβατική νομισματική πολιτική της ομοσπονδιακής κεντρικής τράπεζας των Η.Π.Α[1]. Στη δεκαετία του 1990, πολλοί ερευνητές χρησιμοποίησαν υποδείγματα αυτοπαλίνδρομων διανυσμάτων (VAR) για να διερευνήσουν τη μακροπρόθεσμη επιρροή της τακτικής νομισματικής πολιτικής στις αποδόσεις των μετοχών (μεταξύ άλλων και οι Patelis 1997, Thorbecke 1997). Οι Ehrmann και Fratzscher (2004) καθώς και οι Bernanke και Kuttner (2005) χρησιμοποίησαν ανάλυση μελέτης γεγονότων για να εξετάσουν πώς οι αλλαγές της επιτοκιακής πολιτικής της ομοσπονδιακής κεντρικής τράπεζας επηρέασαν τις αγορές κεφαλαίου των ΗΠΑ.

Όταν η οξεία οικονομική κρίση έπληξε τις χρηματοπιστωτικές αγορές το 2007, η ΕΚΤ σε συνεργασία με άλλες μεγάλες κεντρικές τράπεζες, εισήγαγε νέα αντισυμβατικά μέτρα νομισματικής πολιτικής για να σταθεροποιήσει τις κεφαλαιαγορές, να αναζωογονήσει την οικονομική δραστηριότητα και να ενισχύσει την πιστωτική επέκταση. Τα νέα μη συμβατικά εργαλεία νομισματικής πολιτικής ήταν ένα ιστορικό ορόσημο στην παγκόσμια νομισματική πολιτική συνεισφέροντας αποφασιστικά στη φερεγγυότητα ολόκληρου του χρηματοπιστωτικού συστήματος.

Πιο συγκεκριμένα, κατά την διάρκεια της παγκόσμιας χρηματοοικονομικής κρίσης και της κρίσης δημοσίου χρέους, η ΕΚΤ μείωσε τα βραχυπρόθεσμα επιτόκια της στο κατώτερο τους όριο, προσέφερε απεριόριστη ρευστότητα σε σταθερό επιτόκιο στα χρηματοπιστωτικά ιδρύματα της ζώνης του ευρώ, επέκτεινε τη διάρκεια των πράξεων πιο μακροπρόθεσμης αναχρηματοδότησης, διεύρυνε τις κατηγορίες των αποδεκτών περιουσιακών στοιχείων που θα μπορούσαν να χρησιμοποιηθούν ως ενέχυρο στις πράξεις αναχρηματοδότησης και προχώρησε σε μικρού μεγέθους αγορές χρεογράφων μέσω του πρώτου και του δεύτερου προγράμματος αγοράς καλυμμένων

[1] Σύμφωνα με τους Borio και Disyatat (2016), η συμβατική νομισματική πολιτική αφορά τη διαχείριση των βραχυπρόθεσμων επιτοκίων και τις τακτικές πράξεις ανοικτής αγοράς.

τραπεζικών ομολόγων (CBPPI-II) και του προγράμματος για τις αγορές τίτλων (SMP). Επίσης ανακοίνωσε το πρόγραμμα για τις οριστικές νομισματικές συναλλαγές (OMT) το οποίο τελικά δεν ενεργοποιήθηκε.

Κατά τη διάρκεια της περιόδου του χαμηλού πληθωρισμού η ΕΚΤ εφάρμοσε μέτρα πιστωτικής χαλάρωσης (στοχευμένες πράξεις πιο μακροπρόθεσμης αναχρηματοδότησης-TLTROs) και μέτρα ποσοτικής χαλάρωσης (μεγάλης κλίμακας αγορές χρεογράφων του ιδιωτικού και δημόσιου τομέα μέσω του διευρυμένου προγράμματος αγοράς τίτλων-APP) για την αντιμετώπιση του κινδύνου αποπληθωρισμού. Επίσης, η ΕΚΤ παρείχε αρνητικό επιτόκιο στη πάγια διευκόλυνση αποδοχής καταθέσεων και καθοδήγηση όσον αφορά την πιθανή κατεύθυνση της νομισματικής πολιτικής. Στη περίοδο της πανδημίας, η ΕΚΤ ανακοίνωσε έκτακτα προγράμματα τόσο ποσοτικής όσο και πιστωτικής χαλάρωσης (PEPP και PELTROs) προκειμένου να εξουδετερώσει τους οικονομικούς κινδύνους που συνδέονται με την πανδημία του κορονοϊού.

Αρκετές ερευνητικές εργασίες έχουν αναλύσει τον αντίκτυπο των μη συμβατικών αποφάσεων νομισματικής πολιτικής της ΕΚΤ στις τιμές των χρεογράφων (μεταξύ άλλων αυτές των Rogers et al. 2014, Georgiadis and Gräb 2016, Haitsma et al. 2016, Fratzscher et al. 2016, Pacicco et al. 2019, Chebbi 2019, Weale and Wieladek 2022, Van der Zwan et al. 2024) Επιπλέον, πρόσφατες μελέτες εξέτασαν την αποτελεσματικότητα των μη συμβατικών πράξεων της ΕΚΤ όσον αφορά την παροχή τραπεζικών πιστώσεων (μεταξύ αυτών οι μελέτες των Gambacorta and Marques-Ibanez 2014, Boechx et al. 2017, Martins et al. 2019, Grandi 2019, Boechx et al. 2020, Benetton and Fantino 2021, Burietz and Picault 2023, Sleibi et al. 2023).

Λαμβάνοντας υπόψη προηγούμενες έρευνες, στόχος της παρούσας διδακτορικής διατριβής είναι να συνεισφέρει στη βιβλιογραφία διερευνώντας καθώς και εξηγώντας την επίδραση των μη συμβατικών μέτρων νομισματικής πολιτικής στις τιμές των αξιογράφων και στην τραπεζική πιστωτική επέκταση της ζώνης του ευρώ. Η Ευρωζώνη έχει καταστεί κρίσιμη στον ερευνητικό τομέα, επειδή η ενιαία νομισματική πολιτική που ασκεί η ΕΚΤ αφορά κράτη μέλη με ξεχωριστή δημοσιονομική πολιτική, ετερογενή οικονομικά συστήματα και κρατικές δομές καθώς και διαφορετικούς επιχειρηματικούς κύκλους.

Το πρώτο κεφάλαιο της παρούσας διδακτορικής διατριβής περιγράφει αναλυτικά την εξέλιξη των αντισυμβατικών μέτρων νομισματικής πολιτικής της ΕΚΤ από την έναρξη της χρηματοπιστωτικής κρίσης έως την κρίση της πανδημίας του κορονοϊού.

Στο δεύτερο κεφάλαιο μελετάται εάν οι επεκτατικές συμβατικές και μη συμβατικές νομισματικές παρεμβάσεις που εισήγαγε η ΕΚΤ επηρέασαν μεσοπρόθεσμα τις αποδόσεις των χρηματιστηριακών δεικτών οκτώ χωρών της ευρωζώνης. Επιπρόσθετα, για να διερευνηθεί εάν οι χρηματιστηριακές αγορές αντέδρασαν ετερογενώς στα καινοτόμα μέτρα επεκτατικής νομισματικής πολιτικής, οι υπό εξέταση χώρες ομαδοποιούνται σε δύο επιμέρους κατηγορίες, τις χώρες του πυρήνα και τις περιφερειακές χώρες της ζώνης του ευρώ.

Τα αποτελέσματα έδειξαν ότι η επεκτατική τακτική νομισματική πολιτική έχει θετική και στατιστικά σημαντική επίδραση στις αποδόσεις της χρηματιστηριακών δεικτών σε διαφορετικά επίπεδα στατιστικής σημασίας για ολόκληρο το δείγμα των οκτώ χωρών, τις χώρες του πυρήνα και τις περιφερειακές χώρες της ζώνης του ευρώ. Διαπιστώθηκε επίσης ότι οι μη συμβατικές επεκτατικές παρεμβάσεις της ΕΚΤ είχαν θετικό και στατιστικά σημαντικό αντίκτυπο στις χρηματιστηριακές αγορές των χωρών του πυρήνα της ευρωζώνης καθώς οι χώρες αυτές επηρεάστηκαν λιγότερο από την οικονομική κρίση. Οι περιφερειακές χώρες βίωσαν υποβαθμίσεις της πιστοληπτικής ικανότητας και αναγκάστηκαν να εφαρμόσουν προγράμματα οικονομικής προσαρμογής που αύξησαν την αβεβαιότητα των επενδυτών κατά τη διάρκεια και μετά την περίοδο της κρίσης του δημόσιου χρέους, ενίσχυσαν τις εκροές κεφαλαίων από αυτές τις αγορές και μείωσαν τις προσδοκίες σχετικά με την αποτελεσματικότητα των μη τακτικών μέτρων νομισματικής πολιτικής.

Η δεύτερη εμπειρική μελέτη διερευνά τον αντίκτυπο της νομισματικής πολιτικής της ΕΚΤ στις αποδόσεις των μετοχών των τεσσάρων συστηματικών ελληνικών χρηματοπιστωτικών ιδρυμάτων για την περίοδο Ιανουαρίου 2007 έως Αυγούστου 2018. Χρησιμοποιήθηκαν ανάλυση μελέτης γεγονότων και πολυπαραγοντικά μοντέλα παλινδρόμησης που συνδυάζουν διαστρωματικά δεδομένα με χρονολογικές σειρές και ένα σύνολο από 103 σημαντικές παρεμβάσεις που ανακοίνωσε η ΕΚΤ, και αφορούσαν τακτικά όσο και για μη τακτικά μέτρα νομισματικής πολιτικής. Για επικαλυπτόμενες ανακοινώσεις που περιείχαν δύο ή περισσότερες παρεμβάσεις

νομισματικής πολιτικής χρησιμοποιήθηκε η προσέγγιση των Ricci (2015), Fiordelisi and Galloppo (2018) προκειμένου να γίνει επιλογή της πιο σχετικής παρέμβασης. Για κάθε μια παρέμβαση ξεχωριστά υπολογίσαμε τις σωρευτικές μη κανονικές αποδόσεις σε μια περίοδο γεγονότων έως τρεις ημέρες (-1,+1).

Εκτιμώντας ένα πάνελ οικονομετρικό υπόδειγμα και χρησιμοποιώντας την τεχνική των ψευδομεταβλητών βρήκαμε ότι οι ανακοινώσεις που σχετίζονται με μείωσης των επιτοκίων (χρησιμοποιήθηκαν κυρίως στα πρώτα στάδιά της κρίσης), είχαν θετική και στατιστικά σημαντική επίπτωση στις σωρευτικές μη κανονικές αποδόσεις των ελληνικών χρηματοπιστωτικών ιδρυμάτων σε ένα πολύ σύντομο χρονικό διάστημα τριών ημερών διαπραγμάτευσης. Από την άλλη πλευρά, οι δυσμενείς συνέπειες της ελληνικής κρίσης χρέους, τα τρία προγράμματα οικονομικής προσαρμογής που εφαρμόστηκαν από την Ελληνική κυβέρνηση, η αναδιάρθρωση του δημόσιου χρέους και η ανακεφαλαιοποίηση των συστημικών ελληνικών τραπεζών από τον επίσημο τομέα, περιόρισαν την αποτελεσματικότητα των μη τακτικών μέτρων, καθώς οι επενδυτές έχασαν σταδιακά την εμπιστοσύνη προς την ελληνική οικονομία και τις τοπικές τράπεζες.

Η τρίτη επιστημονική έρευνα χρησιμοποιεί μελέτη ανάλυσης γεγονότων και οικονομετρικά υπόδειγμα που συνδυάζουν διαστρωματικά δεδομένα με χρονολογικές σειρές (πάνελ υποδείγματα) όμοια με αυτά της δεύτερης μελέτης, προκειμένου να εξετάσει την ανταπόκριση των μετοχών δεκατεσσάρων ευρωπαϊκών τραπεζικών ιδρυμάτων μεγάλου μεγέθους στην ανακοίνωση των παρεμβάσεων επεκτατικής πολιτικής της ΕΚΤ από τον Ιούλιο του 2007 έως τον Δεκέμβριο του 2020. Η κύρια διαφορά με τη δεύτερη μελέτη είναι ότι, η τρίτη μελέτη, αντιμετωπίζει τις επικαλυπτόμενες ανακοινώσεις που περιέχουν δύο ή περισσότερα μέτρα επεκτατικής πολιτικής χωρίς τη χρήση υποκειμενικών κριτηρίων για την επιλογή του πιο σχετικού μέτρου, επειδή αυτό θα μπορούσε να οδηγήσει σε απώλεια σημαντικού αριθμού παρατηρήσεων. Για να διατηρηθούν όλα τα μέτρα επεκτατικής πολιτικής στο δείγμα, χρησιμοποιήθηκε συγκεκριμένο σύνολο ψευδομεταβλητών στο υπόδειγμά με σκοπό την επεξεργασία επικαλυπτόμενων ανακοινώσεων. Τα ευρήματα έδειξαν ότι οι επενδυτές δίνουν μεγάλη προσοχή στις ενέργειες της ΕΚΤ, καθώς τόσο οι συμβατικές όσο και οι μη συμβατικές επεκτατικές πολιτικές έχουν θετικό αντίκτυπο

στις μετοχές των τραπεζών σε διαφορετικές όμως περιόδους γεγονότων. Μεταξύ των επεκτατικών μέτρων, οι αγορές περιουσιακών στοιχείων έχουν ισχυρότερη και μακροβιότερη επίδραση στις αποδόσεις των τραπεζικών μετοχών.

Στην τέταρτη εμπειρική μελέτη διερευνούμε την αποτελεσματικότητα των μη συμβατικών μέτρων της ΕΚΤ στην ενίσχυση της τραπεζικής πιστωτικής επέκτασης στη ζώνη του ευρώ. Σε αντίθεση με προηγούμενες μελέτες που χρησιμοποιούν δεδομένα σε επίπεδο τραπεζών (μεταξύ άλλων αυτές των Gambacorta 2005, Gambacorta and Marques-Ibanez 2014, Grandi 2019, Boechx et al. 2020, Burietz and Picault 2023), αυτή η έρευνα χρησιμοποιεί συγκεντρωτικά δεδομένα δανείων σε επίπεδο χωρών για δεκαπέντε οικονομίες της ζώνης του ευρώ για την περίοδο Ιουλίου 2007 έως Ιουνίου 2021. Επεξεργαζόμαστε μηνιαία δεδομένα από τρεις κύριες κατηγορίες δανείων και πιο συγκεκριμένα, τα συνολικά δάνεια των χρηματοπιστωτικών ιδρυμάτων της ζώνης του ευρώ, τα δάνεια προς τον ιδιωτικό τομέα και τα δάνεια σε μη χρηματοπιστωτικές εταιρείες. Χρησιμοποιούμε ανάλυση παλινδρόμησης πάνελ με πολλαπλές εναλλακτικές εξειδικεύσεις του οικονομετρικού υποδείγματος προκειμένου να αναλυθούν σε βάθος οι παράγοντες της πιστωτικής επέκτασης. Τα εμπειρικά ευρήματα υποδηλώνουν ότι τα μη τακτικά μέτρα της ΕΚΤ (προσεγγιζόμενα από διαφορετικές εναλλακτικές μεταβλητές) ενισχύουν πράγματι την πιστωτική επέκταση των τραπεζών και είναι σύμφωνα με τα αποτελέσματα προηγούμενων μελετών. Επιπλέον, η σύγκριση μεταξύ των χωρών δείχνει την παρουσία ετερογένειας στη μετάδοση της μη τακτικής πολιτικής όσον αφορά την επέκταση των τραπεζικών πιστώσεων, αποκαλύπτοντας ασθενέστερη επίδραση στις ευάλωτες οικονομίες της ευρωζώνης που επηρεάστηκαν περισσότερο από τη χρηματοπιστωτική κρίση και την κρίση χρέους.

Σε σύγκριση με τις προγενέστερες εργασίες, η παρούσα διδακτορική διατριβή συνεισφέρει στη βιβλιογραφία με διάφορους τρόπους. Πιο συγκεκριμένα η πρώτη ερευνητική εργασία χρησιμοποιεί υποδείγματα πάνελ παλινδρομήσεων με μηνιαία δεδομένα και τη μέθοδο των ψευδομεταβλητών προκειμένου να αναλύσει τη μεσοπρόθεσμη επίδραση της επεκτατικής νομισματικής πολιτικής στις αποδόσεις των χρηματιστηριακών δεικτών. Οι προγενέστερες εργασίες είτε χρησιμοποιούν μελέτες ανάλυσης γεγονότων με υποδείγματα πάνελ παλινδρομήσεων και ημερήσια

δεδομένα προκειμένου να διερευνήσουν το πολύ βραχυπρόθεσμο αποτέλεσμα της νομισματικής πολιτικής στις αποδόσεις των χρεογράφων (Falagiarda and Reitz 2015, Georgiadis and Gräb 2016, Rici 2015, Haitsma et al. 2016, Fiordelisi and Galloppo 2018, Pacicco et al. 2019, Chebbi 2019), είτε κάνουν χρήση υποδειγμάτων αυτοπαλίνδρομων διανυσμάτων (VAR) για να διερευνήσουν την μεσομακροπόθεσμη σχέση τους (Boechx et. al. 2017, Lewis and Roth 2019; Evgenidis and Papadamou 2021; Weale and Wieladek 2022, Van der Zwan et al. 2024)

Κίνητρο για τη δεύτερη εμπειρική μελέτη ήταν το γεγονός ότι δεν υπήρχε στη βιβλιογραφία έρευνα που να αφορά αποκλειστικά την επίδραση της νομισματικής πολιτικής στις χρηματιστηριακές τιμές των μετοχών των τεσσάρων συστημικών Ελληνικών τραπεζών. Οι τράπεζες αυτές λειτουργούσαν σε μια εθνική οικονομία που επηρεάστηκε δυσανάλογα από την κρίση χρέους, καθώς ήταν σε ύφεση για μεγάλο χρονικό διάστημα, εμφάνισε σημαντικά δημοσιονομικά ελλείματα και χρειάστηκε να εφαρμοστούν τρία προγράμματα δημοσιονομικής προσαρμογής για να αποφύγει την χρεοκοπία.

Η τρίτη εμπειρική έρευνα, σε σύγκριση με τις προγενέστερες μελέτες, δεν εξετάζει μόνο την επιρροή κάθε μέτρου επεκτατικής νομισματικής πολιτικής στις αποδόσεις των μετοχών των μεγάλων Ευρωπαϊκών τραπεζών αλλά προχωρά και σε αξιολόγηση του μεγέθους και της διάρκειας επίδρασης κάθε μέτρου.

Τέλος, η τέταρτη μελέτη συνεισφέρει στη βιβλιογραφία καταδεικνύοντας μια διαρθρωτική μεταβολή στον αντίκτυπο των μη τακτικών παρεμβάσεων στην πίστωση επέκταση, καθώς προκύπτει περιορισμένη επίδραση των μη τακτικών μέτρων στην πρώτη υποπερίοδο πριν τα βραχυπρόθεσμα επιτόκια φτάσουν στο κατώτερο τους όριο (zlb) λόγω του μικρότερου μεγέθους αυτών των παρεμβάσεων κατά την διάρκεια αυτής της υποπεριόδου.

**Λέξεις κλειδιά:** Ευρωπαϊκή Κεντρική Τράπεζα, συμβατική και μη συμβατική νομισματική πολιτική, χρηματοπιστωτική κρίση, Ευρωπαϊκή κρίση δημοσίου χρέους, τιμές μετοχών, πιστωτική επέκταση.

## Abstract

One of the dominant research topics of the last decades in the field of financial economics is the impact of monetary policy on various financial assets. Studies concerning the period before the global financial crisis analyze mainly Fed's conventional monetary policy[2]. In the 1990s, many researchers used vector autoregressive (VAR) models to explore the long term influence of regular monetary policy on equity returns (Patelis 1997; Thorbecke 1997). Ehrmann and Fratzscher (2004) as well as Bernanke and Kuttner (2005) used event study analysis to examine how the Fed's policy rate changes affect the US financial markets.

When the severe economic crisis hit financial markets in 2007, ECB, in collaboration with other major central banks, launched new unconventional monetary policy measures to stabilize capital markets, revive economic activity and enhance credit expansion. New non-conventional monetary policy tools were a historic milestone in global monetary policy having decisively contributed to the solvency of the whole financial system.

More specifically, during the financial and sovereign debt crisis the ECB reduced its key interest rates to zero lower bound, offered unlimited liquidity in fixed interest rate to euro area MFIs, extended the maturity of longer term refinancing operations, expanded the list of eligible collateral in refinancing operations and conducted small scaled purchases of assets via the first and second Cover Bond Purchasing Programs (CBPP I-II) and the Securities Markets Program (SMP). ECB also announced the Outright, open market, Monetary Transactions program (OMTs) which was never activated.

In the low inflation period, ECB engaged in credit easing measures (targeted longer term refinancing operations) and quantitative easing measures (large scaled security purchases through the expanded asset purchasing program- APP) to address the risk of deflation. Also, the ECB lowered the deposit facility rate to negative territory and offered forward guidance on the future direction of its monetary policy.

[2] According to Borio and Disyatat (2016) conventional monetary policy concerns the management of the short maturity interest rates and regular open market operations.

In the covid-19 crisis period ECB announced a pandemic emergency (asset) purchasing programme (PEPP) and non-targeted pandemic emergency longer-term refinancing operations (PELTROs) to neutralize the covid-19 related risks.

Several research papers have explored the impact of the ECB's non-conventional monetary policy decisions on stock prices (see among other Rogers et al. 2014; Georgiadis and Gräb 2016; Haitsma et al. 2016; Fratzscher et al. 2016; Pacicco et al. 2019; Chebbi 2019; Weale and Wieladek 2022; Van der Zwan et al. 2024). Furthermore, recent previous studies have examined the efficiency of the ECB's non-conventional operations on bank credit supply (see, among others, Gambacorta and Marques-Ibanez 2014; Boechx et al. 2017; Martins et al. 2019; Grandi 2019; Boechx et al. 2020; Benetton and Fantino 2021; Burietz and Picault 2023; Sleibi et al. 2023).

Considering previous research, the aim of this doctoral thesis is to contribute to the literature by investigating as well as by explaining the effect of non-conventional monetary policy measures on stock prices and on credit growth of the euro area. The impact of ECB's monetary policy on Eurozone has become crucial to the research field because the unified monetary policy carried out by the ECB concerns member states with separate fiscal policy, heterogeneous economic systems and state structures, as well as different business cycles.

The first chapter of the doctoral dissertation describes analytically the evolution of the ECB's unconventional monetary policy measures from the eruption of the financial crisis to the covid-19 pandemic crisis.

The second chapter of this thesis studies whether expansionary conventional and non-standard monetary interventions introduced by the ECB, affected market equity returns of eight eurozone countries in the medium run. In addition, to investigate whether stock markets reacted heterogeneously to expansionary monetary policy innovations and to other covariates we grouped our country sample into two sub-samples, core countries and peripheral countries.

Results showed that expansionary conventional monetary policy has a positive and statistically significant lagged impact on equity market returns with different levels of statistical significance for the entire country sample, the core countries, and the

peripheral countries. We also documented that ECB's non-conventional expansionary interventions had a positive and statistically significant lagged impact on core eurozone markets that were less influenced by the economic crisis. Peripheral countries experienced credit rating downgrades and were forced to apply economic adjustment programs that increased investors' uncertainty during and after the sovereign debt crisis, boosted capital outflows from these markets and decreased expectations about unconventional monetary policy measures.

The second empirical study explores the impact of the ECB's monetary policy on stock returns of the four systematically important Greek regional MFIs for the period January 2007 to August 2018. We used event study analysis with multivariate panel regression models and a data set of 103 important interventions introduced by the ECB, for both traditional and non-standard monetary measures. We classified the ECB's monetary interventions into four categories: interest rate increases, interest rate cuts, monetary easing (i.e. asset purchases), and extra ordinary liquidity. For overlapping announcements that contain two or more interventions the study adopts the procedure of Ricci (2015), Fiordelisi and Galloppo (2018), to select the most relevant intervention. For each intervention we calculate cumulative abnormal reruns (CARs) up to three days event window (-1,+1).

By estimating a panel regression model using dummy variables procedure we found that interest rate cut announcements (introduced mainly in the first stages of crisis), had positive and statistically significant impact on Greek MFIs′ CARs in a very short event period of three days. On the other hand, the harmful consequences of Greek debt crisis, the three economic and adjustment programs implemented by the Greek government, the restructuring of public debt and the recapitalization of the systemic Greek banks from the official sector, limited the effectiveness of non-standard measures, because investors gradually lost confidence towards Greek economy and the local banks.

The third study employs event study and panel econometric analysis similar to the second in order to examine the stock response of fourteen large European banking institutions to the announcement of the ECB's expansionary policy interventions from July 2007 to December 2020. The main difference with the second study, is that the

third study deals with overlapping announcements that contain two or more measures with out to use subjective criteria to select the most relevant measure because it could lead to the loss of a significant number of observations. To keep all expansionary measures in the sample we include a specific set of dummy variables in our model to process overlapping announcements. Findings suggest that investors give great attention to the ECB's actions as both standard and non-standard expansionary policies have a positive impact on bank stocks in different event windows. Among the expansionary measures, asset purchases have the largest and longest impact on bank stock returns.

In the fourth empirical study we explore the effectiveness of the ECB's nontraditional measures in boosting bank credit in the euro area. In contrast with previous studies which use bank-level credit data (see, among others Gambacorta 2005; Gambacorta and Marques-Ibanez 2014; Grandi 2019; Boechx et al. 2020, Burietz and Picault 2023) this research employs country aggregate loan data for fifteen euro area economies for the period July 2007 to June 2021. We process monthly data from three main categories of aggregate loans, and more specifically, total loans in euro area residents, loans to the private sector and loans to non-financial corporations and use panel regression analysis with different model specifications to analyze credit channel. Empirical findings suggest that the ECB's non-regular measures (proxied by alternative variables) indeed support credit expansion and are in line with the results of previous studies. Moreover, the cross-country analysis indicates the presence of heterogeneity in the transmission of non-regular policy on credit, revealing weaker effects for distressed eurozone economies as they were more affected by the financial and debt crisis.

In comparison with previous studies, the current doctoral thesis contributes to literature in several ways. More specifically, the first research study uses panel regression models with monthly data and the dummy variables method in order to analyze the medium-term effect of expansionary monetary policy measures on stock market indices returns. Previous papers use either event analysis studies with panel regression models and daily data (Falagiarda and Reitz 2015; Georgiadis and Gräb 2016; Rici 2015; Haitsma et al. 2016; Fiordelisi and Galloppo 2018; Pacicco et al. 2019;

Chebbi 2019) in order to investigate the very short-term effect of monetary policy on security returns (Georgiadis and Gräb 2016; Rici 2015; Haitsma et al. 2016; Fiordelisi and Galloppo 2018; Pacicco et al. 2019; Chebbi 2019), or use VAR models to investigate the medium to long run relationship (Boechx et. al. 2017, Lewis and Roth 2019; Evgenidis and Papadamou 2021; Weale and Wieladek 2022, Van der Zwan et al. 2024)

The motivation for the second empirical study was the fact that there was no research in the literature that exclusively concerns the effect of monetary policy on the stock prices of the four systemic Greek banks. These banks operated in a national economy that was disproportionately affected by the debt crisis, as it was in recession for a long period of time, faced significant budget deficits, and had to implement three fiscal adjustment programs to avoid default.

The third empirical study, in relation to previous papers, not only examines the influence of each expansionary monetary policy measure on the stock returns of large-sized European banks, but also proceeds to the evaluation of the strength and persistence of each measure.

Finally, the fourth study contributes to the literature by demonstrating a structural change in the impact of non-regular interventions on credit as it finds a limited (smaller) effect in the first, pre zero bound subperiod, due to the smaller size of these interventions during this subperiod.

**Key words:** European Central Bank, conventional and unconventional monetary policy, financial crisis, european sovereign debt crisis, stock prices, credit expansion.

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## List of Abbreviations

ABSPP Asset-Backed Securities Purchase Programme

APP Asset Purchase Programme

ARs Abnormal Returns

BoE Bank of England

BoG Bank of Greece

BoJ Bank of Japan

BS Total Balance Sheet Assets

CARs Cumulative Abnormal Returns

CBPP-I First Covered Bond Purchase Programme

CBPP-II Second Covered Bond Purchase Programme

CBPP-III Third Covered Bond Purchase Programme

CSPP Corporate Sector Purchase Programme

DEP Deposits

DF Deposit Facility

DFr Deposit Facility Rate

EBA European Banking Authority

ECB European Central Bank

EFSF European Financial Stability Facility

ELB Effective Lower Bound

EMU Economic and Monetary Union

ESI Economic Sentiment Indicator

ESM European Stability Mechanism

EU European union

Fed Federal Reserve

FWG Forward guidance

FRFA Fixed rate full allotment

FTOs Fine-Tuning Operations

GDP Gross Domestic Product

GLS Generalized Least Squares

GSIFIs Globally Significant Financial Institutions

INFL Inflation

IP Industrial Production

LTROs Long-Term Refinancing Operations

ME Monetary Easing

MFIs Monetary Financial Institutions

MLF Marginal Lending Facility

MLFr Marginal Lending Facility rate

MROs Main Refinancing Operations

MROr Main Refinancing Operations rate

MRR Minimum Reserve Requirements

NCBs National Central Banks

NIRP Negative Interest Rate Policy

NFC Non-Financial Corporations

NPLs Non Performing Loans

OLS Ordinary Least Squares

OMOs Open Market Operations

OMT Outright Monetary Transactions

PCSE Panel-Corrected Standard Errors

PELTROs Pandemic Emergency Longer-Term Refinancing Operations

PEPP Pandemic Emergency Purchase Programme

PSPP Public Sector Purchase Programme

QE Quantitative easing

SHMPP Securities Held for Monetary Policy Purposes

SLTROs Supplementary Long-Term Refinancing Operations

SMP Securities Markets Programme

SVAR Structural Vector Autoregressive

TLTROs Targeted Long-Term Refinancing Operations

TLTROs-I First  series of Targeted Long-Term Refinancing Operations

TLTROs-II Second series of Targeted Long-Term Refinancing Operations

TLTROs-III Third series of Targeted Long-Term Refinancing Operations

TSLS Two-Stage Least Squares

VAR Vector Autoregressive

VLTROs Very Longer-Term Refinancing Operations

ZLB Zero Lower Bound

# General Introduction

The eruption of the financial crisis, in the second semester of 2007, caused great uncertainty to global capital markets and developed economies. European MFIs suffered from liquidity shortage due to the freezing of short-term funding markets and started to reduce lending to firms and households. European capital markets slowed down, and economic activity was disrupted as negative spillovers emerged from the financial sector to real economy leading to economic recession and later to sovereign debt crisis.

To recover from recession European governments engaged in fiscal loosening causing credit rating downgrades and sovereign bond yields increases in fiscally weaker peripheral countries due to the large budget deficits and acceleration of debt. The ECB introduced countercyclical policy, combining regular and non-regular measures to boost bank lending, relieve capital markets, revive real economy and support financially distressed countries.

In particular, in the first phase of the financial crisis, ECB decreased significantly the rate of main refinancing operations and introduced unconventional monetary policy measures that included unlimited liquidity provision in fixed interest rate to euro area MFIs, maturity expansion of longer-term refinancing operations, extension of accepted collateral in refinancing operations, currency swap agreements with the US Fed and purchases of euro area covered bank bonds from primary and secondary markets (CBPP-I).

In the so-called sovereign debt crisis (second phase of the crisis), the ECB tried to enhance credit access conditions and support euro area financially distressed countries. The ECB launched the Securities Market Programme (SMP) to intervene in the secondary markets by buying public securities of distressed countries, activated a complementary covered bond program (CBPP-II) and carried out two, 36 months, very longer-term refinancing operations (VLTROs). In September 2012, the ECB introduced outright monetary transactions (OMT) and, from June 2013, provided forward

guidance for its future monetary policy to influence medium and long-term expectations.

In the subsequent period of low inflation ECB's non-standard measures addressed the risk of deflation as well as the avoidance of credit crunch. The ECB's measures included: a negative interest rate on the deposit facility, two series of targeted longer-term refinancing operations (TLTROs), designed to support bank lending to businesses and households, an expanded asset purchase programme (APP), involving purchases of private and public sector securities, to put downward pressure on the term structure of interest rates. In 2018 ECB started to taper its asset purchases as the inflation target was reached and the economic cycle continued to expand steadily.

In 2019 the ECB tried to protect favorable credit conditions, economic activity, and transition of monetary policy by announcing both the third iteration of the targeted LTROs and the reactivation of APP with 20 billion euros monthly purchases of private and public sector assets. Not long after these measures, in the first two months of 2020, the coronavirus pandemic erupted. The ECB responded by announcing both pandemic emergency quantitative and credit easing programs (PEPP and PELTROs respectively) to stabilize financial markets, boost credit operations and neutralize the covid-19 related risks.

Several pioneer studies have surveyed the beneficial impact of the SMP and OMT programs on government bond yields mainly for distressed eurozone member states (see among others Falagiarda and Reitz 2015; Kiplonen et al. 2015; Altavilla et al. 2016; Eser and Schwaab 2016; Ghysels et al. 2017; Jäger and Grigoriadis 2017; Krishnamurthy et al., 2018; Trebesch and Zettelmeyer 2018; Acharya et al. 2019; Demir et al. 2022; Mody and Nedeljkovic 2024).

Various prominent papers have explored the effect of the ECB's non-conventional monetary policy decisions on equity markets (see among other Rogers et al. 2014; Georgiadis and Gräb 2016; Haitsma et al. 2016; Boechx et al. 2017; Fratzscher et al. 2016; Pacicco et al. 2019; Chebbi 2019; Ferreira and Serra 2022; Weale and Wieladek 2022; Zwan van der et al. 2024).

In contrast, there are few surveys exploring the impact of the ECB's monetary interventions on stock returns of monetary financial institutions (Fiordelisi et al. 2014; Ricci 2015; Fiordelisi and Ricci 2016; Fiordelisi and Galloppo 2018).

Regarding bank lending, recent pioneer studies have examined the effectiveness of the ECB's non-regular operations on credit expansion (see, among others, Gambacorta and Marques-Ibanez 2014; Boechx et al. 2017; Salachas et al. 2017; Martins et al. 2019; Grandi 2019; Gibson et al. 2020; Boechx et al. 2020; Benetton and Fantino 2021; Sleibi et al. 2023; Burietz and Picault 2023). Also, some papers analyze ECB's specific non-regular liquidity provision measures. De Santis 2015; Adrande et al. 2018; Crosignani et al. 2020; Caprinelli and Crosignani 2021; analyzed VLTROs, Benetton and Fantino 2021; Andreeva and García-Posada 2021 focused on TLTROs-I and Laine (2021) on TLTROs-II.

The present doctoral dissertation is motivated by the investigation of the impact of the ECB's monetary policy on equity prices and the expansion of bank credit. Considering previous prominent studies, we use different datasets and apply alternative econometric methods to assess the effect of monetary policy interventions on stock and index prices and on bank credit expansion. After an analytical presentation of the ECB's unconventional monetary policy interventions in the period 2007 to 2021 and a comprehensive presentation of previous literature this thesis focused on the following research questions:

**RQ 1**: Do eurozone stock market indices react to ECB's expansionary monetary policy measures?

***RQ 2****: Is the reaction of stock market indices on the ECB's expansionary measures homogeneous between peripheral and core eurozone member states?*

***RQ 3:*** *What is the Greek banking sector response to the ECB's standard and non-standard monetary policy announcements?*

***RQ 4****: Which is the response of the large European banking institutions to the announcement of the ECB's expansionary conventional and non-conventional measures?*

***RQ 5**: Which is the effectiveness of the ECB's non-regular operations on bank credit?*

***RQ 6**. Does the effectiveness of non-regular policies on bank lending varies across euro area countries?*

The second chapter of the doctoral dissertation studies the impact of the ECB's expansionary monetary interventions (along with two main macroeconomic factors and a sentiment indicator) on market equity returns of eight eurozone countries. Two dummy variables are used to capture the impact of conventional and non-conventional expansionary measures on indices returns. What differentiates this study from previous ones is that it uses panel regression analysis with monthly data and the dummy variable procedure to investigate the medium run effect of expansionary monetary policy on market indices returns. Previous papers either use daily data with event study and panel regression analysis (Georgiadis and Gräb 2016; Rici 2015; Haitsma et al. 2016; Fiordelisi and Galloppo 2018; Pacicco et al. 2019; Chebbi 2019) to investigate the very short run effect of policy measures on returns or use VAR models to explore the long run relationship (Boechx et. al. 2017 Weale and Wieladek 2022; Van der Zwan et al. 2024). Empirical findings answer the first two research questions as they suggest that conventional and non-standard monetary policy innovations have a positive lagged impact on equity returns. More specifically, interest rate cuts evenly influenced all market indices while non-conventional actions mainly affected core eurozone countries that were less affected by the crisis. We also document a strong negative relationship between inflation rates and market returns and a positive effect of sentiment indicator on returns.

The third chapter investigates the effect of the ECB's monetary policy interventions on stock returns of the four systemic Greek MFIs for the period January 2007 to August 2018. The motivation of this study is the fact that there is no exclusive research for Greek banking institutions while Greek MFIs which operated in an economy which was hit harder, in relation to any other Eurozone member states, by the sovereign debt crisis. The Greek republic faced a great recession and large budget deficits, its government bond yields reached unsustainable levels and needed to approve three Economic Adjustment Programs to avoid default, refinance public debt and recapitalize banks. Regarding methodology, the study follows the approach of

Fiordelisi and Galloppo (2018). In the first step, we collect and classify 103 monetary interventions into four respective categories. For overlapping announcements that contain two or more interventions the study sets criteria as in Ricci (2015), Fiordelisi and Galloppo (2018), Vortelinos and Gkillas (2019) to select the most relevant intervention. Then for each intervention CARs are calculated using the market model for expected returns. Then a panel regression analysis is performed to identify CARs determinants using the dummy variables approach. Results answer the third research question as they suggest that only expansionary conventional monetary policy interventions introduced mainly in the first stages of crisis significantly affect equity returns of Greek banking institutions in a very short event period up to three days. On the other hand, the harmful consequences of Greek debt crisis (non-performing loans, restructuring of public debt, recapitalization of local MFIs) limited the impact of non-standard measures.

Chapter four responds to the fourth research question as it examines the stock response of large European banking institutions to the announcement of the ECB's expansionary policy interventions from July 2007 to December 2020. As we noticed earlier, only few previous papers explore the impact of the ECB's monetary interventions on stock returns of European MFIs (Fiordelisi et al. 2014; Ricci 2015; Fiordelisi and Ricci 2016; Fiordelisi and Galloppo 2018). This study uses event study and panel econometric analysis similar to the study in chapter three but differentiates in the way it addresses overlapping announcements. More specifically it adopts the approach of Fiordelisi and Ricci (2016) as it keeps all expansionary measures in the sample by including a specific set of dummy variables in the model to process overlapping announcements. Results showed that both traditional and nontraditional expansionary policies have a strong positive impact on stocks of large European banks in different event windows. What differentiates this study from previous ones (Fiordelisi et al. 2014; Ricci 2015; Fiordelisi and Ricci 2016; Fiordelisi and Galloppo 2018) is that it assesses which expansionary monetary policy measure has greater impact on bank stocks. Among the expansionary measures, asset purchases have the largest and longest impact on bank stock returns.

The fifth chapter provides evidence of the effectiveness of the ECB's non-regular measures in boosting bank credit in the euro area for the period July 2007 to June 2021. A significant difference with previous papers is that it uses loan data in country level instead of loan data in bank level (Gambacorta and Marques-Ibanez 2014; Grandi 2019; Boechx et al. 2020, Burietz and Picault 2023). It uses panel regression analysis with different model specifications and processes monthly data from three main categories of aggregate loans, (i.e. total loans, loans to the private sector and loans to non-financial corporations) and from fifteen countries to analyze credit channel. Results respond to fifth and sixth research questions. ECB's non-conventional measures (proxied by alternative variables) indeed enhance credit expansion in the euro area. This research contributes to the literature as it demonstrates a structural change in the impact of non-regular interventions on credit as it finds a limited (smaller) impact in the pre zero bound subperiod. Finally, the cross-country analysis indicates the presence of heterogeneity in the transmission of non-regular policy on credit revealing weaker effects for distressed eurozone economies.

# Chapter 1

# Evolution of the ECB's non-regular monetary policy measures

## 1.1 Introduction

In response to the financial market turmoil, the global economic and the sovereign debt crisis, the ECB, in cooperation with other major central banks, adopted traditional and non-regular monetary policies to revive financial and macroeconomic conditions in the euro area[3]. According to Borio and Disyatat (2016), and Fiorelli and Meliciani (2019) conventional measures concern the management of the ECB's short maturity interest rates and regular open market operations. Non-conventional policies are all other measures adopted by central banks in abnormal times to influence financial conditions beyond the regular policy by adjusting their balance sheet (e.g. large-scale security purchases and the supply of liquidity at longer maturities and for specific purposes). In the next subsections we present the chronology of the ECB's non-regular monetary policy interventions from 2007 to 2021.

## 1.2 Chronology of the ECB's non-regular monetary policy interventions[4]

The pre-global financial crisis period (2000 -2007) was characterized by price stability, expansion of economic activity, reduction in unemployment and steadily growth in bank credit supply (Hobelsberger et al., 2022). The ECB's conventional monetary policy was mainly focused on steering the short-term interest rate by utilizing regular market operations. In this period, developments in risk sharing securities (such as credit default swaps, asset back securities and collateralized debt obligations) allowed MFIs to expand its balance sheets and take on more risks. But when the value of the collateralized assets of these complex risky securities declined, MFIs (mainly in the US) suffered from significant losses.

[3] For a detailed description of the ECB's non-regular interventions since the eruption of market turmoil see Hartmann and Smets (2018), Rostango et al. (2019) and Hobelsberger et al. (2022).

[4] This subsection originates from our paper: Petrakis, N. and Lemonakis, C. (2024). A review of the ECB's non-regular monetary policy interventions. Annals of Social Science and Management Studies, 11 (2): 555807. https://dx.doi.org/10.19080/ASM.2024.11.555807

### 1.2.1 Market financial turmoil and global financial crisis

The financial turmoil emerged in mid-2007, due to the fall in the subprime mortgage market in the United States, caused significant losses to the banks of developed countries as these risky securities were packaged and sold to global financial system. The Eurozone MFIs started to suffer from liquidity shortage due to the collapse in the interbank and other financial markets.

The ECB responded immediately in August 2007, by offering unlimited liquidity to counterparties through fixed term fine tuning operations (FTOs) and supplementary longer-term operations with up to six-month maturity as well as with US dollar liquidity provision (Cour-Thiman and Winkler 2013). This policy was continued until the bankruptcy of Lehman Brothers in September 2008. This credit event signaled the beginning of the global economic crisis as financial market tensions intensified while global trade, consumption, investment, and production plummeted. Starting in October 2008, the european monetary authority moved away from floating-rate operations and adopted the full allotment fixed interest rate procedure (FAFR) for main and longer-term operations to support credit provision. In particular, MFIs had unlimited access to liquidity from the ECB at a pre-specified interest rate, if they could provide eligible collateral. (Falagiarda et al. 2015; Boechx et al. 2017). In addition, the ECB expanded the list of accepted collateral by reducing the threshold rating from A- to BBB-, extended the maturity of longer-term refinancing operations (LTROs) from three to twelve months and provided liquidity in foreign currencies through swap agreements.

The ECB also introduced the first covered bond purchase program (CBPP-I)[5] to buy a portfolio of covered bank bonds worth 60 billion euros from June 2009 to June 2010 (Galariotis et al. 2018; Burietz and Picault 2023). These interventions aimed to strengthen bank funding and improve credit supply.

[5] Beirne et al. (2011) found that CBPP improved market liquidity and encouraged MFIs to expand lending.

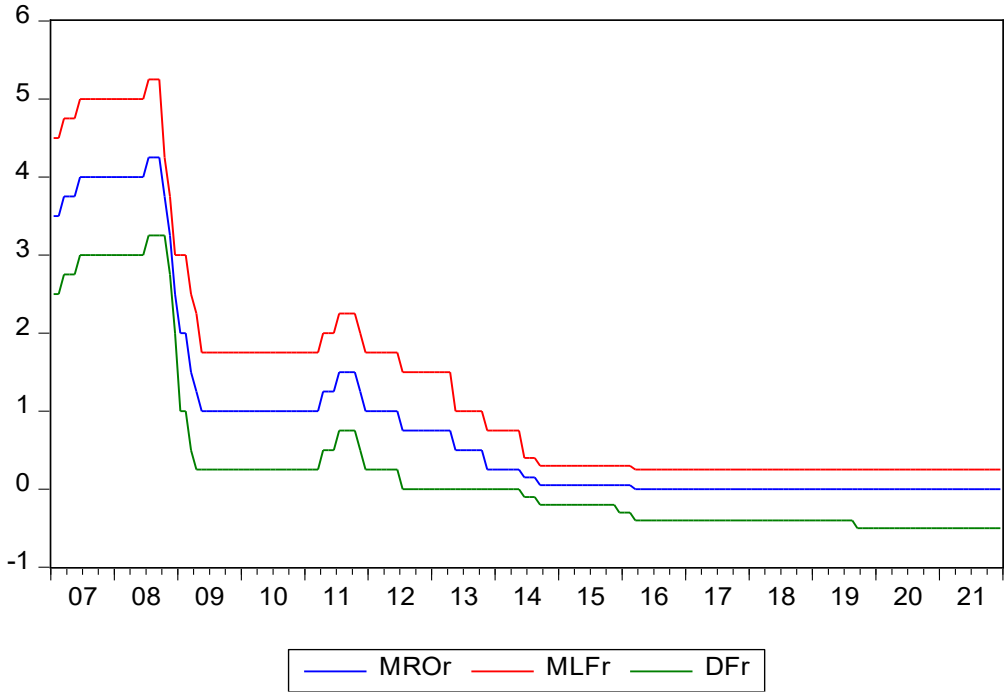



**Figure 1.1** ECB's key interest rates for the period 2007 to 2021 in percentages per annum. Source: Statistical data warehouse of the ECB.

We should underline that since 2008 ECB has used its conventional policy to boost credit operations and stabilize financial markets. As shown in figure 1.1. ECB lowers its main refinancing rate several times, from 4.25 percent in October 2008 to 1.0 percent in May 2009. The same path followed deposit facility rate (DFr) and marginal lending facility rate (MLFr).

### 1.2.2 European sovereign debt crisis

The global financial crisis caused significant imbalances to European sovereign public finances as governments adopted expansionary fiscal policies to support the local banking sector and to recover from recession. According to Kräussl et al. (2016), the average debt to GDP ratio across euro area countries rose from 72% in 2006 to 119.5% in 2014. Peripheral eurozone countries faced budget deficits and accelerating debt levels, which led to an increase in government bond yields. Specifically, seven euro area countries had 10-year bond yields above 6% over time (Greece, Italy, Spain, Portugal, Ireland, Cyprus, and Slovenia; Altavilla et al. 2017). In April 2010, Greece lost access to financial markets and became the focal point of the European debt crisis, having to sign its first adjustment program to receive financial assistance. Other peripheral countries (Ireland, Cyprus, Portugal, and Spain) also temporarily lost access

to capital markets and had to launch adjustment programs to obtain financial support (Petrakis et al. 2022a).

To support the financially distressed eurozone sovereigns, initially Greece, Ireland, and Portugal, the eurozone monetary authority launched the Securities Markets Programme (SMP) in May 2010, while the program reactivated in August 2011 for Italy and Spain (Galariotis et al. 2018). Under the SMP, the ECB purchased, from secondary markets, a portfolio of government assets worth 218 billion euros (102.8 billion euros for Italy, 44.3 billion euros for Spain, 33.9 billion euros for Greece, 22.8 billion euros for Portugal, and 14.2 billion euros for Ireland, Falagiarda and Reitz 2015), with all purchases being sterilized by liquidity provision operations ((Boechx et al. 2017; Fioreli and Meliciani 2019). Figure 1.2 presents SMP purchases of government bonds per country. According to literature, the SMP has a beneficial impact of sovereign bond spreads of distressed eurozone member states (see among others Falagiarda and Reitz, 2015; Szczerbowicz 2015; Eser and Schwaab, 2016; Fratzscher et al., 2016; Jäger and Grigoriadis, 2017; Ghysels et al. 2017; Krishnamurthy et al. 2018; Trebesch and Zettelmeyer, 2018).

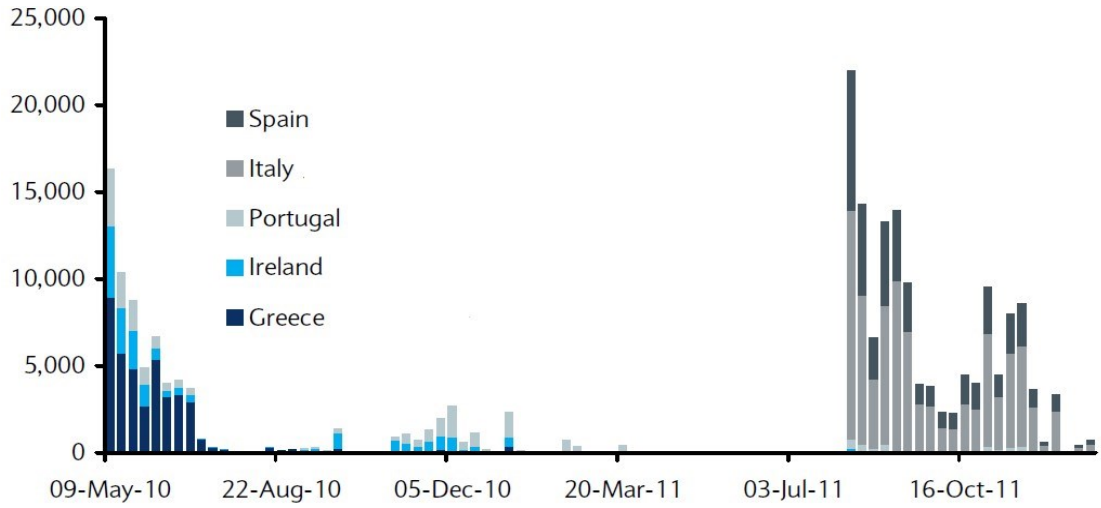



**Figure 1.2** SMP purchases per country in million euros. Source ECB , Jäger and Grigoriadis, 2017

In addition, in the last two months of 2011, the ECB attempted to restore the transition of monetary policy by launching a second covered bond program (CBPP-II) of 40 billion euros (Burietz and Picault 2023) and the very longer-term refinancing operations with

a maturity of 36 months (VLTROs)[6]. Also, ECB reduced the minimum required reserves ratio from 2% to 1% offering an additional amount of 100 billion euros in MFIs liquidity (Cour-Thimann and Winkler 2013). Table 1.1 presents monthly cumulative purchases under CBPP-II from primary and secondary markets. The share of secondary and primary market purchases to total cumulative purchases is 63.30% and 36.70% respectively at the expiration of the program.

**Table 1.1** Purchases under the CBPP-II in billion euros. Source ECB.

| Month | Primary markets | Secondary markets | Total cumulated purchases |
|---|---|---|---|
| November-11 | 0.23 | 1.30 | 1.53 |
| December-11 | 0.50 | 2.63 | 3.13 |
| January-12 | 2.27 | 3.24 | 5.51 |
| February-12 | 3.29 | 4.12 | 7.41 |
| March-12 | 3.72 | 5.49 | 9.21 |
| April-12 | 4.08 | 6.60 | 10.68 |
| May-12 | 4.32 | 7.94 | 12.26 |
| June-12 | 4.79 | 9.03 | 13.83 |
| July-12 | 5.02 | 9.51 | 14.53 |
| August-12 | 5.13 | 10.17 | 15.30 |
| September-12 | 5.91 | 10.30 | 16.21 |
| October-12 | 6.01 | 10.38 | 16.39 |

In 2012, the ECB launched the outright, open market, monetary transactions program (OMTs) in order to replace the SMP, but finally the new program was not activated. Only the announcement of the OMT program, which consisted of secondary market purchases of public bonds of stressed countries under an EFSF/ESM program, led to a significant reduction in eurozone sovereign bond spreads (Fratzscher et al., 2016; Altavilla et al., 2016; Jäger and Grigoriadis, 2017; Krishnamurthy et al., 2018; Acharya et al. 2019; Mody and Nedeljkovic 2024). As shown in figure A.1 in appendix A, the 10-year bond spreads of distressed eurozone countries started to decrease after the ECB's announcement of the SMP and the OMT.

[6] The beneficial impact of 3 years VLTROs on bank lending has been studied by Darracq Paries and De Santis (2015), Garcia-Posada and Marchetti (2016), Adrande et al. (2018) Crosignani et al. (2020) and, Caprinelli and Crosignani (2021).

Also, after modest increases, the ECB decreased its key short-term rates close to zero lower bound (see figure 1.1).

### 1.2.3 The low inflation period

Starting in the third quarter of 2013, the euro area entered a period of low inflation, when core inflation dropped under 1% and concerns about deflation risk emerged. To bring inflation to its main objective, below but close to 2%, the eurozone monetary authority since July 2013, offered forward guidance of its future monetary policy intentions, introduced a negative interest rate policy for the deposit facility[7,8] to encourage credit operations, and announced the Credit Easing Package (CEP). The CEP consisted of the first tranche of targeted longer term refinancing operations (TLTROs-I) which aimed to provide liquidity to eurozone MFIs on favorable terms for periods of up to four years upon eligible collateral[9], the third covered bond program (CBPP-III) and the outright purchases of asset backed securities (ABSPP). Tables 1.2 and 1.3 present distribution of CBPP-III and ABSPP holdings per country in the third quarter of 2021. The Eurosystem conducted net purchases of eligible securities from primary and secondary markets for both programs till the end of 2018 and then reinvested the principal payments. From November 2019 net security purchases for both programs restarted.

**Table 1.2** Distribution of CBPP-III holdings per country. Source ECB.

| Country | Holdings | Benchmark |
|---|---|---|
| France | 29% | 33% |
| Germany | 23% | 25% |
| Spain | 17% | 12% |
| Italy | 10% | 7% |
| Netherlands | 7% | 8% |
| Finland | 4% | 4% |
| Austria | 4% | 5% |
| Other (euro area) | 5% | 6% |

[7] In June 20014 the DFRr turned negative to -0.10 percent and finally reached -0.50 percent in September 2019.

[8] According to Molyneux et al. (2020) and Heider et al. (2021) negative interest rates led to less lending and more risk taking by eurozone MFIs.

[9] The weight average maturity of bank borrowing from Eurosystem was increased from 130 days to 804 days after the settlement of TLTROs-I (ECB 2015).

**Table 1.3** Distribution of ABSPP holdings per country. Source ECB.

| Country | Holdings | Universe |
|---|---|---|
| Netherlands | 38% | 32% |
| Germany | 24% | 20% |
| Italy | 9% | 14% |
| Spain | 14% | 19% |
| France | 11% | 10% |
| Ireland | 1% | 1% |
| Portugal | 2% | 3% |
| Finland | 1% | 2% |

On January 22, 2015, the government council of the ECB launched the expanded Asset Purchasing Programme (APP) by including Public Sector Purchasing Programme (PSPP) to the existing two programs[10]. PSPP includes purchases of sovereign bonds, bonds from recognized agencies, regional and local governments and international organizations. Figure 1.3 presents PSPP net cumulated purchases at the end of 2021 per country (and supranationals) with the largest shares coming Germany, France, Italy, Spain and Supranational organizations.

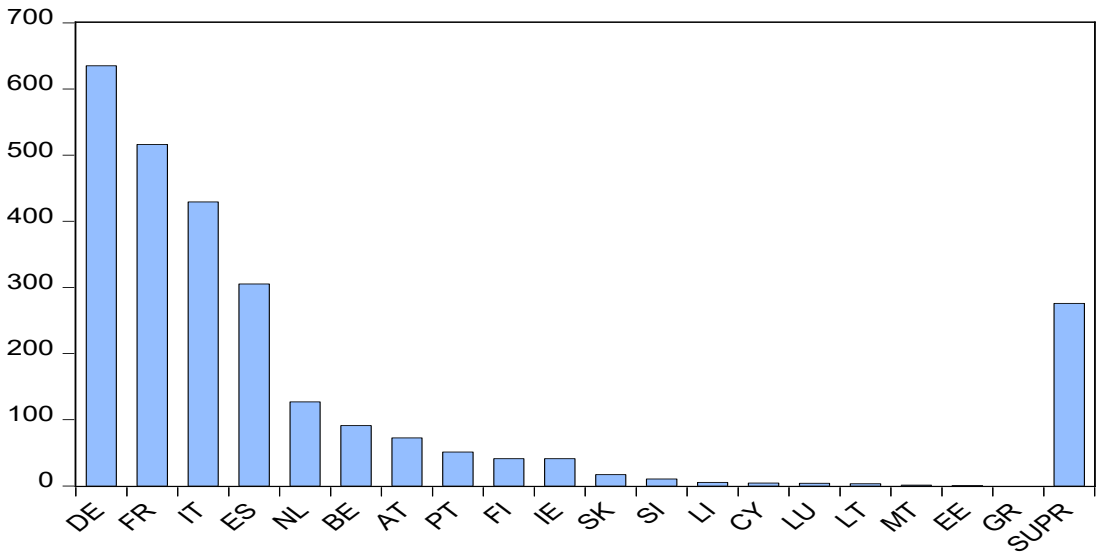



**Figure 1.3** PSPP net cumulated purchases till the end of 2021 per country and Supranational organizations, in billion euros. Source: ECB[11].

[10] For more details about APP see ECB (2019) Economic Bulletin, issue 2, https://www.ecb.europa.eu/press/economic-bulletin/articles/2019/html/ecb.ebart201902_01~3049319b8d.en.html

[11] Country codes: AU- Austria, BE- Belgium, DE- Germany, EE- Estonia, IE- Ireland, EL-Greece, ES- Spain, FI- Finland, FR- France, IT- Italy, CY- Cyprus, LV- Latvia, LT- Lithuania, LU- Luxembourg, MT- Malta, NL- Netherlands, PT- Portugal, SI- Slovenia, SK- Slovakia.

As we can see vulnerable eurozone countries (Greece, Portugal, Ireland and Cyprus) as well as Slovenia, Slovakia, Lithuania, Latvia and Estonia present very low cumulative purchases. Especially Greek sovereign bonds were ineligible for PSPP.

At the beginning of the expanded APP total purchases of public bonds and private securities amounting to 60 billion euros per month. In March 2016, security purchases were increased to 80 billion euros per month, a new corporate sector purchasing programme (CSPP)[12] was added to APP, and a second series of TLTROs (TLTROs-II) was implemented with a maturity up to 4 years. The ECB launched several recalibrations and extensions of the APP (net purchases of 60 billion euros from April to December 2017, 30 billion euros from January to September 2018 and 15 billion euros from October to December 2018) until the program expired at the end of 2018[13]. Overall, these accommodative measures in the form of credit easing (TLTROs) and quantitative easing (APP) helped eurozone inflation recover from its previously very low levels.

In March 2019 the ECB announced the third series of TLTROs (TLTROs-III)[14] and, in September, the reactivation of APP with 20 billion euros monthly purchases. Table 1.4 reviews the main characteristics of three rounds of TLTROs.

**Table 1.4** Main characteristics of three rounds of TLTROs. Source ECB.

| | Announced | Duration | Borrowing allowance | Pricing | Allotment in billion euros |
|---|---|---|---|---|---|
| TLTROs-I | June 5, 2014 | Up to 4 years | Initially 7% of eligible loans with additional allowance based on lending performance. | First two operations: MROr + 10 bps, subsequent operations average MROr | 418 |

[12] Total holdings of CSPP at the end of 2018 were 178 million euros.

[13] APP purchases were conducted by the Eurosystem with the ECB acting as coordinator. More specifically PSPP purchases were executed by the entire Eurosystem (involving securities of 110 issuers), CBPP-III purchases were executed by NCBs and ECB while six NCBs purchased securities under CSPP and ABSPP(ECB 2019).

[14] For more details about TLTROs-III see ECB (2021) Economic Bulletin, issue 6, available at https://www.ecb.europa.eu/press/economic-bulletin/articles/2021/html/ecb.ebart202106_02~35bf40777b.en.html

| | | | | | |
|---|---|---|---|---|---|
| TLTROs-II | March 10, 2016 | Up to 4 years | 30% of eligible loans | Min: DFr<br>Max: MROr | 750 |
| TLTROs-III | September 7, 2019 | Up to 3 years | Initially 30%, subsequently increased to 55% of eligible loans | Min DFr, Max: MROr (DFr – 50 bps from 24 June 2020) | 2,214 |

Figure 1.4 presents cumulative net purchases by APP program for the period 2015 to 2021 in billion euros. At the end of 2021 cumulative net purchases were 3,123.38 billion euros of which 2,487.14 billion euros (79.63%) concerns the PSPP, 309.68 billion euros (9.91%), the CSPP, 298.17 billion euros (9.55%) the CBPP-III and 28.40 billion euros (0.91%) the ABSPP.

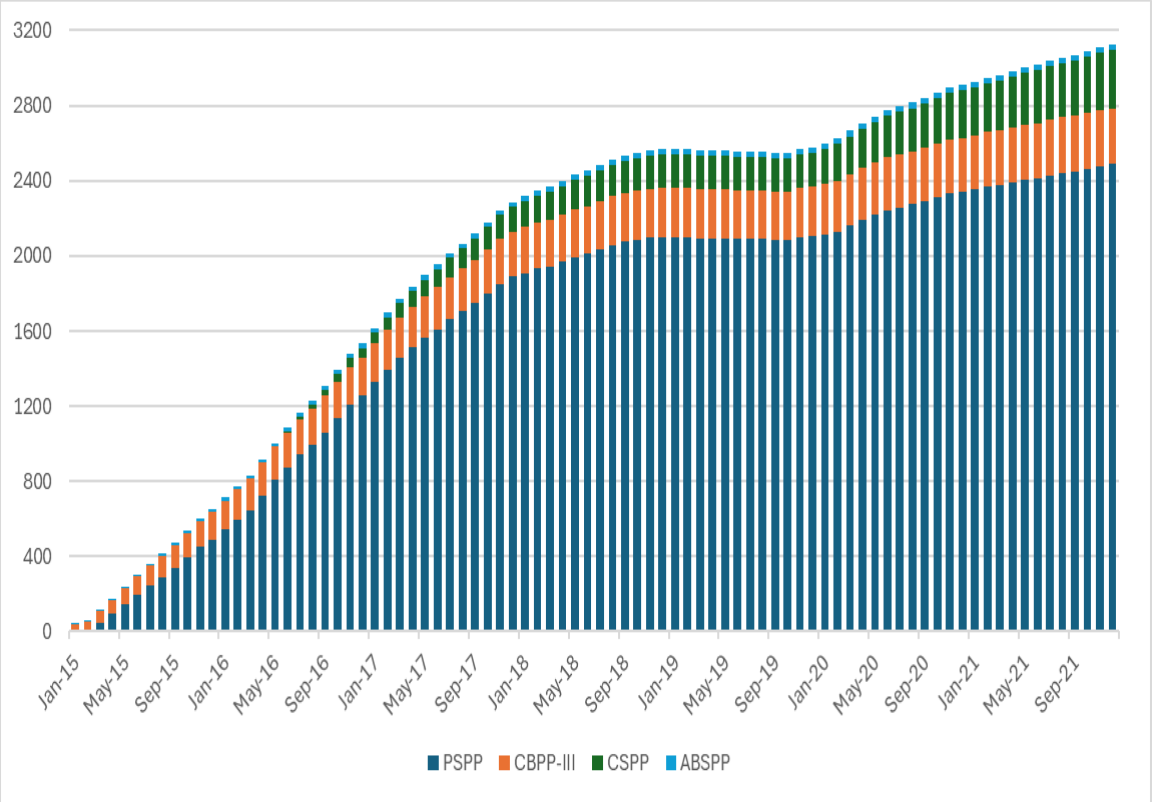



**Figure 1.4 C**umulative net purchases by APP program from 2015 to 2021 in billion euros.

### 1.2.4 The coronavirus pandemic crisis

The outbreak of the coronavirus crisis, in the first quarter of 2020, negatively affected eurozone economies and financial markets. The ECB tried to stabilize markets, reinforce

credit supply and ensure monetary policy transition by launching pandemic emergency purchase program (PEPP) of 750 billion euros, in March 2020, to purchase private and public assets and announced a temporary envelope of 120 billion euros for APP (Hobelsberger et al. 2022). In the following months the PEPP envelope was increased to a total amount of 1.85 trillion euros. Furthermore, the ECB launched a new tranche of pandemic emergency non-targeted LTROs (PELTROs) in May 2020 and proceeded to the recalibration of the third series of TLTROs (TLTROs-III). Figure 1.6 shows composition of refinancing operations from 2007 to 2021 broken into regular (MROs and 3-month LTROs) and non-regular operations (3-year LTROs, TLTROsI-III and PELTROs).

The implementation of non-regular liquidity provision policies led to a significant expansion of refinancing operations to 2.2 trillion euros at the end of 2021 (through TLTROs-III) while the regular operations decreased significantly.

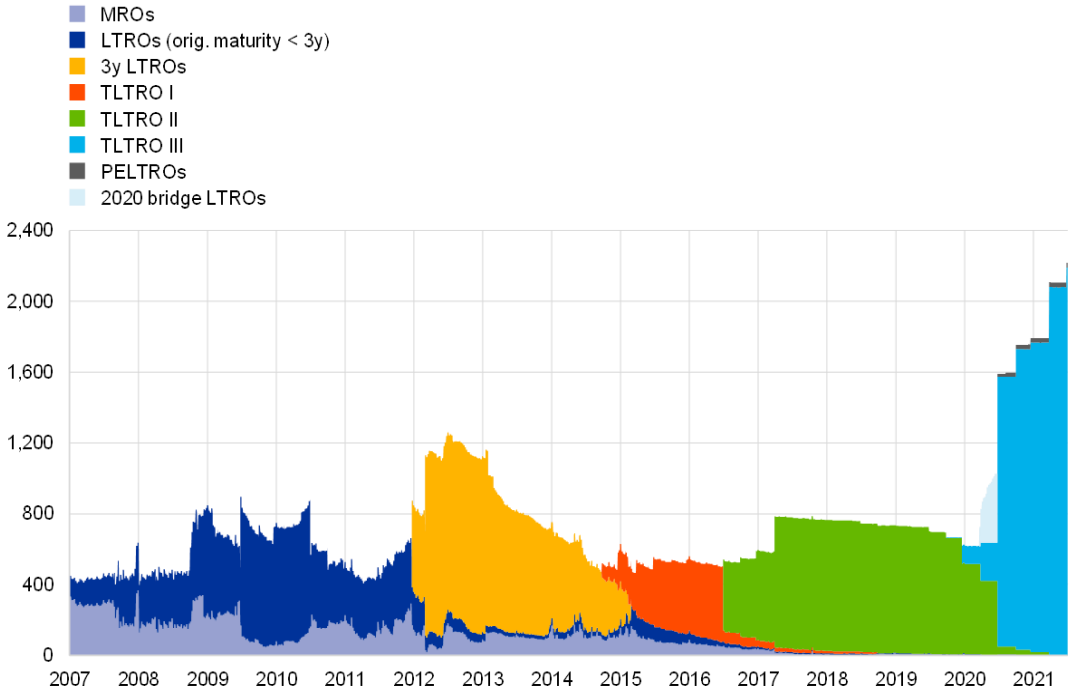



**Figure 1.5** Composition of refinancing operations from 2007 to 2021. Source: ECB.

Figure 1.6 presents public sector net cumulated purchases under PEPP at the end of 2021 per country (and supranationals). In comparison with figure 1.4, public purchases under PEPP are higher for distressed eurozone member states, as PEPP purchases were

extended to securities that are not eligible under the APP while eligibility requirements were full waived for Greek government bonds[15].

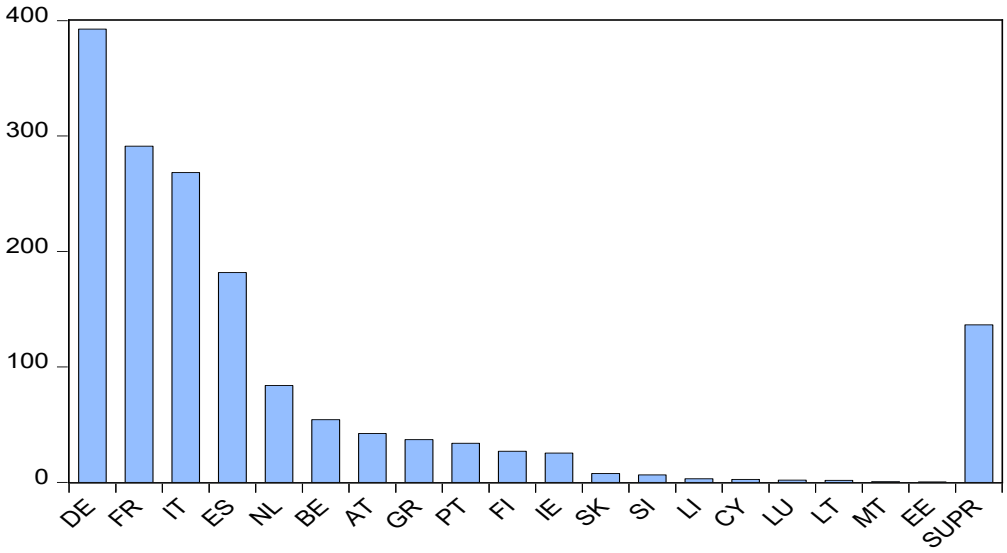



**Figure 1.6** Public sector net cumulated purchases under PEPP till the end of 2021 per country and Supranational organizations, in billion euros. Source: ECB.

Finally, figure 1.7 presents the upward path of the ECB's total assets from 1.1 trillion euros at the beginning of 2007 to 8.6 trillion euros at the end of 2021, mainly due to the implementation of unconventional measures (extraordinary liquidity provision and asset purchases)[16,17].

[15] Hubert et al. 2024 find different financial market effects between PSPP and PEPP as PSPP affects inflation swaps whereas PEPP impacts sovereign spreads.

[16] Securities held for monetary policy purposes includes ECB's asset purchases of private and public securities. Longer term refinancing operations includes the supplementary, very long term, targeted and pandemic emergency LTROs introduced by the ECB over time.

[17] Table A.1 in appendix A, presents ECB's unconventional monetary policy measures in chronological order.

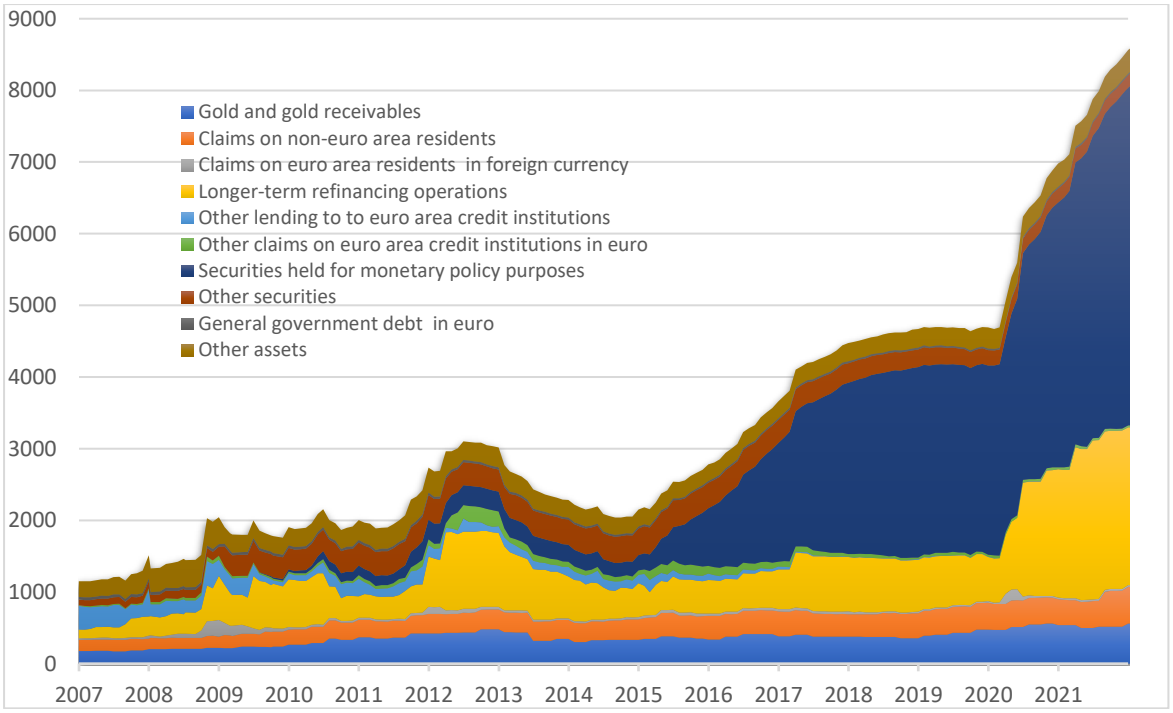



**Figure 1.7** ECB's assets in billion euros for the period 2007 to 2021.

### 1.3 Comparison with unconventional measures of other major central banks

We must point out that the ECB introduced monetary tools similar to those of other central banks. Major central banks, the Federal Reserve (Fed), the Bank of Japan (BoJ), and the Bank of England (BoE) cut key interest rates, adopted asset purchases programs, undertook longer term liquidity providing operations, and provided forward guidance. While the ECB and the BoJ implemented a negative interest rate policy, Fed and BoE did not adopt this measure (Dell' Ariccia et al. 2018). Moreover, liquidity-providing operations to commercial banks were more relevant for the ECB due to the bank-based financial structure of the euro area. Another significant difference is that the Fed started large-scale asset purchases in 2009 while, in the same period, ECB introduced purchases of covered bond (CBPP-I), a smaller scale program, focusing only on private sector debt securities. The ECB started large-scale purchases of public bonds in 2015 with the expanded APP.[18]

Unconventional monetary policy tools used by the Fed, BoJ, and the BoE aimed at and succeeded in reducing their own government bond yields while the ECB's actions aimed at intra Eurozone public bond spreads and not at the level of German yields. The ECB's tools targeted and succeeded in decreasing peripheral sovereign bond spreads with

[18] For more details see European Central Bank (2021), Assessing the efficacy, efficiency, and potential side effects of the ECB's monetary policy instruments since 2014, occasional paper series, no. 278.

German counterparts. Additionally, expansionary unconventional measures introduced by the Fed, BoJ, and the BoE caused domestic currency depreciation and corporate bond yield reduction. On the other hand, the ECB's measures resulted in the appreciation of the euro (Rogers et al. 2014).

# Chapter 2

## Eurozone stock market reaction to monetary policy interventions and other covariates[19]

### 2.1 Introduction

The financial turmoil and the sharp deterioration of the macroeconomic environment in 2008 caused significant shocks to capital markets and global economies. At the beginning of the economic crisis, there was great uncertainty about the financial health of globally significant financial institutions (GSIFIs), which led to intense pressure in interbank markets and a possible collapse in financial activity. In 2010, there were market expectations regarding a possible Greek sovereign default, because Greek government bond yields reached unsustainable levels with a risk of "infection" in Spain, Italy, Ireland, and Portugal. The impending sovereign debt crisis forced peripheral eurozone countries to apply for economic adjustment programs in order to receive financial support. With no access to money and capital markets, Greece launched three programs (lasting from May 2010 to August 2018) to refinance public debt, recapitalize banks, and cover budget deficits. In April 2011, the Portuguese government requested financial assistance to finance its budget and recapitalize the banks. In July 2012, Spain also requested financial support to restructure the country's banking system. Further, the Italian banking sector was hit hard during the second phase of the crisis. In addition, Ireland and Cyprus, two more peripheral countries, asked for loan packages[20]. Reacting to the global economic and debt crisis, the monetary authority of the euro area implemented both conventional and non-standard monetary policy measures to strengthen lending to the business sector, support financial activity, and support the eurozone countries facing sovereign debt difficulties.

[19] A version of this chapter was presented in the 11th national conference of the Financial Engineering and Banking Society (FEBS, 2021) and published in Journal of Risk and Financial Management, Vol. 15(2):56 https://www.mdpi.com/1911-8074/15/2/56

[20] For more information about financial assistance to Eurozone peripheral countries see https://www.esm.europa.eu/

This study explores the medium run influence of the ECB's expansionary monetary policy on equity returns of eurozone countries using the panel regression econometric method. Several previous studies surveyed the influence of monetary policy mainly on euro area capital markets (see, among others, Fratzscher et al. 2016; Haitsma et al. 2016; Hau and Lai 2016; Pacicco et al. 2019; Chebbi 2019). Considering previous research (Fama and Schwert 1977; Fama 1981, 1990; Schwert 1990; Baker and Stein 2004; Stambaugh et al. 2011), we also study (along with monetary policy interventions) whether two main macroeconomic factors, inflation and industrial production, and a sentiment indicator could affect market returns.

The sample consists of eight eurozone countries and covers the period from January 2007 to December 2017. The analysis period covers the first phase of the crisis (global economic crisis), the second phase (sovereign debt crisis), and the third phase (post debt crisis). We also group our country sample into two sub-samples, core euro area countries and peripheral countries, in order to investigate whether stock markets react heterogeneously to expansionary monetary policy innovations and other covariates. As we have previously noted, peripheral eurozone countries faced sovereign debt difficulties and were more affected by the economic crisis, while core countries were less influenced.

We address herein the research questions (RQs) analyzed within the framework of this study:

***RQ 1:*** *Do eurozone markets react to ECB's expansionary monetary policy interventions?*

***RQ 2:*** *Do inflation and output affect the returns of eurozone equity markets?*

***RQ 3:*** *What impact does a sentiment indicator have on the performance of eurozone stock markets?*

***RQ 4:*** *Is there a heterogeneous reaction to expansionary monetary policy innovations and to other covariates between core and peripheral eurozone countries?*

This study contributes to the literature by analyzing a wide set of monetary, macroeconomic, and sentiment variables that influence eurozone stock returns during and after a crisis period and helps to better understand how markets function. We also present a comparison between core and peripheral eurozone equity market reactions to expansionary monetary policy innovations and other covariates, and we perform a

comprehensive analysis to determine the significance of each variable. Our results are useful for both decision-makers and investors, in order to determine their financial strategies.

The rest of this chapter is structured as follows. First, in Section 2.2 we examine previous studies that provide evidence on the impact of the ECB's exceptional monetary policy on bond yields and equity returns. In Section 2.3, we seek to underscore the main transmission channels of monetary policy that influence equity returns. In Section 2.4, we describe the empirical approach used to analyze the influence of monetary policies along with main macroeconomic variables and a sentiment indicator on equity markets, as well as the data and methodology used to address the research questions. In Sections 2.5 and 2.6, we describe the main results and the robustness test of this study while section 2.7 concludes the study.

## 2.2 Literature review of monetary policy effects on bond and stock markets

Regarding research on monetary policy, several previous studies surveyed the influence of monetary policy mainly on US capital markets[21]. In the 1990s, many published papers used the vector autoregressive (VAR) approach. Patelis (1997), studying the US stock market from 1964 to 1992, provided evidence that monetary policy variables can determine future stock returns, but they cannot fully absorb the estimated return forecasting ability. Thorbecke (1997), applying VAR analysis, found that expansionary monetary policy raises equity returns. Jensen and Mercer (2002) reexamined the three-factor model, which contains market beta, market value, and book-to-market factors, as well as the monetary sector. They concluded that the stringency of monetary policy significantly influences the relationship between equity returns and the three variables. Ehrmann and Fratzscher (2004) concluded that for the period from February 1992 to January 2003, industry and individual stocks responded in a profoundly different way to the Fed's policy announcements. Ridogon and Sack (2004) studied the response of securities to monetary policy shifts and suggested using the identification through heteroscedasticity approach to overcome endogeneity issues. Bernanke and Kuttner (2005), applying event study methodology, documented

[21] See Sellin (2001) for a comprehensive literature review on how monetary policy affects stock prices.

a strong and statistically significant response of the US stock markets to monetary policy actions from May 1989 through December 2002. They also found that responses to unexpected monetary policy news tend to vary across industries.

Several research papers have considered the influence of the ECB's exceptional monetary policy on bond yields. Trebesch and Zettelmeyer (2018) showed that under the SMP, Greek bond yields substantially decreased. Falagiarda and Reitz (2015) concluded that from 2008 to 2012, announcements about SMP reduced the government bond spread of four distressed euro countries, while OMT announcements had an impact on only two of them. Kilponen et al. (2015) reported that the ECB's news about SMP and OMT reduced the 10-year bond spreads of seven European countries. Altavilla et al. (2016) reported that the ECB's announcements of outright monetary operations decreased the two-year sovereign bond yields of Italy and Spain by about 200 basis points. Jäger and Grigoriadis (2017) concluded that by increasing the magnitude of its balance sheet, the ECB successfully affected bond yield spreads, but heterogeneously, with a more significant effect on distressed countries.

Recent surveys have explored the impact of ECB´s monetary policy decisions on equity markets. Bohl et al. (2008) reported that European financial markets negatively responded to the unexpected conventional part of ECB's decisions, while ECB successfully communicated its policy. Bredin et al. (2009) pointed out that the VAR approach used in the late 1990s served as a panacea for the endogeneity problems. Using an event study approach similar to Bernanke and Kuttner (2005), they found that for the period May 1989 to May 2004, unexpected shocks to German and euro area monetary policies did not influence DAX and sectoral indices.

Rogers et al. (2014) examined the impact of non-standard monetary measures of the Federal Reserve (Fed), ECB, Bank of England (BoE), and Bank of Japan (BoJ) on rates of exchange, stock returns, and bond yields. To measure monetary policy innovations introduced by the ECB, using the change in the spread between Italian and German 10-year government bond yields. Many other researchers also followed this approach. They reported that the ECB's announcement of a non-conventional monetary policy had a positive and statistically significant effect on stock returns during the crisis period.

Fratzscher et al. (2016) evaluated the impact of the ECB's unconventional measures (SMP, OMT, VLTROs) on various asset returns from 2007 to 2012 and ended up showing positive results. Haitsma et al. (2016) tested the response of equity markets to the traditional and non-conventional monetary policies of the ECB from 1999 to 2015. They used the difference between the daily futures spot rate and proxy standard policy surprises and the change in the daily difference between German and Italian 10-year bond yields as a proxy for the unconventional surprises. They reported that unexpected non-conventional measures, more than conventional policies, affected the EURO STOXX 50 index. Georgiadis and Gräb (2016) found that the announcement of APP had global spillover, enhancing equity prices worldwide. Hau and Lai (2016) showed that expansive euro area monetary policy was related to a switch from money markets toward equity markets.

Fausch and Sigonius (2018), focusing on the German market, observed a significant equity response to unexpected policy interventions when the real interest rates were negative. Pacicco et al. (2019) applied a joint event study and panel fixed effects regression analysis to explore whether European monetary union (EMU) equity markets reacted to traditional and unconventional ECB policy innovations from April 1999 to June 2016. They concluded that conventional policies heterogeneously affected financial markets, while unconventional measures exerted homogeneous pressure on all markets. Fiorelli and Meliciani (2019), using structural vector autoregressive (SVAR) and factor augmented vector autoregressive (FAVAR) models, showed that conventional and unconventional monetary policies had mutual relations, and one cannot be substituted for the other; instead, the ECB should combine them to stabilize the eurozone's real economy. Chebbi (2019), using three measures of non-standard monetary policy, event study methodology, and an exponential general autoregressive conditional heteroskedastic (E-GARCH) base model of conditional volatility, concluded that for 2009 to 2015, the effect of non-standard monetary policy on stock returns of core and distressed countries was statistically significant and positive. Ferreira and Serra (2022) studied period 2008 to 2018 and argued that non-standard interventions by the Fed, BoE and ECB influenced positive equity indices.

### 2.3 Transmission channels of monetary policy

This section evaluates the main transmission channels of monetary policy that can influence the equity returns investigated in our research[22].

First, we analyzed the interest rate channel of conventional policy, which affects equity prices by influencing the present value of future net cash flows. According to Bernanke and Kuttner (2005), interest rate cuts reduce the risk-free rate used as a discount factor and reduce the equity risk premium while enhancing expected cash flows. Tobin (1978) argued that a contractionary policy decreases the present value of future flows and therefore reduces equity prices. Further, interest rate cuts reduce the cost of banks' refinancing operations, increase liquidity, enhance credit expansion, strengthen bank revenues, and boost asset prices.

Second, the literature proposes the confidence channel (see Falagiarda et al. 2015; Fratzscher et al. 2016). By taking immediate action when sovereign bond yields of peripheral countries reached unsustainable levels, the ECB, via asset purchasing programs (SMP, OMT, and PSPP), helped the markets to calm down. As a consequence, risk premia of stressed euro area countries were reduced and confidence was restored. Thus, there was an expectation that increased capital inflows in those countries would positively influence equity prices.

Third, the ECB could influence equity prices via the portfolio rebalancing channel (see among others Falagiarda et al. 2015; Georgiadis and Gräb 2016; Fratzscher et al. 2016; Bernanke, 2020, Vayanos and Villa 2021). Specifically, when the ECB purchases government bonds issued by euro area countries, their yields decrease. With lower yields, investors who hold them are encouraged to sell them and rebalance their portfolios by reinvesting in other securities such as bonds or equity.

Fourth, the direct pass-through and broad bank lending channels could also affect bank equity prices. TLTROs, the main instrument of these channels, are designed to provide long-term liquidity to banks, substitute market funding, and reduce their

[22] See Mishkin (2001) for a complete presentation of transition channels.

funding costs, thus decreasing bank liquidity risk. In addition, ECB through CBPPI-III raised the prices of covered bonds and lowered the cost of market funding for banks. Further, through TLTROs, euro area banks have an incentive to expand lending by increasing loans to non-financial firms and households. Such credit expansion, along with the decreased liquidity risk, is expected to boost equity prices by decreasing risk premiums (Fratzscher et al., 2016; Kashyap and Stein, 2023).

Fifth, from 2013, ECB has given forward guidance (known as the signaling channel), as it officially declared that key interest rates were anticipated to remain low for an extended period. Also, large-scaled security purchases provide a signal that short policy interest rates would remain low for extended periods (lower for longer rate policy, Bauer and Rudebusch 2014; Bernanke 2020). This signaling channel affects investors' expectations about the forecasted path of interest rates. The signaling channel of low-interest rates reduces uncertainty and volatility in the market, which is very important for investment. Consequently, the risk premium spread across riskier assets, such as stocks, decreased, resulting in equity price recovery.

Monetary policy transmission channels are not substitutes, and they can work alongside one another. In Figure 2.1, we show how expansionary monetary policy measures (interest rate cuts, liquidity provision, and monetary easing) can influence asset prices via the main transmission channels. In addition, changes in asset prices can trigger the ECB's reaction, as in the case of the sovereign debt crisis when Greek government bond yields reached unsustainable levels with a possibility of contamination in Italy, Ireland, Portugal, and Spain. During this period, the ECB established the SMP to help markets calm down by buying public debt bonds from the five stressed countries (GIIPS). Thus, we recognize a cyclical framework operating between monetary interventions and asset prices.

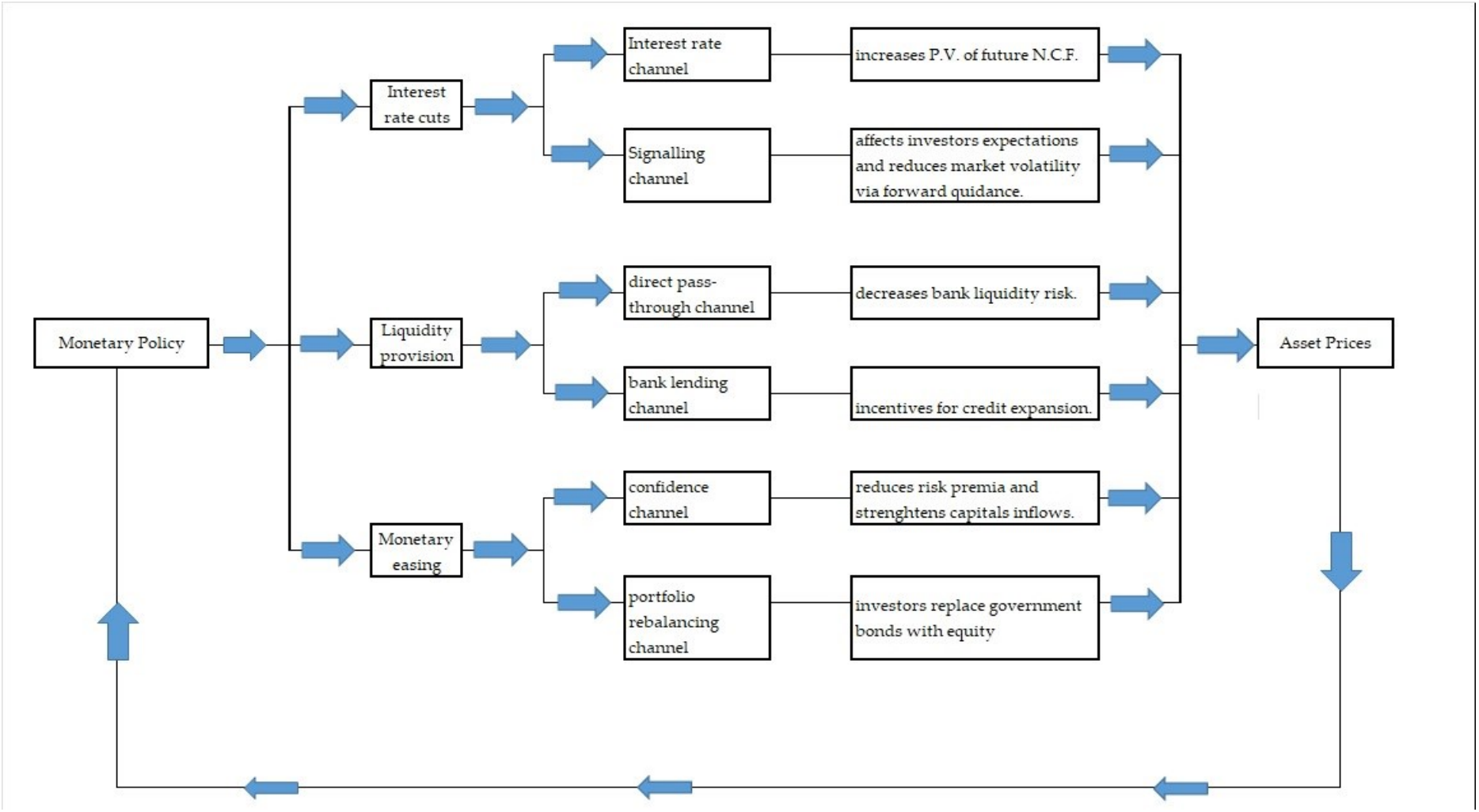



**Figure 2.1** Cyclical effect framework (CEF) for figuring out the effect of ECB's monetary policy interventions on asset prices, and vice versa.

## 2.4 Empirical approach

In this part, we present the data and regression approach used in this research.

### 2.4.1 Data

Our study analyzes whether expansionary monetary interventions introduced by the ECB, along with two main macroeconomic factors and a sentiment indicator, affected market equity returns of eight eurozone countries for the period January 2007 to December 2017. Our sampling period covers the first phase of the crisis (global financial crisis), the second phase (sovereign debt crisis), and the third phase (post debt crisis). We also grouped our country sample into two sub-samples, core countries (Belgium, France, Germany, and the Netherlands) and peripheral countries (Italy, Spain, Portugal, and Greece) to investigate whether stock markets reacted heterogeneously to expansionary monetary policy innovations and other covariates.

#### 2.4.1.1 Dependent variable

This paper employs monthly data of closing equity market prices of eight eurozone markets, in core and peripheral countries: CAC 40, DAX 30, BEL 20, AEX, ASE Comp, FTSE MIB, PSI 20, and IBEX 30[23]. Monthly returns (RET) from each index are calculated as the first differences of log prices:

$$R_{i,t} = \ln(P_{i,t}) - \ln(P_{i,t-1}) \qquad (2.1)$$

Table 2.1 presents the indices used in this study and the corresponding countries, and Table 2.2 presents descriptive statistics on returns by country. We note negative mean monthly returns for peripheral markets and greater volatility. According to panel unit root tests, RET is a stationary variable.

**Table 2.1** Market indices.

| Stock Index | Country |
|---|---|
| BEL 20 | Belgium |
| CAC 40 | France |
| DAX 30 | Germany |
| ASE Gen. Comp. | Greece |

[23] Figure B.1 in appendix B presents closing prices of main indices of the eight euro area equity markets. We can observe that indices of core euro area countries have recovered from their low levels during the financial crises in contrast with indices od peripheral countries.

| | |
|---|---|
| FTSE MIB | Italy |
| AEX | Netherlands |
| PSI 20 | Portugal |
| IBEX 30 | Spain |

**Table 2.2** Descriptive statistics for monthly returns by country.

| Country | Mean | Median | Max | Min | Std. Dev. |
|---|---|---|---|---|---|
| BELGIUM | −0.000744 | 0.004634 | 0.110650 | −0.240879 | 0.049945 |
| FRANCE | −0.000320 | 0.002259 | 0.118287 | −0.145225 | 0.049831 |
| GERMANY | 0.005091 | 0.010683 | 0.154968 | −0.213096 | 0.055215 |
| GREECE | −0.011196 | −0.003996 | 0.198539 | −0.326730 | 0.097612 |
| ITALY | −0.004847 | −0.003831 | 0.188966 | −0.178007 | 0.063794 |
| NETHERLANDS | 0.000718 | 0.010110 | 0.105922 | −0.219583 | 0.053387 |
| PORTUGAL | −0.005541 | −0.003481 | 0.100720 | −0.233478 | 0.057707 |
| SPAIN | −0.002595 | 0.002270 | 0.153789 | −0.219408 | 0.060079 |
| All | −0.002413 | 0.004244 | 0.198539 | −0.326730 | 0.062535 |

#### 2.4.1.2 Independent variables

We considered the following independent variables:

Interest rate cuts (**IRC**): To capture the results of conventional expansionary monetary policy measures on returns, we constructed a dummy variable that takes a value of 1 in the month when the ECB decreased the policy rate and 0 otherwise. As a proxy for the policy rate, we used the main rate of refinancing operations (MRO). During our sampling period, ECB decreased MRO 15 times (see Table B.1 in Appendix B).

Unconventional monetary policy intervention (**UNC**) is a dummy variable that takes a value of 1 in the month of a non-standard policy intervention and 0 otherwise. This variable captures the effect of the ECB's unconventional policy announcements on stock indices. Unconventional innovations include monetary easing and liquidity provision announcements. Monetary easing comprises the ECB's purchases of public bonds (Securities Market Programme, Outright Monetary Transactions, and Public Sector Purchase Programme) and corporate bonds from banks or non-financial institutions (i.e., first, second and third Covered Bond Purchase Programme, Corporate Sector Purchase Programme, and Asset-Backed Securities Purchase Programme).

Liquidity provision measures include full allotment fixed-rate procedure for refinancing operations, supplementary, very longer-term, and targeted refinancing operations (SLTROs, VLTROs, and TLTROs I and II). Intervention announcements were collected from press conferences, press releases, critical speeches, and Martins et al. (2019) (see Table B.2 in Appendix B). Cross-checking with previous research was also carried out (Rogers et al. 2014; Falagiarda et al. 2015; Haitsma et al. 2016).

The industrial production index (**IPI**) was seasonally adjusted as a proxy for output because data for GDP are available in quarter values. According to the literature, there is a positive relationship between output growth and equity returns (Schwert 1990; Fama 1990; Choi et al. 1999; Mauro 2003). To ensure stationarity, we used monthly percentage change through the first differences of logs. Data processing revealed negative means for peripheral countries.

The inflation rate (**INFL**) is measured as the 12-month percentage change of the Harmonized Index of Consumer Prices (HICP). For the Fisher-ADF and Im et al. (2003) panel unit root tests, the variable is stationary. Regarding inflation rate and returns, some studies suggest a negative relation (Fama and Schwert 1977; Fama 1981; Bakshi and Chen 1996) while others find a positive relationship (Graham 1996; Choudry 2001). Descriptive statistics for inflation rates are presented in Table 2.3 All eight countries have a positive mean, with an overall value of 1.48%.

**Table 2.3** Descriptive statistics for inflation rate by country.

| Country | Mean | Median | Max | Min | Std. Dev. |
|---|---|---|---|---|---|
| BELGIUM | 0.019080 | 0.018373 | 0.058927 | −0.017293 | 0.014168 |
| FRANCE | 0.012979 | 0.011884 | 0.040416 | −0.007963 | 0.010429 |
| GERMANY | 0.014695 | 0.015350 | 0.033784 | −0.006501 | 0.009544 |
| GREECE | 0.013880 | 0.010462 | 0.056552 | −0.028560 | 0.021675 |
| ITALY | 0.015477 | 0.014078 | 0.042529 | −0.005076 | 0.012854 |
| NETHERLANDS | 0.014092 | 0.014117 | 0.033742 | −0.006702 | 0.010678 |
| PORTUGAL | 0.013530 | 0.010743 | 0.040464 | −0.017872 | 0.014122 |
| SPAIN | 0.015184 | 0.018326 | 0.053256 | −0.014574 | 0.017094 |
| All | 0.014865 | 0.014340 | 0.058927 | −0.028560 | 0.014386 |

The economic sentiment indicator (**ESI**) is used as a proxy for sentiment. The ESI is constructed by the European Commission as a monthly survey result weighted average

from five sectors (40% industry, 30% services, 20% consumption, 5% retail trade, 5% construction). Previous studies documented that sentiment indices reflect information that is not already incorporated in other macro variables (Carroll et al. 1994; Barsky and Sims 2012). Financial researchers have also demonstrated that sentiment indicators affect stock prices (see, among others, Fisher and Statman 2003; Brown and Cliff 2004; Baker and Stein 2004; Lemmon and Portniaguina 2006; Stambaugh et al. 2011; Dahmene et al. 2021). To avoid non-stationarity issues, we used the monthly first difference of ESI[24].

Table 2.4 presents the descriptive statistics of variables from January 2007 to December 2017 for the full sample of eight eurozone countries. The data sources are as follows: DataStream for equity market prices, Eurostat for HICP and IPI, and European Commission for ESI and other indicators.

**Table 2.4** Descriptive statistics for the full sample.

| Variable | Mean | Median | Max | Min | Std. Dev. |
|---|---|---|---|---|---|
| RET | −0.002413 | 0.004244 | 0.198539 | −0.326730 | 0.062535 |
| IPI | −0.000645 | 0.000932 | 0.110244 | −0.096355 | 0.021470 |
| INFL | 0.014865 | 0.014340 | 0.058927 | −0.028560 | 0.014386 |
| ESI | 0.000758 | 0.100 | 8.100 | −10.800 | 2.411.091 |

Notes: RET, equity market returns; IPI, monthly percentage growth of industrial production; INFL, inflation rate as annual percentage change of HICP; ESI, monthly first difference of economic sentiment indicator.

### 2.4.2 Methodology

In order to study the influence of the ECB's expansionary monetary policy as well as main macroeconomic factors and a sentiment indicator on eurozone market returns (RET), we conducted a panel data regression analysis. More specifically, we created two dummy variables that capture the announcements of expansionary monetary policy innovations introduced by the ECB, interest rate cuts (IRC) for conventional and unconventional monetary policy interventions (UNC) for non-standard measures.

According to the literature (Fama and Schwert 1977; Fama 1981, 1990; Schwert 1990), macroeconomic factors determine equity returns, so we used two main

[24] In tables B.4. to B.6 in appendix B we use the monthly percentage change of ESI (GESI) instead of its first difference as an independent variable.

macroeconomic variables, inflation rate (INFL) and monthly percentage change of the industrial production index (IPI), as a proxy for output. A sentiment indicator (ESI) was also used (in monthly first differences) because previous studies (Fisher and Statman 2003; Stambaugh et al. 2011) documented that sentiment contains information that is not already incorporated in other macro variables.

The model introduced in our empirical work is as follows:

$$R_{i,t} = \beta_{0i} + \beta_1 IRCL + \beta_2 UNC_L + \beta_3 INFL_{i,t} + \beta_4 IPI_{i,t} + \beta_5 ESI_{i,t} + \varepsilon_{i,t} \quad (2.2)$$

Market returns, $R_{i,t}$, are considered as the dependent variable, and $IRC_t$ and $UNC_t$, the two dummy variables capturing announcements of traditional and nonconventional expansionary monetary policy measures, respectively (same for all countries), inflation rate (INFL), monthly percentage change of industrial production index (IPI), and monthly first difference of economic sentiment indicator (ESI) are the independent variables; $\beta_{0i}$ indicates cross-country specific effects and $\varepsilon_{i,t}$ is the error term. We checked pairwise cross-correlations between explanatory variables, and we found relatively low correlations so there is no multicollinearity[25].

We employed data from January 2007 to December 2017 (132 monthly observations) and our sample consisted of eight eurozone countries (periods t = 1, …, 132; cross sections i = 1, …, 8). L = 0, -1, -2,… denotes lags[26]. The model was estimated with panel data regression analysis in order to reduce bias in coefficient estimators.

We can rewrite the main equation (2) in matrix form as:

$$y = X\beta + \varepsilon \quad (2.3)$$

y is a NT × 1 column vector of dependent variable observations, X is a NT × (k+1) matrix of independent variables' observations with k=5, β is a (k+1) × 1 column vector of unknown parameters and ε is a NT × 1 column vector of errors.

The simple OLS estimates of β are given by

$$\hat{\beta} = (X^T X)^{-1}((X^T y) \quad (2.4)$$

[25] The higher cross-correlation, in absolute value, was 0.2633, between inflation rate and first difference of the economic sentiment indicator.

[26] For example, L = −2 means two periods (months) lagged.

where X denotes the matrix of independent variables for all observations and $X^T$ its transpose

In case of a fixed effects model the OLS estimates of β can be written as:

$$\widehat{\beta} = (X^T Q X)^{-1}((X^T Q y) \quad (2.5)$$

where Q is the is the fixed effects transformation operator.

In case of a random effects model the estimates of β can be written as:

$$\widehat{\beta} = (X^T \widehat{\Omega}^{-1} X)^{-1}(X^T \widehat{\Omega}^{-1} y) \quad (2.6)$$

where $\widehat{\Omega}$ is the estimated covariance matrix of the residuals.

Panel corrected standard errors are calculated by the square roots of the diagonal terms of

$$PCSE = (X^T X)^{-1}\{X^T \widehat{\Omega} X\}(X^T X)^{-1} \quad (2.7)$$

Further, it takes into account cross-sectional heterogeneity (Wooldride 2010)[27]. We distinguish between core countries (France, Belgium, Netherlands, and Germany) and peripheral countries (Italy, Spain, Greece, and Portugal) to count whether stock markets of stressed and non-stressed countries reacted heterogeneously to the ECB's expansionary monetary policy innovations and other covariates. Compared with core countries, peripheral countries were more influenced by the economic crisis.

### 2.5 Main results

Tables 2.5-2.7 report our empirical findings for the full sample and the core and peripheral countries, respectively, regarding the research questions set out in the introduction and more specifically the response of eurozone equity to expansionary monetary policy interventions launched by the euro area monetary authority to two main macroeconomic variables and a sentiment indicator. Hausman's test gives evidence in favor of random effects against fixed effects for the full country sample, core and peripheral countries, but the differences in coefficient estimators between these two models are not statistically significant. The Breusch–Pagan LM test provides evidence for cross-sectional correlation in residuals. The likelihood ratio test rejects the hypothesis of panel cross-sectional homoskedasticity for the full sample and

[27] Many researchers use the same econometrical approach to study this topic (see among others Fiordelisi and Ricci, 2016; Fiordelisi and Gallopo, 2018; Pacicco et al., 2019; Fasas et al., 2021)

peripheral countries. Beck and Katz (1995) proved that the combination of OLS with panel-corrected standard errors (PCSEs) allows for more accurate estimation compared to GLS in the presence of panel error structures (cross-sectional heteroskedasticity and cross-sectional correlation in residuals). So, particular emphasis should be placed on the OLS with panel-corrected standard error model estimation[28].

**Table 2.5** Results for full sample of eight countries.

| Dependent Variable RET | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Panel OLS | | Random Effects | | Fixed Effects | | Panel OLS with PCSEs | |
| Independent Variables | coeff. | std.error | coeff. | std.error | coeff. | std.error | coeff. | std.error |
| C | 0.001111 | 0.003098 | 0.001111 | 0.003098 | 0.001400 | 0.003111 | 0.001111 | 0.003335 |
| IPI | 0.080181 | 0.088117 | 0.080181 | 0.088115 | 0.066169 | 0.088316 | 0.080181 | 0.096750 |
| INFL | −0.475166 * | 0.136316 | −0.475166 * | 0.136313 | −0.493096 * | 0.137454 | −0.475166 * | 0.155883 |
| IRC(-2) | 0.016715 * | 0.005997 | 0.016715 * | 0.005997 | 0.016487 * | 0.005999 | 0.016715 * | 0.006027 |
| UNC(-2) | 0.006144 | 0.004465 | 0.006144 | 0.004465 | 0.006118 | 0.004465 | 0.006144 | 0.004462 |
| ESI | 0.006674 * | 0.000812 | 0.006674 * | 0.000812 | 0.006669 * | 0.000812 | 0.006674 * | 0.000799 |
| R squared | 10.45% | | 10.45% | | 11.07% | | 10.45% | |
| Hausman test RE/FE | | | 6.518 | | | | | |
| LM test for no cross-sectional dependence | 1793.05 * | | | | | | | |
| LR test for cross-sectional heteroskedasticity | 125.14 * | | | | | | | |

Notes: Table reports equity reaction of eight eurozone markets to ECB's expansionary monetary policy announcements, two main macroeconomic variables, and sentiment indicator. Monthly market return is dependent variable of panel regression. We use two dummy variables: IRC, which specifies announcements for interest rate cuts, and UNC, which specifies announcements for non-traditional monetary policy innovations. Remaining independent variables are: monthly percentage change of Industrial Production Index (IPI), inflation rate (INFL), and monthly first difference of economic sentiment indicator (ESI). IRC(-2), UNC(-2) denote two months lagged dummy variables. * indicate statistical significance at 1% level.

**Table 2.6** Results for Core Countries.

| Dependent Variable RET | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Panel OLS | | Random Effects | | Fixed Effects | | Panel OLS with PCSEs | |
| Independent Variables | coeff. | Std.error | coeff. | Std.error | coeff. | Std.error | coeff. | Std.error |
| C | 0.006153 | 0.004016 | 0.006153 | 0.004024 | 0.006442 | 0.004080 | 0.006153 | 0.003991 |

[28] Tables B.4 to B.6 in appendix B, present results for the full sample and the core and peripheral countries, respectively, using the monthly percentage change of ESI (GESI) instead of its first difference. Results remain the same.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| IPI | 0.182698 | 0.103476 | 0.182698 *** | 0.103682 | 0.179951 *** | 0.103751 | 0.182698 *** | 0.101367 |
| INFL | −0.582786 * | 0.195515 | −0.582786 * | 0.195904 | −0.600562 * | 0.200300 | −0.582786 * | 0.190955 |
| IRC(-2) | 0.013870 ** | 0.006818 | 0.013870 ** | 0.006831 | 0.013752 ** | 0.006836 | 0.013870 ** | 0.006817 |
| UNC(-2) | 0.009806 *** | 0.005087 | 0.009806 *** | 0.005097 | 0.009784 *** | 0.005097 | 0.009806 *** | 0.005087 |
| ESI | 0.006827 * | 0.000942 | 0.006827 * | 0.000943 | 0.006794 * | 0.000945 | 0.006827 * | 0.000915 |
| R squared | 16.92% | | 16.92% | | 17.07% | | 16.92% | |
| Hausman test RE/FE | 0.918 | | | | | | | |
| LM test for no cross-sectional dependence | 489.09 * | | | | | | | |
| LR test for cross-sectional heteroskedasticity | 6.61 | | | | | | | |

Note: Same variables used as in Table 2.5. *, **, *** indicate statistical significance at 1, 5 and 10% level, respectively.

**Table 2.7.** Results for peripheral countries.

| Dependent Variable RET | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Panel OLS | | Random Effects | | Fixed Effects | | Panel OLS with PCSEs | |
| **Independent Variables** | **coeff.** | **std.error** | **coeff.** | **std.error** | **coeff.** | **std.error** | **coeff.** | **std.error** |
| C | −0.002543 | 0.004740 | −0.002543 | 0.004747 | −0.002430 | 0.004750 | −0.002543 | 0.004938 |
| IPI | −0.035462 | 0.141639 | −0.035462 | 0.141863 | −0.040430 | 0.141950 | −0.035462 | 0.159566 |
| INFL | −0.456559 ** | 0.192437 | −0.456559 ** | 0.192742 | −0.464099 ** | 0.192991 | −0.456559 ** | 0.211265 |
| IRC(-2) | 0.019174 *** | 0.009866 | 0.019174 *** | 0.009882 | 0.019093 *** | 0.009882 | 0.019174 *** | 0.009937 |
| UNC(-2) | 0.001584 | 0.007364 | 0.001584 | 0.007376 | 0.001570 | 0.007376 | 0.001584 | 0.007348 |
| ESI | 0.006348 * | 0.001326 | 0.006348 * | 0.001328 | 0.006348 * | 0.001328 | 0.006348 * | 0.001296 |
| R squared | 7.55% | | 7.55% | | 7.80% | | 7.55% | |
| Hausman test RE/FE | 0.00 | | | | | | | |
| LM test for no cross-sectional dependence | 386.04 * | | | | | | | |
| LR test for cross-sectional heteroskedasticity | 49.19 * | | | | | | | |

Note: Same variables used as in Table 2.5. *, **, *** indicate statistical significance at 1, 5 and 10% level, respectively.

First, interest rate cut announcements by the eurozone monetary authority have a positive and statistically significant impact on equity market returns. The impact takes two months after the announcement. In linear panel regressions with IRC(-2) as an

independent variable, coefficients of IRC are statistically significant, but with different levels for the entire country sample, the core countries, and the peripheral countries. Results are stronger for core countries. Further, estimated coefficients show rather stable values in multivariate regressions. So, announcements of conventional expansionary monetary policy measures seem to affect market reactions. Interest rate cuts increase the present value of future net cash flows by decreasing equity risk premium, which, in turn, leads to higher stock prices. It takes about two months for equity prices to reflect new risk premiums as investors need time to adjust their financial strategy. In addition, the reduction in the official interest rates affects money market rates, deposit rates, and other short-term interest rates. Low interest rates make riskier securities more attractive as agents search for higher returns.

We previously noticed that from the last quarter of 2008 until May 2009, the ECB decreased the rate of main refinancing operations from 4.25% to 1% to overcome the first phase of the crisis, but the margins for further reduction were restricted as the MRO rate was near the zero lower bound level. For this reason, the ECB introduced non-standard measures. Regarding the announcements of these interventions, our results display country heterogeneity.

For the core country sample, unconventional expansionary monetary policy interventions positively and statistically significantly affect market returns at a 10% level with a delay of two months. Mamaysky (2018) documented that stocks respond over several weeks after quantitative easing announcements.

While core equity markets exhibit a positive significant response, peripheral stock markets seem not to react, as the UNC coefficient has a positive sign but is not statistically significant[29]. So, peripheral countries reacted less to non-standard monetary policy measures. During the sovereign debt crisis, three peripheral countries in our sample (Greece, Portugal, and Spain) faced economic difficulties, received financial support, and were forced to apply economic adjustment programs in cooperation with the International Monetary Fund (IMF), European Commission (EC),

[29] Dummy variable UNC is displayed with two lags, UNC(-2), in models for full country sample and peripheral counties only for comparison reasons with the corresponding models for core countries.

and European Central Bank (ECB). Those programs increased investors' uncertainty and decreased expectations about unconventional monetary policy measures. Also, market participants knew that banks in peripheral countries could not efficiently transmit central bank support to the real economy because of financial fragility, higher rates of non-performing loans, and lower capitalization rates. In addition, for a long time, Greek government bonds were ineligible as collateral in the ECB's liquidity transactions, as were Portuguese bonds for a shorter period of time. Besides this, due to low credit rating, Greek public and private securities were not eligible for expanded APP operations, while Portuguese public securities had limited participation[30].

Overall, our findings indicate that the ECB's non-traditional expansionary interventions produced a positive and statistically significant impact on eurozone core countries that were less influenced by the economic crisis. Core countries participated more in unconventional operations because of their higher credit rating. By purchasing bonds from high-rating countries, ECB reduced their availability to private investors, while bond prices increased and yields declined. Investors were encouraged to rebalance their portfolios by investing in other securities such as equity. Also, through liquidity operations, the ECB gives incentives to euro area banks to expand lending by increasing loans to non-financial firms and households. The credit expansion, along with the decreased liquidity risk, boosts equity prices by decreasing risk premiums. Banks in highly rated countries participated more in liquidity operations and expanded credit. Banks in weaker peripheral economies faced the risk of collapse and decreased credit (Martins et al. 2019). For the lagged impact, we should take into account that bank lending channels take about two months to operate because banks have a bureaucratic process and need time to evaluate the financial situation of the candidate borrower. In addition, investors need time to evaluate the ECB's announcements and rebalance their portfolios. Moreover, we recall that there was a time delay between the announcement and the implementation of monetary measures. For example, CBPP3 was announced on 4 September 2014, but operations launched on 20 October 2014.

[30] See Figure 1.4

We must point out that, for policymakers, conventional and unconventional measures are supplementary, not substitutes, and could jointly stabilize financial markets in turbulent periods. Conventional interventions, accompanied by non-standard measures, reduce banks' funding costs, decrease liquidity risk, reduce asset risk premia, increase collateral value, enhance credit expansion, restore market confidence, increase capital inflows, strengthen revenues, and boost asset prices.

Regarding the inflation rate and returns, we find a statistically significant negative relationship in the full country sample and core and peripheral countries. Previous research supports our findings (Bakshi and Chen 1996; Fama 1981; Fama and Schwert 1977). The coefficient estimates range from −0.42 for peripheral countries (with an average inflation rate of 1.45%) to −0.65 for core counties (with average inflation of 1.52%). High inflation impacts investment strategy because it increases the cost of inputs, reduces consumer purchasing power, decreases firms' revenues and profits, reduces fixed incomes, and is associated with economic deceleration, higher borrowing rates, and risk premiums.

We also document a marginally positive statistically significant effect of monthly percentage change of industrial production on market returns at the 10% level for the core country sample, in agreement with previous research (Fama 1990; Choi et al. 1999, Mauro 2003). On average, core countries present a positive monthly rate of change for IPI, while peripheral countries exhibit a negative rate.

Finally, we examined the relationships between sentiment indicator and current month eurozone equity return. We found a statistically significant and positive impact at the 1% level for the full country sample and the two sub-samples. In multivariate panel regressions with all independent variables, coefficient estimates range from 0.51 for peripheral countries to 0.59 for core counties. Our results are in line with those of Fisher and Statman 2003; Jansen and Nahius 2003; Brown and Cliff 2004; and Stambaugh et al. 2011. According to Ho and Hung (2012), ESI reflects the trust of firms and consumers in each EU country regarding the economy and its prospects. We can suppose that firms and consumers feel optimistic about the future prospects of the economy and their own welfare conditions. In that case, they are more willing to

consume, produce, and invest so security markets should incorporate such economic operations.

### 2.6 Robustness test

The economic sentiment indicator (ESI) was constructed by the European Commission as a weighted average of monthly survey results from indicators of five sectors: 40% industry, 30% services, 20% consumption, 5% retail trade, and 5% construction. These indicators are concerned with production, business climate and demand evolution, the economic and financial situation, business activity, and employment, respectively. The ESI is likely to be influenced by contemporaneous equity market returns leading to a potential endogeneity problem. More specifically, because some questions included in indicators are related to the financial situation of businesses and households, market returns could probably influence ESI.

For this reason, we re-estimated our equation using instrumental variables regression. The two-stage least squares (TSLS) method is a special case of instrumental variables used by researchers to reduce estimation bias. The instruments used in our specification include: a constant C, IRC(-2), UNC(-2), IPI, INFL (as defined above), and the monthly first difference of the industrial confidence indicator (INDU). The cross-correlation between the monthly first difference of INDU and of ESI is 0.79 for the full country sample. We choose INDU as an instrumental variable because the weight of the industrial confidence indicator on the ESI is the highest (40%) among all indicators. Also, our estimation procedure satisfies order and rank conditions. Table 6 reports our empirical results.

**Table 2.8** Results using TSLS with PCSEs.

| Dependent Variable RET | | | | | | |
|---|---|---|---|---|---|---|
| Instrument Specification: C IPI INFL IRC(-2) UNC(-2) INDU | | | | | | |
| | Full Country Sample | | Core Countries | | Peripheral Countries | |
| Independent Variables | coeff. | std.error | coeff. | std.error | coeff. | std.error |
| C | 0.000226 | 0.003390 | 0.006426 | 0.004027 | −0.003745 | 0.005021 |
| IPI | 0.071168 | 0.097086 | 0.193015 *** | 0.100187 | −0.046648 | 0.159609 |
| INFL | −0.423797 * | 0.159545 | −0.608979 * | 0.194946 | −0.394386 *** | 0.216272 |
| IRC(-2) | 0.017358 * | 0.006034 | 0.013941 ** | 0.006748 | 0.020075 ** | 0.009959 |

| | | | | | | |
|---|---|---|---|---|---|---|
| UNC(-2) | 0.006247 | 0.004470 | 0.009759 *** | 0.005023 | 0.002079 | 0.007379 |
| ESI | 0.007769 * | 0.001099 | 0.006875 * | 0.001145 | 0.008080 * | 0.001835 |
| R squared | 10.29% | | 17.92% | | 7.24% | |

Notes: Table presents estimation results using two-stage least squares (TSLS) method. Same variables used as in Table 2.5. INDU, monthly first difference of industrial confidence indicator. *, **, *** indicate statistical significance at 1, 5 and 10% level, respectively.

Our findings are consistent with the instrumental variables approach. With the two-stage least squares panel regression method, ESI has a positive and statistically significant effect on equity market returns at the 1% level for the full sample and the two sub-samples. Comparing this with the results shown in Section 6, the respective coefficients of other independent variables remain statistically significant with similar magnitudes.

## 2.7 Conclusion

The global financial system was under unprecedented pressure at the beginning of the economic crisis. There was great uncertainty about the financial health of globally significant financial institutions that led to a collapse in financial activity. The impending sovereign debt crisis forced peripheral eurozone countries to apply for economic adjustment programs to receive financial support.

During the financial crisis, the euro area monetary authority launched an extensive set of standard and non-conventional policy interventions in order to reduce uncertainty and risk in the markets. Our study explored the impact of these measures on market returns of eight eurozone countries for the period January 2007 to December 2017 along with two main macroeconomic variables and a sentiment indicator. In order to investigate whether stock markets react heterogeneously to expansionary monetary policy innovations and other covariates, we divided the sample into two sub-samples, core and peripheral countries.

Our results indicate that interest rate cuts significantly affect equity returns for core and peripheral markets. So, investors appreciated the conventional expansionary monetary policy interventions and ECB's intense efforts to overcome the first stage of the financial crisis by reducing its main refinancing rate to a lower bound. Low official interest rates affect short-term interest rates and make equity more attractive as agents are searching for higher returns. Besides this, the ECB's official intention to

maintain key interest rates at a deficient level for an anticipated period reduced uncertainty and volatility in the market and positively affected investors' expectations.

We also documented that ECB's non-conventional expansionary interventions had a positive and statistically significant lagged impact on core eurozone markets that were less influenced by the economic crisis. Peripheral countries were forced to apply economic adjustment programs that increased investors' uncertainty during and after the sovereign debt crisis, boosted capital outflows from these markets and decreased expectations about unconventional monetary policy measures. Also, due to low credit rating, securities issued by public or private sector of peripheral countries were ineligible for APP purchases and as collateral in the ECB's liquidity transactions. On the other hand, equity markets of core countries were influenced by unconventional interventions via the portfolio rebalancing and bank lending channels.

Concerning inflation rates and returns, in a sampling period of low inflation, we found a statistically significant negative relationship for the full country sample, core, and peripheral countries. Our results are in line with those of Fama and Schwert (1977), Fama (1981), and Bakshi and Chen (1996). High inflation impacts investment strategy because it is associated with economic deceleration and higher borrowing rates. During our sampling period, the inflation rate moved at low to moderate levels, with an average value of 1.48%, below but close to 2%, which is the main objective of the euro area monetary authority.

Finally, we documented evidence that the economic sentiment indicator introduced by the European Commission had a strongly positive statistically significant effect on eurozone stock markets, in agreement with previous research (see Stambaugh et al. 2011; Brown and Cliff 2004; Jansen and Nahius 2003; Fisher and Statman 2003). ESI reflects the expectations of EU firms and consumers about the economy and its prospects. If prospects are promising, firms and consumers are more willing to consume, produce, and invest. Security markets should incorporate such economic operations.

We recognize some limitations in our study, as we did not consider spillover effects from conventional and non-standard monetary policy measures introduced by other

central banks (Fed, BoE) during our sample period. We also did not examine effects from fiscal policy interventions that could affect market returns or the predictive ability of other macroeconomic variables such as exchange rate and trade balance. These could constitute interesting topics for future research.

Despite the limitations, our results are useful both for policy-makers and investors, because they should consider a broad set of monetary measures and macroeconomic and sentiment variables that could affect financial markets.

Regarding monetary policy, during the first phase of the financial crisis, ECB managed to calm and support euro area markets by reducing the MRO near to the zero lower bound level. On the other hand, the effect of non-standard monetary policy innovations is not uniform across euro area equity markets. Core equity markets seem to be more affected by unconventional measures than peripheral countries. By taking into account these effects, policy-makers could design more effective monetary policy measures. In addition, investors build their strategies with the goal of increasing returns. Our findings shed light on the effects of standard and non-standard policies, along with two main macroeconomic variables and a sentiment indicator, on equity returns.

# Chapter 3

## Greek banking sector stock reaction to ECB's monetary policy interventions[31]

### 3.1 Introduction

Due to the sharp deterioration of the fiscal and macroeconomic environment in 2009, the consequent deterioration of Greece's credit rating resulted among other reasons in the gradual country's exclusion from the international capital and money markets[32]. Additionally, the significant outflow of deposits, the fall in the prices of collateral (i.e., the real estate, government, and corporate bonds) of loans and the stifling liquidity conditions have also put intense pressure on the Greek banking sector. In early 2010, Greece's financial position was unsuitable due to budget deficit, the acceleration of debt stock and the dramatic rise in government bond yields. Therefore, investors worried about a possible Greek sovereign default (Cour-Thiman and Winkler 2013). In May 2010, Greece's first economic adjustment program was arranged with the International Monetary Fund (IMF), the European member states, and the European Central Bank (ECB), totaling a multilateral loan of EUR 110 billion to avoid bankruptcy and improve fiscal imbalances. The imminent European sovereign debt crisis caused other peripheral member states to launch economic adjustment programs including Ireland, Portugal, and Spain. To calm down the markets, the ECB launched the Securities Market Programme (SMP) and bought public debt bonds issued by the distressed peripheral Eurozone member states in secondary markets.

The ongoing economic recession forced Greece to launch a second economic adjustment program in March 2012 alongside the implementation of sovereign debt restructuring. The Greek debt exchange deal, with the voluntary involvement of the private sector, managed to reduce the debt burden by EUR 107 billion (Zettelmeyer et

[31]A version of this chapter was presented at the 2020 Symposium on Circular Economy and Sustainability organized by the International Network For Economic Research (INFER) and Democritus University of Thrace and published in Journal of Risk and Financial Management, Vol. 15(10):448 https://www.mdpi.com/1911-8074/15/10/448

[32] See Floros and Chatziantoniou (2017) for more details about the Greek debt crisis.

al. 2013) while the yields of government bonds declined significantly. In December 2012, the Greek government performed a bond buy-back operation to decrease the debt-to-GDP ratio by another EUR 21 billion. The second adjustment program alongside the private sector involvement (PSI) prevented Greece exiting the Eurozone but the sharpness of recession lead to a third, three-year adjustment program, in August 2015. Finally, in 2018, the gross domestic product started to grow, the budget introduced a surplus, and Greece could raise funding from capital markets. On 20 August 2018, Greece exited the third adjustment program. We must point out that the granted bailout loans agreed in parallel with the three programs were accompanied with austerity measures (tax increases and spending cuts) as well as with structural reforms.

In the onset of financial crisis, the Greek economy was foremost bank-based while the regional MFIs were healthy and resilient as they were among the best capitalized banks in Europe but, eventually, the regional banking sector was weakened by the sovereign debt crisis (Avramidis et al. 2020). The outburst of sovereign debt crisis led rating agencies to downgrade Greece affecting negatively both assets used as collateral by the Greek MFIs in the refinancing operations performed by the ECB as well as the MFIs' own credit ratings (Louri and Migiakis 2019). To support Greek MFIs, the ECB four times decided to waive the quality threshold for accepting Greek debt securities as collateral in refinancing operations[33]. The ECB's liquidity provision to Greek MFIs was crucial for avoiding a possible bank default as there was increasing demand for deposit withdrawals during the Greek public debt crisis[34]. Figure 3.1 presents the significant reduction in domestic deposits over the period 2008 to 2018. As shown in Figure 3.2, during the Greek debt crisis and in the first quarter of 2015, regional monetary financial institutions received vast amounts of liquidity from ECB . The ECB's liquidity provision was mainly used to cover deposit outflows (Louri and Migiakis 2019) while,

[33] See relevant press releases on 3 May 2010, 8 March 2012, 19 December 2012, and 22 June 2016. European Central Bank (3 May 2010, 8 March 2012, 19 December 2012, 22 June 2016).

[34] Also, Greek MFIs used emergency liquidity assistance from Bank of Greece (Greek NCB) to cover liquidity needs when the quality and the value of assets held by banks was limited and did not meet the lowest credit rating threshold for ECBs' collateral eligibility.

as shown in Figure 3.3, from the onset of the sovereign debt crisis, in the middle of 2010, bank loans to the private sector declined significantly.

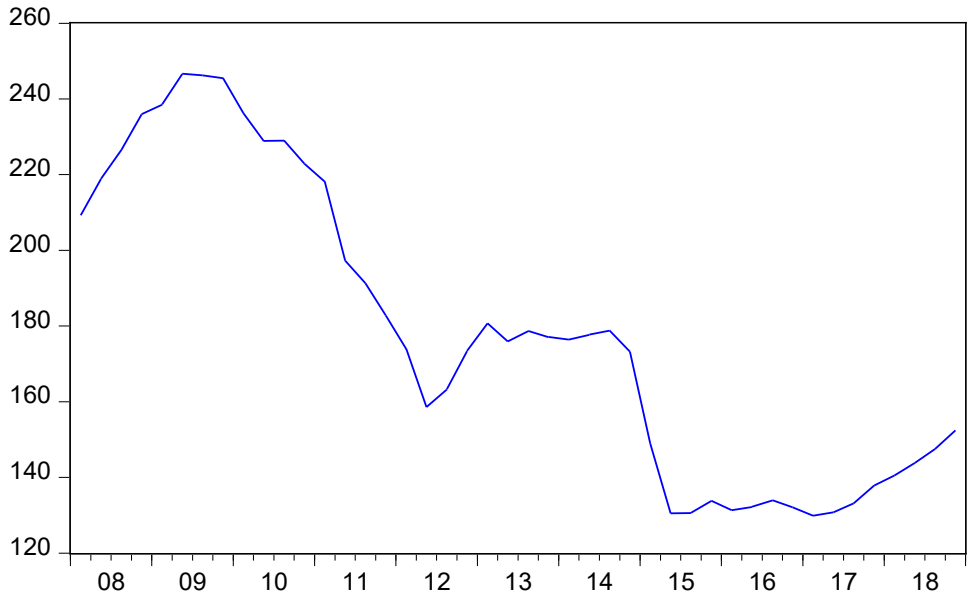



**Figure 3.1** Greek domestic deposits over the period 2008 to 2018 in billion euros. Source: Bank of Greece.

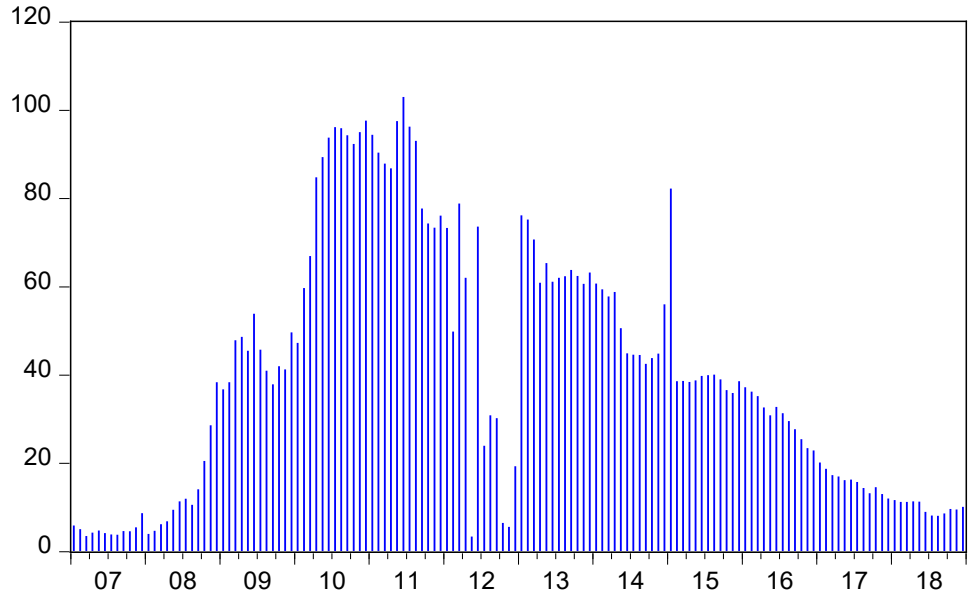



**Figure 3.2** ECB's liquidity provision to Greek monetary financial institutions in billion euros. Source: Bank of Greece.

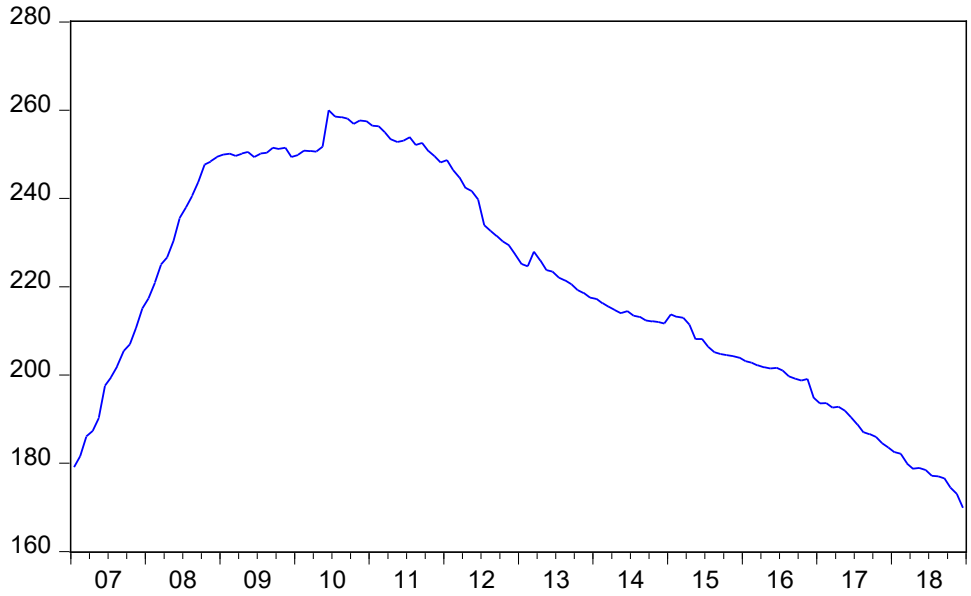



**Figure 3.3.** Loans of Greek MFIs to the private sector in billion euros. Source: Bank of Greece and owns' calculations.

In June 2015, capital controls were imposed to avoid full-scale bank run. In addition, the Greek debt exchange deal caused severe losses to the Greek MFIs balance sheets (around 45 billion) decreasing dramatically capital adequacy ratios. An amount of 40 billion from the multilateral loan of the second adjustment program was used to recapitalize Greek banks[35]. Another recapitalization of 10 billion was held in 2015 from the funds foreseen in the third adjustment program.

This research paper explores the impact of the ECB's monetary policy on stock returns of the systematically important Greek regional banks. Our study lasts from 2007 to 2018, so it covers the subprime crisis phase, the financial crisis phase, the European sovereign debt crisis period, and the three Greek economic adjustment pro-grams. Banks under investigation are the National Bank of Greece, Alpha Bank, Eurobank E.F.G., and Piraeus Bank. These banks participated in the capital exercise of 2011/2012 as well as in the comprehensive assessments of 2014 and 2015 organized by the ECB and have been characterized as systemic banks.

We state herein the research questions processed under the framework of this re-search:

[35] After the share capital increases, the Hellenic Financial Stability Fund on behalf of Greek government became the main shareholder of the four core banks.

***R.Q. 1:*** *What is the Greek banking sector response to the ECB's standard monetary policy announcements?*

***R.Q. 2:*** *Does the Greek banking sector react to the ECB's expansionary unconventional monetary policy announcements?*

This research contributes to the literature because there is no exclusive study on the effects of the ECB's both conventional and non-standard measures on equity returns of Greek MFIs which were operating in a stressed economy with high recession and large fiscal deficits. In relation with other Eurozone member states, Greece was hit harder by the sovereign debt crisis and was the only peripheral country that implemented three adjustment programs. Additionally, policy makers and investors are interested in evaluating equity performance of regional banks especially during periods of strong financial tension.

The structure of this chapter is organized in the following way. The next section reviews relevant studies on research subject and Section 3.3 present the empirical approach, the data, and the methodology. In Sections 3.4 and 3.5 we refer to the main results and the robustness tests of this study. Conclusion and suggestions for further research are presented in Section 3.6.

## 3.2 Literature review[36]

Various early surveys have studied the influence of monetary policy mainly on the US financial markets. For example, Fama and French (1989) argue that the monetary sector can greatly influence stock market performance. In the 1990s, many researchers used vector autoregressive (VAR) analysis to investigate the long run impact of standard monetary policy on equity returns (Patelis 1997; Thorbecke 1997). The heteroscedasticity-based estimation approach was proposed by Rigobon and Sack (2003) to overcome endogeneity and omitted variables problems. This approach assumes that the volatility of a policy shock is relatively higher on announcement day of a policy intervention. Bernanke and Kuttner (2005) using event study and VAR analysis showed that an unexpected 0.25 percent cut in Fed's funds rate would cause

[36] To avoid repetition, section 3.2 presents the literature review of chapter 3 combined with chapter 4.

an increase in stock prices by 1.0 percent for the 1989-2002 period. Chodorow-Reich (2014) found that Fed's unconventional policy announcements from 2008 to 2013 increased the prices of bank stocks. Neely (2015) demonstrated that the Fed's quantitative easing program caused a significant reduction in UK and German long-term bond yields. Neuhierl and Weber (2018) also surveyed the influence of monetary surprises on stocks in relation to Fed's interventions. They found that markets responded significantly when the Fed deviates from agents' expectations. Swanson (2021) found that Fed's announcements about forward guidance and large scale asset purchases in U.S. in the effective lower bound period generate significant effects on treasury and corporate bonds yields as well as on stock prices, comparable in magnitude with Fed's standard policy in conventional times. Kashyap and Stein (2023) reviewed previous studies and concluded that quantitative easing tends to reduce risk premiums on a range of financial assets, including equity, Treasury and corporate bonds and exchange rates.

Recent studies have surveyed the beneficial effect of the ECB's SMP on bond yields of distressed euro area member states (Trebesch and Zettelmeyer 2018; Falagiarda and Reitz 2015). Eser and Schwaab (2016) estimated (upon the first SMP announcement) a yield decrease in five-year government bonds of 773 bps for Greece, 139 bps for Ireland and 226 bps for Portugal and of 97 bps for Spain and 93 bps for Italy on the second SMP announcement, whereas German Bund yields remained broadly unchanged. Ghysels et al (2017) find that SMP purchases of Italian and Spanish bonds lowered two-year yields by 3.2 and 1.8 percentage points respectively, and ten-year yields by 2.3 percentage points for both countries. Altavilla et al. (2016) showed that ECB's announcements of OMT decreased the two-year government bond yields of Spain and Italy by 2 percentage points.

Krishnamurthy et al. (2018) also showed that SMP, OMTs and LTROs decreased bond yields of three distressed eurozone countries (Portugal, Spain, and Italy). Demir et al. (2022) studied the impact of the ECB's non-standard interventions on eighty different government bond yield from 8 eurozone countries for the period 2008 to 2019 using a VAR model and the heteroscedasticity-based estimation approach of Rigobon and Sack (2003). They concluded that non-conventional measures had overall a strong

negative effect on bond yields with more persistent and substantial results for peripheral countries. Blotevogel et al. (2024) using an event study design found considerable announcement effects of the ECB's asset purchases that caused significant reductions in sovereign bond spreads of distressed eurozone countries during the coronavirus pandemic period. Mody and Nedeljkovic (2024) reported that OMT and dollar liquidity provision by the ECB's led to a contraction in the sovereign bond spreads of peripheral countries. It should be noted that the aim of the Fed's unconventional actions was to lower US sovereign bond yields, while the ECB's measures were aiming at reducing the bond spreads of the peripheral countries relative to German counterparties (Rogers et al., 2014).

Several research papers have explored the impact of the ECB's monetary policy decisions on capital markets (see among others Rogers et al. 2014; Fratzscher et al. 2016; Haitsma et al. 2016; Hau and Lai 2016; Georgiadis and Gräb 2016; Fausch and Sigonius 2018; Pacicco et al. 2019; Chebbi 2019)[37].

Angeloni and Ehrmann (2003) find that stock prices of telecommunications, consumer goods, technology and finance firms seem most sensitive to monetary policy surprises. Farinha and Vidrago (2020) study announcement effects of APP for core and peripheral stock indices distinguishing between positive and negative policy surprises. Petrakis et al. (2022a) showed that conventional monetary policy measures affected all euro area equity markets while non-conventional actions had a positive effect on core euro area equity markets that were less affected by the economic crisis. Ferreira and Serra (2022) argued that unconventional interventions by the ECB, BoE and Fed influenced positive equity indices for the period 2008 to 2018.

Furthermore, recent studies applied various VAR procedures and reported a positive impact of ECB's non-conventional measures on output, inflation and stock indices over medium to long time horizons. Boeckx et al. (2017) and, Evgenidis and Papadamou (2021) proxied non-conventional measures by the ECB's total assets while Lewis and Roth (2019) by the securities held for monetary policy purposes. Weale and Wieladek

[37] All these studies have been presented and analyzed in section 2.2 of the second chapter.

(2022) applied Bayesian VAR methodology to analyze ECB's, BoE's and Fed's conventional and quantitative easing policies. They proxied non-conventional monetary policy by the cumulative asset purchases announced by the respective central bank divided by the GDP and the shadow rate of Wu and Xia (2016). They provided evidence that there is no statistically significant difference between the effects of these policies in the examined financial variables. Van der Zwan et al. (2024) used the announced cumulative volume of the ECB's asset purchases to capture asset purchase shocks and a Bayesian structural VAR model to examine the impact of quantitative easing programs on macroeconomic and financial variables. They concluded that, for the period July 2009 to March 2021 the ECB's asset purchase programs stimulate stock prices and decrease long and short term bond yields favoring peripheral eurozone countries.

Neely and Klarson (2021) described the implementation of nonconventional measures by major central banks (Fed, ECB, BoJ, BoJ and BoE) for the period 2013 to 2019 while Bhattarai and Neely (2022) reviewed empirical research about the influence of international nonconventional policies on capital markets and real economy.

In addition, several economists have analyzed the impact of standard and unconventional policies mainly on macroeconomic variables (i.e., inflation and output). Gambacorta et al. (2014) used the panel structural VAR procedure for eight advanced economies and suggested that, for the sampling period January 2008–June 2011, unconventional policy leads to a temporary rise in output (similar to the one obtained by conventional policy) while the reaction of price level is less persistent and weaker. Kucharcukova et al. (2016) applied factor-augmented VAR econometric techniques to explore the transmission of the ECB's monetary measures on Eurozone countries as well as on six European union countries outside the euro area. Standard monetary shocks affected in a similar way inflation and output while non-conventional measures generated various responses among countries. Boeckx et al. (2017) estimated the impact of the ECB's balance sheet policies, for the period 2007–2014, using the structural VAR framework and found a positive effect on consumer prices of all euro area countries. The output effect was stronger for countries that were less influenced by the financial crisis. Moder (2019) applied the structural Bayesian VAR

econometric approach and suggested spillover effects of the ECB's non-conventional monetary policy measures on output and prices of southeastern Euro-pean countries. Fiorelli and Meliciani (2019) studied the period January 2001 to December 2016 also using the factor-augmented VAR model and concluded that the ECB should combine conventional and non-standard monetary tools to stabilize the Eurozone economies.

There are few surveys exploring the impact of the ECB's monetary interventions on stock returns of financial institutions. Fiordelisi et al. (2014), considering systematically important global financial institutions and using event study methodology and a five-year sampling period (June 2007 to June 2012), concluded that announcements of unconventional monetary policy measures generated a positive reaction in GSIFIs returns. Ricci (2015), applying a panel regression procedure along with an event study, found that for the period from June 2007 to June 2013, large European banks were more susceptible to unconventional interventions ( mainly monetary easing measures) than to traditional ones and that the crisis stage influenced each kind of crisis intervention. Fiordelisi and Ricci (2016) used a detailed set of 1322 global monetary, financial sector, and bailout policy interventions along with a fixed econometric effect panel model. They showed that stock returns for systematically important international banks were affected by monetary policy interventions, but not those for non-financial companies. Fiordelisi and Galloppo (2018) also applied event study and panel regression methodology to analyze the reactions to fiscal and monetary announcements in 12 worldwide stock markets from June 2007 to June 2012. The results showed that expansionary monetary measures (mainly liquidity provision) positively affected banking indices.

As we can see, previous scientific investigation concerns macroeconomic variables, bond yields, market indices, and global financial institutions while there is no exclusive research for Greek banking institutions which operated in a different economy with specific financial characteristics. In the period under investigation, Greece was hit harder in relation to any other Eurozone member states by the sovereign debt crisis. The Greek republic faced a great recession and large budget deficits, approved three Economic Adjustment (Bailout) Programs to avoid default, to refinance public debt and to recapitalize banks. Its government bond yields reached unsustainable levels and it

was forced to apply tax increases, wage cuts, and other austerity measures. Additionally, Greek MFIs suffered from limited liquidity due to the fall of collateral value, non-performing loans (highest in the euro area), and low capital adequacy ratios (Charalambakis et al. 2017; Anastasiou et al. 2018; Louri and Migiakis 2019). For these reasons, Greece and the local MFIs constitute a special case for investigation

### 3.3 Empirical approach

Several different procedures have been used to study the impact of monetary policies on equity markets. Some studies apply impulse response functions of VAR models (Patelis 1997; Thorbecke 1997). According to Bredin et al. (2009), the results of VAR methodology depended on the data frequency used, while endogeneity issues were presented. Additionally, Rudebusch (1998) criticized VAR models used in this topic as somewhat artificial. Several other papers (Kholodin et al. 2009) used the identification through the heteroscedasticity approach of Ridogon and Sack (2004) to overcome endogeneity issues but most researchers apply the event study approach (Fiordelisi et al. 2014; Ricci 2015). Other studies apply both procedures (Rogers et al. 2014; Haitsma et al. 2016). The Ridogon and Sack (2004) method assumes that the variance of policy shocks is higher on days when a monetary policy measure is announced in contrast to the variance on days with no monetary policy news. The event study approach assumes that a monetary policy measure can affect security prices in a specific event window nearby the date or the time of the announcement. According to Rosa (2011), the event study approach estimates tend to out-perform the heteroscedasticity-based estimates, hence, generally the event study approach should be preferred.

In the remaining two subsections we present the data, event study, and regression methodology used in our study.

#### 3.3.1 Data

This research analyzes whether interventions introduced by the ECB could affect equity returns of the systematically important Greek regional banks for the period January 2007 to August 2018. Our sampling period extends from the beginning of the financial crisis to the end of the three Greek Economic Adjustment Programs. The four core Greek banks under investigation are the National Bank of Greece, Alpha Bank,

Eurobank E.F.G., and Piraeus Bank. These banks participated in the capital exercise of 2011/2012 as well as in the comprehensive assessments (asset quality review and stress test) of 2014 and 2015 organized by the ECB and have been characterized as systemic banks. As mentioned above, there is no exclusive research exploring the ECB's monetary policy announcement measures on Greek banking industry returns as previous research mainly concerns Greek sovereign bond yields and the market index of the Athens stock exchange.

Our dataset consists of 103 important monetary policy interventions, for both traditional and non-standard measures. Non-conventional interventions include monetary easing and liquidity provision. The ECB's measures have been discussed in chapter 1. Crucial monetary policy announcements were collected from press releases, press conferences, key speeches, in contrast to the databases of Falagiarda et al. (2015) and Rogers et al. (2014).

We classify the ECB's monetary interventions into four categories: interest rate increases (IRIN), interest rate cuts (IRC), monetary easing (ME), and liquidity provision (LIQ). As a proxy interest rate changes, we use the main refinancing operations rate. Monetary easing includes ECB's purchases of private and public financial assets (SMP, OMT, PSPP, CBPP, ABSPP, and CSPP). Liquidity provision interventions cover unlimited provision of liquidity to euro area banks through the fixed rate tender procedure with full allotment (FRTPFA), supplementary, very longer term and targeted refinancing operations (SLTRO, VLTRO, TLTRO I, and TLTRO II), expansion of accepted collaterals, and liquidity provision in foreign currency. We also note that the ECB decided four times (in May 2010, March 2012, December 2012, and June 2016) to waive the quality threshold in order for Greek debt securities to be acceptable as collateral in monetary policy transactions.

When the ECB declared more than one type of intervention on the same day, to avoid overlapping events we adopt criteria following Fiordelisi and Galloppo (2018). (a) If all interventions belong to the same category, we encounter them as a single event, (b) the ECB's decisions to change the rate of the main refinancing operations are always considered as main events, (c) decisions to leave a current measure unchanged are considered less important than new measures, and (d) if the above criteria are not

enough, we identify, in terms of significance, the main event. Table 3.1 reports the classification of monetary policy interventions into four categories.

**Table 3.1** Classification of the ECB's monetary policy interventions announced between January 2007 and August 2018 into four related categories[38].

| Monetary Policy Category | Number of Interventions |
|---|---|
| Interest rate cuts (IRC) | 15 |
| Interest rate increases (IRIN) | 5 |
| Monetary easing (ME) | 22 |
| Liquidity provision (LIQ) | 61 |
| Total | 103 |

Therefore, our sample consists of 412 observations, as we essentially study the impact of 103 ECB's monetary interventions on equity returns of four systemic Greek banks.

### 3.3.2 Methodology

Regarding methodology, the present investigation follows the practice of Fiordelisi and Galloppo (2018). Firstly, daily returns from each of the four systemic Greek banks (Alpha Bank, Eurobank, National Bank, and Peireaus Bank) and the market index are calculated as:

$$R_{i,t} = \ln(P_{i,t}/P_{i,t-1}) \qquad (3.1)$$

Data for the bank equity prices and the general composite index of Athens stock exchange were retrieved from EIKON Datastream.

Subsequently we employed an event study procedure as in MacKinlay (1997). Normal-expected returns are computed using the market model with the Ordinary Least Squares (OLS) estimation procedure and an estimation period of 40 trading dates ending 10 trading dates before the event period[39].

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + u_{i,t} \qquad (3.2)$$

[38] See Table C.1 in Appendix C for a detailed presentation of interventions along with their categorization.

[39] For the return generating process of market model, we follow the procedure of Hendricks and Singhal (2003), Vortelinos and Gkillas (2019).

For each announcement date, we estimate Abnormal Returns (ARs) and Cumulative Abnormal Returns (CARs). Each AR is calculated as the difference between actual-real return and normal-expected return.

$$AR_{i,t} = R_{i,t} - \left( \hat{a}_i + \hat{\beta}_i R_{m,t} \right) \quad (3.3)$$

Then, Cumulative Abnormal Returns are calculated for one day event period (0,0), two day event window (0,+1), and three day event window (−1,+1) as:

$$\mathrm{CAR_i}^{(t1,t2)} = \sum_{t=t1}^{t2} \mathrm{AR_{i,t}} \quad (3.4)$$

To isolate the impact of announcements, the estimation period is not connected to the event period.

We employ an event window up to three days to avoid "contamination" of our results. According to Haitsma et al. (2016), too small a window might lose part of the responses to the monetary policy news, but too wide a window might infect the monetary interventions with other news.

Table 3.2 presents the descriptive statistics of Cumulative Abnormal Returns. We find a positive reaction of Greek banking security returns to the ECB's monetary policy interventions.

**Table 3.2** Descriptive statistics of Cumulative Abnormal Returns on announcement dates for the period January 2007 to August 2018.

| Variable | Mean | Median | Std. Dev. |
|---|---|---|---|
| CAR(0,0) | 0.001533 | 0.000253 | 0.042928 |
| CAR(0,+1) | 0.001160 | 0.001112 | 0.072824 |
| CAR(−1,+1) | 0.000305 | −0.001588 | 0.077599 |

Our result shows up stronger, if we consider that during the examination period, the general composite index of Athens stock exchange recorded a negative average daily return of 0.064% for 2872 trading dates.




**Figure 3.4** Closing prices of the Athens stock exchange general composite index

In the second step, an OLS multivariate panel regression analysis is performed using dummy variable procedure aiming to recognize the determinants of stock reactions. The model used in our empirical work is the following:

$$\mathrm{CAR}_{\mathrm{i,j}}^{(\mathrm{t1,t2})} = \gamma + \sum_{\mathrm{j=1}}^{\mathrm{n}} \beta_{\mathrm{j}} \mathrm{X}_{\mathrm{i,j}}^{\mathrm{m}} + \varepsilon_{i,j} \quad (3.5)$$

CAR for the each i-th bank (i = 1, 2, …, 4) to the j-th intervention (j = 1, 2, 3, …, 103) over each event window ($t_1$,$t_2$) is the dependent variable. $\mathrm{X}_{\mathrm{i,j}}^{\mathrm{m}}$ is the vector of dummy variables identifying each monetary policy category. Dummies identifying the category of monetary policy interventions are: interest rate increases (IRIN), interest rate cuts (IRC), monetary easing (ME), and liquidity provision (LIQ). For example, IRC is a dummy variable that takes a value of one (1) the day in which the ECB's governing council decided to decrease the main refinancing operations rate (MROr), and zero (0) otherwise. During the examination period, the ECB announced the reduction of the MROr 15 times. Respectively, LIQ is a dummy variable that takes a value of one (1) the day of a liquidity provision announcement and zero (0) otherwise (m = IRIN, IRC, ME, LIQ). $\varepsilon_{i,j}$ is the error term. To avoid multicollinearity problems, we did not estimate our model using jointly IRC, LIQ, and ME.

### 3.4 Discussion of results

Tables 3.3–3.5 report our empirical findings regarding the reaction of the Greek banking industry to conventional and non-standard monetary policy interventions introduced by the ECB[40].

**Table 3.3** Greek banking sector stock reaction to the ECB's monetary policy interventions. One-day event window. CARs are obtained by the market model.

| Dependent Variable CAR(0,0) | | | | | | |
|---|---|---|---|---|---|---|
| **Independent Variables** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** |
| γ | −0.000868 | 0.002274 | −0.002450 | 0.002619 | −0.003233 | 0.005615 |
| IRC | 0.016485* | 0.005959 | 0.018067* | 0.006087 | 0.01737** | 0.006984 |
| ME | | | 0.006327 | 0.005239 | | |
| LIQ | | | | | 0.002776 | 0.004559 |
| R squared | 1.84% | | 2.19% | | 1.84% | |

Note: This table reports the Greek banking sector stock reaction to the ECB's monetary policy announcements. The dependent variable is CAR(0,0). The independent variables are IRC, a dummy variable that specifies announcements for interest rate reductions, ME, a dummy variable that specifies announcements for monetary easing, and LIQ, a dummy variable that indicates announcements for liquidity provision. *, ** denote that estimates are statistically significant at 1%, 5% levels, respectively

**Table 3.4** Greek banking sector stock reactions to the ECB's monetary policy interventions. Two-day event window. CARs are obtained by the market model.

| Dependent Variable CAR(0,1) | | | | | | |
|---|---|---|---|---|---|---|
| **Independent Variables** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** |
| γ | −0.003789 | 0.003833 | −0.005852 | 0.004427 | −0.007166 | 0.006801 |
| IRC | 0.033984* | 0.010045 | 0.036047* | 0.010287 | 0.037361* | 0.011514 |
| ME | | | 0.008253 | 0.008854 | | |
| LIQ | | | | | 0.004953 | 0.008236 |
| R squared | 2.72% | | 2.9% | | 2.8% | |

Note: The dependent variable is CAR(0,+1). The same independent variables used as in Table 3.3. * denotes statistical significance at the 1% level.

[40] A multivariable panel regression model was estimated for a five-day event period with no statistically significant results.

**Table 3.5.** Greek Banking sector stock reactions to the ECB's monetary policy interventions. Three-day event window. CARs are obtained by the market model.

| | Dependent Variable CAR(-1,1) | | | | | |
|---|---|---|---|---|---|---|
| **Independent Variables** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** |
| γ | −0.003466 | 0.004112 | −0.006010 | 0.004748 | −0.007282 | 0.007296 |
| IRC | 0.025897** | 0.010776 | 0.028441** | 0.011032 | 0.029713** | 0.012352 |
| ME | | | 0.010174 | 0.009495 | | |
| LIQ | | | | | 0.005597 | 0.008835 |
| R squared | 1.39% | | 1.67% | | 1.48% | |

Note: The dependent variable is CAR(−1,+1). The same independent variables used as in Table 3.3. ** denotes that estimates are statistically significant at the 5% level.

First, interest rate cut announcements have positive and statistically significant impacts on banks' Cumulative Abnormal Returns. In panel linear regressions with IRC as the independent variable, coefficients of IRC are statistically significant at the 1% level when the dependent variable is either CAR(0,0) or CAR(0,+1) and at the 5% level when the dependent variable is CAR(−1,+1). Additionally, in all multivariate panel regressions with combinations of IRC with LIQ and ME, the coefficients of IRC remain statistically significant at 1% and 5% levels, respectively[41]. Our results show up stronger for the two-day event period (the day of announcement and the next day). Furthermore, we evidence rather stable estimated coefficients for IRC for each event window. This interesting result suggests that ECB's expansionary conventional monetary policy measures produce positive and statistically significant impacts on Greek banking returns over a very short time event window even in a crisis period.

According to the interest rate channel (Bernanke and Kuttner 2005), interest rate reductions increase the present value of future cash flows by decreasing the risk-free rate as well as the risk premium and hence equity prices are increased. Interest rate cuts decrease the cost of banks' funding, increase the provision of liquidity, boost the expansion of credit, increase the loan demand, improve the interest margins, increase the collateral provided by debt holders, strengthen bank revenues, and enhance the

[41] We did not estimate our model using jointly IRC, LIQ, ME as independent variables as we noticed multicollinearity issues.

equity prices. Additionally, the ECB's intention to keep the key interest rates at the zero lower bound for an extended period of time affects downward lending and deposit rates as well as other short-term and long-term rates. This signaling process decreases the market uncertainty and leads to adjustment in demand of equity prices due to investors aiming at higher yields.

Previous research (e.g., Fiordelisi and Ricci 2016) supports our findings about the stock reaction of financial institutions on expansionary conventional monetary policy interventions. Additionally, Fiordelisi and Galloppo (2018) reported that during the crisis period, the investors believed that interest rate cuts is an effective tool for boosting the banking industry. Moreover, Petrakis et al. (2022) showed that that conventional monetary policy interventions affected distressed Eurozone equity markets.

Contractionary convectional monetary policy announcements (interest rate increases) have no statistically significant explanatory power on CARs. Additionally, in multivariable regressions, announcements concerning unconventional, non-standard monetary measures (monetary easing and liquidity provision) are found to produce positive but not statistically significant effects on Greek banking stock returns[42].

We observed that since the last four month of 2008 until mid-2009, the ECB cut rapidly the main refinancing operations rate to dominate the first stage of the crisis but margins for more expansive conventional policy were limited because the MROr was close to the zero level. Due to this fact, the Eurozone monetary authority launched unconventional measures mainly in the second and third stages of the crisis.

As we previously noticed, during and after the debt crisis, the Greek government implemented three economic and adjustment programs accompanied with austerity measures that decreased investors' expectations about the effectiveness of non-traditional measures. The restructuring of public debt that caused great losses to private bondholders, the recapitalization of systemic Greek banks from the official

[42] In Tables 3.3– 3.5 we present only statistically significant results.

σector, and the imposition of capital controls resulted in the gradual loss of investors' confidence towards the Greek economy and the regional capital market.

As shown in Figure 3.3, in the case of Greek MFIs, the bank lending and direct pass-through channels were not activated as credit to the private sector declined from the onset of the debt crisis. Greek MFIs suffered from a liquidity shortage due to inadequate collateral, high non-performing loan ratios, low capital adequacy ratios, and high deposit withdrawals (Charalambakis et al. 2017; Louri and Migiakis 2019). The ECB decided four times to waive the application of the quality threshold and accepted Greek debt securities as collateral in monetary policy transactions, but these decisions were not enough to boost credit expansion as loans to households and corporations became negative in net terms.

In addition, the portfolio rebalancing mechanism did not operate properly. The extreme uncertainty conditions prevailed in Greece during and after the eruption of the debt crisis and the possibility of sovereign default along with the financial fragility of Greek MFIs forced investors to shift their funds from Greece to non-stressed countries eliminating the impact of non-standard measures on local banking equity returns. Another reason that the portfolio rebalancing channel did not work properly was the fact that the Greek private and official sector debt securities were not eligible for APP operations because of the low credit rating[43].

Previous studies support our results. Pacicco et al. (2019) reported that Greek stock market did not react to the ECB's non-conventional monetary interventions in the aftermath of the debt crisis. Additionally, Vortelinos and Gkillas (2019) found that equity markets of distressed Eurozone members states did not show a significant response to the ECB's monetary events in subperiods following the eruption of the debt crisis while investors were directed to non-troubled economies. Boeckx et al. (2017) pointed out that the ECB's unconventional balance sheet policy turned out to be more effective in countries that were less influenced by the economic crisis.

[43] See figure 1.5 in chapter 1.

### 3.5 Robustness tests

As a robustness check, we use market adjusted procedure in which expected-normal returns are equal to market returns[44]. Hence abnormal returns are calculated as actual returns minus market returns. In our case, market returns are proxied by national indices returns.

$$AR_{i,t} = R_{i,t} - R_{m,t} \quad (3.6)$$

The market adjusted procedure has been applied in several research studies dealing with bank returns in periods of crises (Kosmidou et. al., 2015; Fiordelisi and Ricci, 2016) to reduce possible bias of market model which uses data from the estimation window to calculate expected returns in the event window. More specifically, the market model's returns could have been affected by policy interventions already announced during the estimation period.

Tables 3.6 to 3.8 reports the respective results from the estimation of equation (3.5) using market adjusted procedure to calculate CARs.

**Table 3.6** Greek banking sector stock reaction to the ECB's monetary policy interventions. One-day event window. CARs are obtained by market adjusted procedure.

| Dependent Variable CAR(0,0) | | | | | | |
|---|---|---|---|---|---|---|
| **Independent Variables** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** |
| γ | 6.70E-05 | 0.002390 | -0.001438 | 0.002760 | 0.001046 | 0.004242 |
| IRC | 0.012829** | 0.006264 | 0.014335** | 0.006413 | 0.01185*** | 0.007183 |
| ME | | | 0.006022 | 0.005519 | | |
| LIQ | | | | | -0.001435 | 0.005138 |
| R squared | 1.00% | | 1.30% | | 1.03% | |

Note: This table reports the Greek banking sector stock reaction to the ECB's monetary policy announcements. The dependent variable is CAR(0,0). The same independent variables used as in Table 3.3. **,*** denotes statistical significance at the 5% and 10% level respectively.

[44] For details about different models of the return-generating processes see Brown and Warner (1985).

**Table 3.7** Greek banking sector stock reactions to the ECB's monetary policy interventions. Two-day event window. CARs are obtained by market adjusted procedure.

| Dependent Variable CAR(0,1) | | | | | | |
|---|---|---|---|---|---|---|
| **Independent Variables** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** |
| γ | -0.006440 | 0.003883 | -0.006959 | 0.004488 | -0.010072 | 0.006888 |
| IRC | 0.035432* | 0.010174 | 0.035951* | 0.010430 | 0.039064* | 0.011662 |
| ME | | | 0.002075 | 0.008977 | | |
| LIQ | | | | | 0.005328 | 0.008342 |
| R squared | 2.87% | | 2.89% | | 2.97% | |

Note: The dependent variable is CAR(0,+1). The same independent variables used as in Table 3.3.
* denotes statistical significance at the 1% level.

**Table 3.8** Greek Banking sector stock reactions to the ECB's monetary policy interventions. Three-day event window. CARs are obtained by the market adjusted procedure.

| Dependent Variable CAR(-1,1) | | | | | | |
|---|---|---|---|---|---|---|
| **Independent Variables** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** |
| γ | -0.007877 | 0.004417 | -0.007218 | 0.005106 | -0.015995 | 0.007824 |
| IRC | 0.026913** | 0.011573 | 0.026254** | 0.011865 | 0.035032* | 0.013247 |
| ME | | | -0.002635 | 0.010211 | | |
| LIQ | | | | | 0.011908 | 0.009476 |
| R squared | 1.30% | | 1.32% | | 1.68% | |

Note: The dependent variable is CAR(−1,+1). The same independent variables used as in Table 3.3.*, ** denotes that estimates are statistically significant at the 1% and 5% level respectively.

Results are remarkably the same. In simple panel linear regressions the coefficients of IRC are statistically significant at the 1% level when the dependent variable is either CAR(0,+1) and at the 5% level when the dependent variable is either CAR(0,0) or CAR(−1,+1). Additionally, in all multivariate panel regressions with combinations of IRC with LIQ or ME, the coefficients of IRC remain statistically significant.

Further, to investigate if the effects of the ECB's conventional and non-traditional monetary policy measures change over time, we decided to divide our sampling period

into two different subperiods. As we previously noticed, on the 02/05/2010 Greece's first rescue program was agreed (in the form of a Memorandum of Understanding, MoU) with the IMF, the European member states, and the ECB, totaling a multilateral loan of EUR 110 billion. So, the first sub-period (the pre-bailout sub-period), is between 01/01/2007 and 01/05/2010 and covers the subprime crisis phase and the global financial crisis phase. The second sub-period (the bailout sub-period) extends from 02/05/2010 to 20/08/2018 and covers the Greek debt crisis along with the three adjustment programs. In the first sub-period, the ECB reduced the key interest rate seven times while in the second sub-period eight times (see Table C.1 in Appendix C).

To search further the robustness of our empirical results, we re-estimated our equation introducing a time dummy variable.

$$\mathrm{CAR}_{i,j}^{(t1,t2)} = \gamma + \sum_{j=1}^{n} \beta_j X_{i,j}^{m} + \delta \mathrm{TD}_t + \varepsilon_{i,j} \quad (3.7)$$

TD is a time dummy variable that takes the value of zero (0) at the first, pre-bailout sub-period from 1 January 2007 to 1 May 2010, and the value of one (1) at the second bailout sub-period from 2 May 2010 to 20 August 2018[45]. Tables 3.9 to 3.11 report the empirical findings.

**Table 3.9** Greek banking sector stock reaction to the ECB's monetary policy interventions. One-day event window. CARs are obtained by the market model.

| | **Dependent Variable CAR(0,0)** | | | | | |
|---|---|---|---|---|---|---|
| **Independent Variables** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** |
| γ | −0.002575 | 0.003681 | −0.002979 | 0.003700 | −0.003233 | 0.005615 |
| IRC | 0.016811* | 0.005978 | 0.018093* | 0.006095 | 0.017370** | 0.006984 |
| ME | | | 0.005956 | 0.005556 | | |
| LIQ | | | | | 0.000785 | 0.005059 |
| TD | 0.002590 | 0.004395 | 0.000943 | 0.004655 | 0.002776 | 0.004559 |
| R squared | 1.93% | | 2.20% | | 1.93% | |

[45] Ricci (2015), Fiordelisi and Galloppo (2018) as well as Vortelinos and Gkillas (2019) used the same procedure to investigate monetary impacts over time.

Note: The same dependent and independent variables used as in Table 3.3. We added TD, a dummy that takes the value of one in the bailout sub-period and zero otherwise, as an independent variable. *, ** denote that estimates are statistically significant at 1%, 5% levels, respectively.

**Table 3.10** Greek banking sector stock reactions to the ECB's monetary policy interventions. Two-day event window. CARs are obtained by the market model.

| Dependent Variable CAR(0,1) | | | | | | |
|---|---|---|---|---|---|---|
| **Independent Variables** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** |
| γ | −0.002154 | 0.006219 | −0.002856 | 0.006249 | -0.005958 | 0.009482 |
| IRC | 0.033672* | 0.010099 | 0.035901* | 0.010296 | 0.036905* | 0.011795 |
| ME | | | 0.010359 | 0.009385 | | |
| LIQ | | | | | 0.004544 | 0.008544 |
| TD | −0.002481 | 0.007425 | −0.005346 | 0.007863 | −0.001409 | 0.007700 |
| R squared | 2.74% | | 3.03% | | 2.81% | |

Note: The same dependent and independent variables used as in Table 3.3. We added TD, a dummy that takes the value of one in the bailout sub-period and zero otherwise, as an independent variable. * denotes that estimates are statistically significant at the 1% level.

**Table 3.11** Greek banking sector stock reactions to the ECB's monetary policy interventions. Three-day event window. CARs are obtained by the market model.

| Dependent Variable CAR(-1,1) | | | | | | |
|---|---|---|---|---|---|---|
| **Independent Variables** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** | **Coeff.** | **Std.Error** |
| γ | −0.000482 | 0.006670 | −0.001391 | 0.006698 | −0.004330 | 0.010171 |
| IRC | 0.025328** | 0.010831 | 0.028216** | 0.011035 | 0.028598** | 0.012651 |
| ME | | | 0.013420 | 0.010059 | | |
| LIQ | | | | | 0.004596 | 0.009164 |
| TD | −0.004529 | 0.007963 | −0.008240 | 0.008428 | −0.003444 | 0.008259 |
| R squared | 1.46% | | 1.90% | | 1.53% | |

Note: The same dependent and independent variables used as in Table 3.5. We added TD, a dummy that takes the value of one in the bailout sub-period and zero otherwise, as an independent variable. ** denotes that estimates are statistically significant at 5%.

Our empirical results are remarkably consistent with those reported above. More specifically, in all panel univariate and multivariate regressions, coefficients of IRC have

similar magnitudes and statistical significance as before, while coefficient estimates on ME and LIQ are positive but not statistically significant.

The inclusion of the TD time dummy variable confirms that there is a no different effect between pre-bailout and bailout crisis periods. Therefore, we underscore a sustainable effect lasting for the whole investigating period, from January 2007 to August 2018. Additionally, Fiordelisi and Galloppo (2018) found that the statistically significant banking sector reaction on expansionary monetary policy measures is irrelevant with the evolution of the financial crisis.

### 3.6 Conclusion

Greece and the regional banking system faced the devastating consequences of the financial and sovereign debt crisis. In early 2010, the Greek government lost access to financial markets and was forced to launch the first economic and adjustment program to receive financial assistance and to avoid default. Greece implemented two more economic and adjustment programs until August 2018, due to the ongoing economic recession and the budget deficits. In the onset of the financial crisis, the regional monetary financial institutions (MFIs) were healthy and resilient as they were among the best capitalized banks in Europe but, eventually, they were weakened by the sovereign debt crisis.

From the onset of financial crisis, the ECB implemented a wide set of traditional and unconventional monetary policy interventions to influence financing conditions and to boost economic activity in the euro area.

Our research examined the response of Greek banking stock returns to these measures during the period of January 2007 to August 2018. In the first step of our study, we collected 103 significant monetary policy announcements and classified them to several categories. In the second step we performed an event study and panel regression analysis to estimate banking stock reactions to the collected monetary interventions.

The results of this study indicate that market participants appreciate expansionary conventional monetary policy interventions, introduced by the ECB. This type of policy

activates the interest rate transmission mechanism and is found to be efficient in restoring investors' trust in Greek banking stocks in a very short event window.

The upcoming sovereign debt crisis in mid-2010, the uncertainty about the country's prospects as a member state of Eurozone, the three economic and adjusted programs implemented by the Greek government, the restructuring of public debt, the high stock of non-performing loans, and finally the imposition of capital controls resulted in a gradual loss of investors' confidence towards the Greek economy and regional monetary financial institutions. As a result, investors shifted their funds from the Greek capital market to non-stressed countries limiting the effectiveness of non-standard measures on local banking equity returns. Additionally, the two main unconventional monetary policy transmission channels, the portfolio rebalancing, and the direct pass-through, that could boost bank equity prices, did not operate properly in the case of Greece due to the financial fragility of local banks and the exclusion of Greek private and public debt securities from the expanded APP operations.

Despite the valuable findings of this study there are some limitations as it analyses only monetary policy measures and does not include the impacts of financial support, fiscal, and state aid policies as well as announcements about macroeconomic and fiscal data (e.g., inflation, out-put, unemployment, and budget deficit) that could affect equity prices. Despite these limitations, this study provides interesting findings for investors and decision makers. Results raise concern about the effectiveness of unconventional measures on a peripheral capital market (Greek equity market) designed by the policy makers. Furthermore, the findings of the research are useful for investors because they shed light on the impact of traditional and unconventional monetary policy interventions on stocks of the Greek banking sector which was operating in a very turbulent economic environment with extreme uncertainty conditions.

Today, the Greek banking sector has overcome most of the problems of the economic and debt crisis. The three rounds of recapitalization improved noticeably capital adequacy ratios, the stock of non-performing loans decreased significantly, and the investors' interest returned. Nevertheless, the future stands ahead, and the local MFIs seem ready to contribute to the economic development of the country.

# Chapter 4

# Market dynamics and critical responses of leading european banks to ECB's expansionary policies.[46]

## 4.1. Introduction

The eruption of the financial crisis, in the second semester of 2007, caused great uncertainty to global capital markets and developed economies. More specifically, European capital markets slowed down, and economic activity was disrupted as negative spillovers emerged from financial sector to real economy leading to economic recession and later to sovereign debt crisis. To recover from recession European governments engaged in fiscal loosening causing credit rating downgrades and sovereign bond yields increases in fiscally weaker peripheral countries. The ECB introduced countercyclical policy, combining regular and non-regular measures to boost bank lending, relieve capital markets distress, revive real economy and support financially distressed countries.

Our study aims to evaluate the reaction of bank stocks to the announcement of the ECB's expansionary policy interventions from July 2007 to December 2020, as it is crucial for decision-makers, investors, and researchers to fully understand how these measures affect stock markets.

For example, on March 10, 2016, meeting, the ECB announced both conventional and non-conventional measures[47]. More specifically, it announced a deeper zero rate for main refinancing operations, an increase in monthly asset purchases from 60 to 80 billion euros and introduced the second tranche of targeted LTROs and the corporate sector purchase program (CSPP). Using the event study approach of MacKinley (1997) we present, in Figure 4.1, the abnormal returns (AR) and the two-day cumulative abnormal returns (CAR[0,+1]) of fourteen large European banks[48]. Our estimates show strong positive reaction as all banks present ARs between 1.0 percent and 4.1 percent

[46] A version of this study was presented in the 13th national conference of the Financial Engineering and Banking Society (FEBS, 2023) and published in Journal of Economic Studies https://doi.org/10.1108/JES-09-2024-0592

[47] https://www.ecb.europa.eu/press/press_conference/monetary-policy-statement/2016/html/is160310.en.html

[48] For the estimation of ARs and CARs see subsections 3.3.2 and section 4.3.

on the day of the announcement, and CARs between 1.4 percent and 8.3 percent over a two-day event period. The fundamental hypothesis is that the official release of a monetary policy measure impacts not only on the stock market of a country, but also on the stock price of a particular bank due to the idiosyncratic characteristics of the bank. If the announcement of the policy measure increases bank's net present value more than average of firms participating in the market index, it produces positive abnormal returns (Fiordelisi and Ricci, 2016).

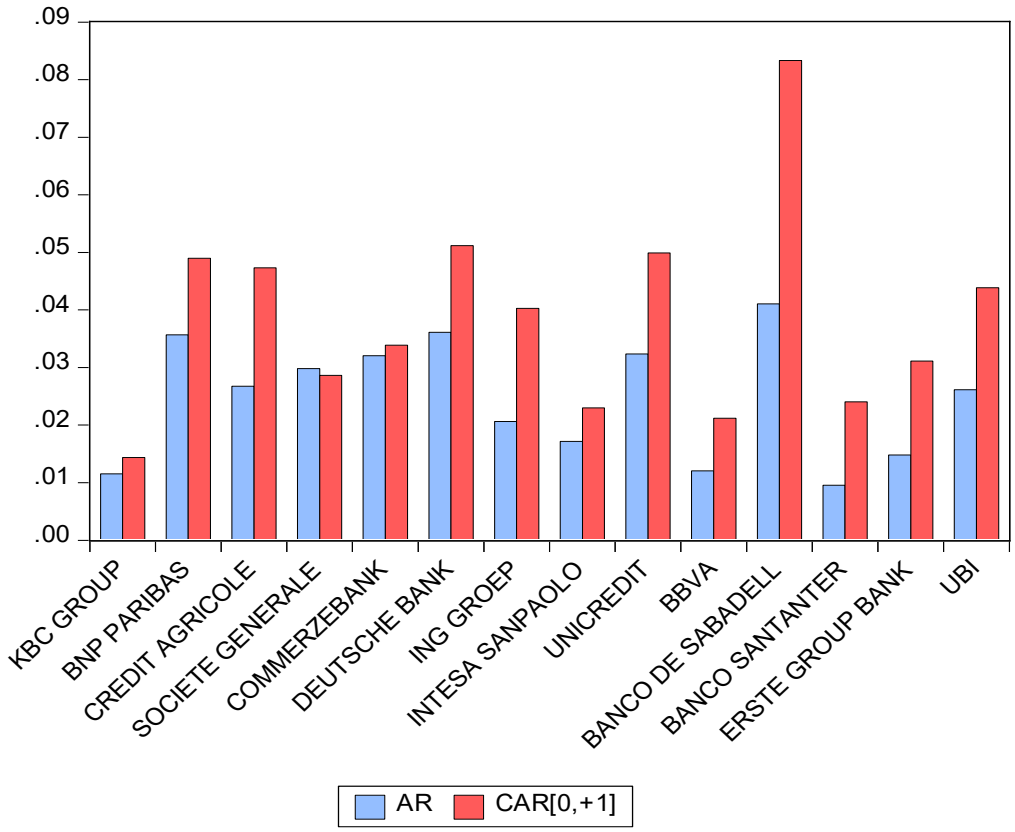



**Figure 4.1** ARs and two-day CARs for fourteen large European banks on March 10, 2016, using market model to estimate expected returns.

According to economic theory, a decrease in interest rates increases net present value of expected cash flows by reducing the risk free rate and the risk premium and by enhancing expected future cash flows (Bernanke and Kuttner 2005). This in turn leads to higher stock prices. When the main short-term interest rates reached the effective lower bound (ELB), the ECB resorted to nonconventional measures (mainly quantitative easing) to enhance its accommodative policy. Economic theories of

quantitative easing suggest that large scale security purchases lead to a decrease in the long-term interest rates (Eggertson and Woodford, 2003; Sims et al., 2022). This in turn is likely to lead to increased stock prices as agents rebalance their portfolios from bonds to stocks (Vayanos and Villa, 2021).

We refer herein the testable hypotheses investigated under this study.

***H1.*** *Is there an impact of the ECB's interest rate reductions on European bank stocks?*

***H2.*** *What was the response of the European banking institutions to the announcement of the ECB's expansionary non-conventional measures?*

***H3.*** *Which type of expansionary monetary policy (conventional or unconventional) has a greater impact on bank stock prices?*

The first hypothesis is related to the theory of the traditional transmission channel of monetary policy while the second with new unconventional channels analyzed in chapter , section 2.3.

This research aims to investigate these hypotheses by estimating large banks' reaction to a set of 77 crucial expansionary measures, classified to four respective types of policy, by using event study and panel regression analysis. Few recent studies had used panel regression methodology to survey the reaction of the European banking industry to monetary policy announcements (Rici, 2015; Galloppo and Rici, 2016; Fiordelisi and Galloppo 2018).

Our paper contributes to the literature by extending the analyzing period from July 2007 to December 2020 to include the low inflation period and the covid-19 pandemic. Also, our study does not use subjective criteria as in Ricci (2015), and, Fiordelisi and Galloppo (2018), to select the most relevant measure but keeps all expansionary measures in the sample by introducing a specific set of dummy variables. By applying this methodology, we find that both asset purchases and liquidity provisions affect bank stock prices while previous studies suggest that only one type of non-conventional monetary policy impacts on banking stocks (monetary easing for

Fiordelisi et al., 2014 and Ricci, 2015 and liquidity provision for Fiordelisi and Gallopo, 2018).

Furthermore, we not only examine the difference between standard and non-standard expansionary policies, but also, we consider the impact of each non-standard program separately. To the best of our knowledge this is the first study that analyses and compare the persistence and strength of each measure in generating abnormal returns.

Our results suggest that European banking stocks have a positive reaction to both conventional and unconventional expansionary policies. While short term rate cuts and extraordinary liquidity provision affect stocks over short event windows, asset purchases produce stronger positive effects and over longer event periods.

The rest of the present chapter proceeds as follows. Sections 4.2 and 4.3 present empirical approach and the dataset while section 4.4 the econometric approach employed in this research. The research findings and robustness tests are reported in sections 4.5 and 4.6, while section 4.7 concludes[49].

## 4.2 Empirical approach

Several approaches have been employed to research the effects of monetary policy interventions on stock prices. VAR models' impulse reaction functions were applied in certain research in the 1990s (Thorbecke 1997; Patelis 1997). In our times structural and Bayesian VAR models are used with monthly data researching medium to long term relationships (Boeckx et al. 2017; Lewis and Roth 2019; Evgenidis and Papadamou 2021, Weale and Wieladek 2022; Van der Zwan et al., 2024). The heteroscedasticity-based estimation approach was proposed by Ridogon and Sack (2003) to overcome endogeneity and omitted variables issues. Some studies used the heteroscedasticity-based estimation approach (Kholodin et al., 2009) however, the event study approach is applied by most researchers (Ricci, 2015; Georgiadis and Gräb 2016; Haitsma et al. 2016; Pacicco 2019; Ferreira and Serra 2022). According to Bernanke et al. (2004) the

[49] The literature review section of chapters 3 and 4 appears combined in section 3.2

event study provides accurate estimates of the equity's reactions to policy interventions by employing considerable narrow event periods. Also, as outlined by Rosa (2011), estimates from the event study approach generally perform better than estimates based on heteroscedasticity approach, therefore, the event study methodology should be selected.

In the studies of Rogers et al. (2014), Haitsma et al. (2016) Fausch and Sigonius (2018), Pacicco et al. (2019), Ferreira and Serra (2022) non-regular monetary policy surprises were proxied by the difference between the yields of 10-year Italian and German sovereign bonds without to classify them in several categories (i.e. liquidity provision, asset purchases).

Ricci (2015), Fiordelisi and Galloppo (2018), Petrakis et al. (2022b) inserted in their econometric models a set of dummy variables to classify announcements of expansionary measures in several categories. To deal with overlapping announcements that contain two or more expansionary monetary measures they adopted four subjective criteria to select the most relevant measure. As a consequence, they suggested that only one type of non-conventional monetary policy (i.e. monetary easing for Ricci, 2015 and liquidity provision for Fiordelisi and Gallopo, 2018) affects bank stock prices.

To fill this gap, we use a set of dummies as explanatory variables in panel regressions to process overlapping announcements. More specifically, in overlapping announcements we keep all expansionary measures in our sample without using subjective criteria to identify the most relevant measure as in Fiordelisi and Ricci (2016). This procedure is more appropriate for us as we don't lose a significant number of observations (for more details see section 4.4).

For example, ECB's overlapping announcement on March 10, 2016, would be categorized by Ricci (2015) and others as an interest rate cut only because, according to their criteria, an interest rate cut is always the main measure, dropping other measures from their sample. Our procedure classifies it as interest rate cut, liquidity provision, asset purchase and forward guidance (see table D.1 in appendix D).

By using subjective criteria to select the most relevant measure the sample would include only 55 measures while our approach permits us to analyze all 77 interventions.

### 4.3 Data and sample description

We evaluate the impact of the expansionary policy interventions, both regular and non-regular, on stock returns of a sample of fourteen large European banks from July 2007 to December 2020. The selected banks meet the following criteria: a) the bank is based in a euro area member state; b) the bank participated on the 2011, 2014, 2016 and 2018 European Union-wide stress tests directed by the European Banking Authority (EBA) jointly with ECB; c) the bank is listed on a national stock exchange; d) the bank has not been declared insolvent or nationalized during our examination period[50]. The banks included in our sample are presented in table 4.1.

**Table 4.1** Sample of selected European banks.

| Bank name | Country | Market Index | Global Systemically Important Banks |
|---|---|---|---|
| Erste Group Bank AG | Austria | ATX | |
| KBC Group NV | Belgium | BEL 20 | |
| Societe Generale S.A. | France | CAC 40 | From 2011 to 2020 |
| Credit Agricole S.A. | France | CAC 40 | From 2011 to 2020 |
| BNP Paribas S.A. | France | CAC 40 | From 2011 to 2020 |
| Commerzbank A.G. | Germany | DAX 30 | 2011 |
| Deutsche Bank A.G. | Germany | DAX 30 | From 2011 to 2020 |
| Unione di Banche Italiane Societa Per Azioni (UBI) | Italy | FTSE MIB | |
| UniCredit S.p.A. | Italy | FTSE MIB | From 2011 to 2020 |
| Intesa Sanpaolo S.p.A. | Italy | FTSE MIB | |
| ING Groep N.V. | Netherlands | AEX | From 2011 to 2020 |
| Banco Santander S.A. | Spain | IBEX 30 | From 2011 to 2020 |
| Banco de Sabadell S.A. | Spain | IBEX 30 | |
| Banco Bilbao Vizcaya Argentaria S.A. (BBVA) | Spain | IBEX 30 | From 2012 to 2014 |

[50]We exclude from our sample the two Irish banks (Allied Irish Bank and Bank of Ireland Group), the four Greek systemic banks (Alpha Bank SA, Eurobank Ergasias SA, National Bank of Greece SA, Piraeus Bank SA) and the two Portuguese banks (Banco Portugues de Investimento and Banco Comercial Portugues) as they were recapitalized by the Irish (2009), Greek (2013, 2015) and Portugal (2012) state respectively, the large French-Belgian banking institution Dexia S.A. and the Spanish Banco Popular Espanol, S.A which went in resolution in 2012 and 2017 respectively, as well as the Italian Banca Monte dei Paschi di Siena which proceeded with a precautionary state recapitalization in 2017.

All fourteen banks have been characterized as systematic banks by EBA while, the Financial Stability Board (FSB) has listed BNP Paribas, Deutsche Bank, Credit Agricole, Societe Generale, ING, UniCredit and Banco Santander as global systemically important banks (G-SIBs) for the years 2011 to 2020, Commerzbank for 2011 and BBVA for the years 2012 to 2014.

Regarding monetary policy interventions we collected a sample with the ECB's most significant announcements containing expansionary policy measures. Policy interventions have been collected from official announcements (press conferences and releases) and key speeches. Overall, we collected 77 crucial interventions from July 2007 to December 2020. We also carried out cross-checking with previous studies (Martins et al., 2019; Fereira and Serra, 2022; Petrakis et al., 2022b).

To deal with overlapping announcements we adopted the methodology of Fiordelisi and Ricci (2016). We kept all expansionary measures in our sample and used a specific set of dummy variables in panel regressions.

ECB's expansionary policy measures have been classified into four categories: interest rate cuts (INTC), asset purchases (ASSP), liquidity provision (LIQP) and forward guidance (FWG). We use the main refinancing operations rate as a proxy for interest rate cuts. Asset purchases include ECB's purchases of public, covered bank and corporate bonds as well as asset backed securities (PEEP, CSPP, PSPP, ABSPP, CBPPI-III, OMT and SMP), in primary or secondary markets. Liquidity provision decisions include pandemic emergency, targeted, very longer term and supplementary refinancing operations as well as full allotment procedure at fixed rate for open market operations. Forward guidance comprises official statements about the expected direction of the ECB's short-term policy rates. Table 4.2 illustrates our classification of the expansionary policy interventions into four respective categories.

**Table 4.2** Classification of the ECB's expansionary policy interventions into four respective categories.

| Category of expansionary monetary policy | Number of policy interventions |
|---|---|
| Interest rate cuts (INTC) | 15 |
| Asset purchases (ASSP) | 30 |
| Liquidity provision (LIQP) | 26 |

| | |
|---|---|
| Forward guidance (FWG) | 6 |
| Total | 77 |

### 4.3 Methodology

To evaluate the impact of the ECB's expansionary policy measures on stock prices of fourteen large European banks we combine events study approach along with panel econometric models. First, we calculated actual returns for each bank and the respective market index by the equation (3.1)[51]:

Subsequently we applied MacKinlay's (1997) event study estimation procedure. As in chapter 3 we estimated expected-normal returns using standard market model with forty trading days estimation window ending ten trading days before to the event window by the equation (3.2).

To account for country specific effects, we used national equity market indices instead of a European index for all banks. According to Petrella and Resti (2013), by utilizing national equity market indices we can be sure that residuals will include only firm's idiosyncratic characteristics.
Abnormal-excess returns are then considered as the difference between (ex post) actual returns and the market model's predicted expected returns as in equation (3.3).

Next, the cumulative abnormal returns are computed for one day [0], two day [0,+1], three day [−1,+1] and five day [-1,+3] event windows as in equation (3.4).

According to Gagnon et al. (2011), Fiordelisi and Ricci (2016) a narrow event window is adequate to limit the bias in the estimation of the impact of policy intervention on equity prices. Also, by employing a narrow event window around each expansionary monetary policy announcement, an event study keeps constant other macroeconomic variables (i.e. gdp growth, inflation rate) allowing to more effectively isolate the impact of each announcement on stock markets (Fiordelisi et al. 2014).As a second step, we employ a multivariate panel regression model to identify the impact of the ECB's policy interventions on stocks. Following the procedure of Fiordelisi and Ricci (2016), we

[51] Closing prices of bank stocks and market indices were retrieved from EIKON Reifinitiv.

estimate the following panel regression model using Ordinary Least Squares with Panel Corrected Standard Errors[52]:

$$CAR_{i,k}(T_1, T_2) = a_i + \sum_{k=1}^{n} \gamma_k X_{i,k}^{g} + MUL_l + \varepsilon_{i,k} \quad (4.1)$$

Dependent variable is the cumulative abnormal return for the each i-th large bank (i=1,2,…,14) to the k-th day of intervention (k = 1, 2,…,55). Independent variables are represented by vector $X_{i,k}^{g}$ of dummy variables determining the respective category of the ECB's expansionary policy interventions. More specifically dummy variables are: INTC for policy rate reductions, ASSP for asset purchases, LIQP for liquidity provision and FWG for forward guidance. For example, ASSP is a dummy variable that equals to 1, the day of an asset purchasing announcement and 0 otherwise (g = INTC, ASSP, LIQP, FWG). $MUL_l$ is a dummy variable that equals to 1 if two or more categories of measures were announced in the same day and zero when only one measure was announced[53]. In our sample period, in 18 days out of a total of 55 days, more than one measure was announced. $\varepsilon_{i,k}$ is the error term.

### 4.4 Results from regression analysis

Table 4.3 reports empirical findings from our panel regression model regarding the testable hypotheses determined in the introduction, and particularly the equity reaction of large European banks to expansionary interventions announced by the ECB. In general, we show that estimated coefficients of expansionary interventions are statistically significant and positive except for forward guidance. According to Bernanke (2020) asset purchases and forward guidance are closely intertwined as both operate through the signaling channel of lower to longer rate policy. Notably, ECB connected low interest rates with the conclusion of net asset purchases in March 10,

[52] To account for cross sectional clustering of banks on the announcement dates we used OLS with panel-corrected standard errors of (PCSE) which, according to Beck and Katz (1995) leads to more accurate estimates than the Generalized Least Squares. In what follows we present the respective results using feasible GLS estimation procedure.

[53] Table D.1 in appendix D presents the classification of the ECB's monetary policy interventions in the respective categories.

2016, governing council meeting. Eberly et al. (2019) noted that it is difficult to separate the impact of those two non-traditional measures on security prices[54].

Firstly, the stock reaction of European banks to the ECB's interest rate cut announcements is positive and significant. In panel regressions with either CAR[0] or CAR[0,+1] as dependent variable, coefficient of INTC is statistically significant at the 1% level and at the 10% level when CAR[-1,+1] is the dependent variable. Looking at the magnitude, the higher coefficient estimate is at 2-day event window (1.64 percent). According to the theory, the traditional monetary policy channel indicates that short term rate cuts decrease the discount rate (both risk free rate and risk premium) and thus raise the net present value of banκs' expected cash flows and therefore stock prices are appreciated. It should be mentioned that the ECB's policy rate cuts allowed to overcome the financial and European debt crisis, but when the main policy rate reached the effective lower bound (ELB) and more accommodative policy was needed, the ECB was forced to employ unconventional policy to a greater extent.

Announcements for extraordinary liquidity provision measures positively influenced large European banks. The coefficient estimates of LIQP are positive and significant at 5% level in two short term event periods of one day [0], two day [0,+1] and at 10% level in three day event window [−1,+1]. We also observe that coefficient estimates for LIQP have smaller magnitudes than the INTC coefficients for the corresponding event windows. This finding is consistent with Fiordelisi and Galloppo (2018) who reported that liquidity provision measures produce strong positive reactions to banking sector indices. According to to the broad bank lending channel and the bank credit risk channel, the unlimited access to central bank liquidity, subsistutes market funding, decreased cost of funding, boosted bank lending expansion, strengthened the solvency of banks, decreased their credit risk and so boost bank stock prices by lowering their risk premia (Falagiarda and Reitz, 2015; Fratzscher et al., 2016; Kashyap and Stein, 2023).

[54] Fereira and Serra (2022) found that forward guidance announcements affected positive broad european stock indices, but the results were mute for the Europrean banking index STOXX 600. Their sample includes announcements from ECB, Fed and BoE not only from the european monetary authority

**Table 4.3** European banks' stock response to expansionary measures announced by the ECB using OLS regression with PCSEs and the market model to obtain CARs.

| | Dependent variable | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | CAR[0] | | CAR[0,+1] | | CAR[-1,+1] | | CAR[-1,+3] | |
| Explanatory variables | coeff. | stand. err. | coeff. | stand. err. | coeff. | stand. err. | coeff. | stand. err. |
| CONS | -0.008623* | 0.003024 | -0.014867* | 0.004531 | -0.012574** | 0.005496 | -0.006926 | 0.007645 |
| INTC | 0.012347* | 0.003001 | 0.016445* | 0.004496 | 0.010132*** | 0.005454 | -0.011779 | 0.007586 |
| ASSP | 0.011193* | 0.003043 | 0.019321* | 0.004559 | 0.024068* | 0.005530 | 0.015797** | 0.007692 |
| LIQP | 0.006927** | 0.003136 | 0.010539** | 0.004698 | 0.009465*** | 0.005700 | 0.000388 | 0.007928 |
| FWG | -0.000596 | 0.003390 | 0.005225 | 0.005078 | -0.001461 | 0.006161 | -0.009514 | 0.008569 |
| MUL | -0.008601** | 0.003624 | -0.011325** | 0.005428 | -0.01132*** | 0.006585 | 0.007767 | 0.009160 |
| R squared | 3.37% | | 3.13% | | 3.94% | | 3.25% | |

Note: This table reports European banks' stock response to expansionary measures announced by the ECB from July 2007 to December 2020. CAR for each event window is the dependent variable. A set of dummy variables is used as explanatory-dependent variables indicating respective category of the ECB's expansionary policy interventions. INTC for policy rate reductions, ASSP for asset purchases, LIQP for liquidity provision and FWG for forward guidance. MUL is a dummy variable that equals to 1 if two or more types of measures were announced in the same day and 0 when only one measure was announced. *, ** and *** indicate significance at the 1%, 5% and 10% levels, respectively.

Asset purchase interventions generate strong positive responses to equity of large European banks even in longer time event periods. In our regression estimates with either CAR[0] or CAR[0,+1], or CAR[-1,+1] as dependent variable, the coefficient of ASSP is statistically significant at 1% level and at 5% level when CAR[-1,+3] is the dependent variable. This result is also in line with Fiordelisi et al. 2014 and Rici (2015) who suggested that monetary easing measures affected stocks of European banks.

The magnitude of the coefficient is higher in the 3-day event window (2.41 percent) and is generally larger than that of the other expansionary measures (INTC, LIQP) in the corresponding event windows. While announcements about policy rate reductions (INTC) and extraordinary liquidity provision (LIQP) influence positive equity returns over short term event periods ([0], [0,+1], [-1,+1]), asset purchases (ASSP) produce positive response to banks over the longer, 5 day, event period [-1,+3] (i.e. the previous day, the day of the announcement and the following three days), suggesting that this type of expansionary policy has the largest and the longest impact on equity returns of European banks.

According to literature asset purchases supported bank funding, restorded agents' confidence, strengthened banks's balance sheets, reduced long term inerest rates, enchance investors to reallocate their portfolios towards stocks, reduced market risk premiums and so enchanced equity prices (Fratzscher et al., 2016; Bernanke, 2020; Kashyap and Stein, 2023). A possible explanation of the most pronounced effect of asset purchases is the fact that they operate through more transition channels as analyzed in section 3 ( i.e. confidence, portfolio rebalancing, bank lending and signaling channel). Also, when ECB's key rates approached ELB, ECB announced large volumes of asset purchases through APP ( about 2.9 trillion euros) and PEPP (1.85 trillion euros) reducing agents' uncertainty, boosting capital markets and real economy in the eurozone (Weale and Wieladek, 2022; van der Zwan et. al. 2024) and signaling the lower for longer interest rate policy[55].

Comparing the results of this chapter with the results of the third chapter we can notice that the ECB's unconventional expansionary monetary policy announcement significantly affects equity prices of large European banks in contrast with stock prices of Greek systemic banks.

Table D.2 in Appendix D, presents our empirical findings using feasible GLS from our estimation procedure. The respective results are similar to those reported in Table 4.3. Announcements about short term rate cuts (INTC) and extraordinary liquidity injections (LIQP) affect positive equity returns over one-to-three-day event windows. In comparison, asset purchase announcements (ASSP) generate stronger positive response to large European banking institutions and over longer periods (one-to-five-day event windows).

Overall, by examining all categories of the ECB's expansive policy actions we provide evidence in favor of economic theory which states a positive impact of interest rate reductions and quantitative easing on stock prices. Our main hypotheses hold as investors responded positively to expansionary policy interventions. Even more, by applying this intuitive methodology we find that two categories of unconventional

[55] See relevant announcements on 22-Jan-2015, 10-Mar-2016, 8-Dec-2016, 26-Oct-2017, 14-Jun-2018, 12-Sep-2019, 12-Mar-2020, 19-Mar-2020, 4-Jun-2020 and 10-Dec-2020, in appendix D, table D.1.

policy (both asset purchases and liquidity provision) affect bank stock prices. Previous studies that used subjective criteria to treat overlapping announcements suggested that only one type of non-conventional monetary policy impacts on banking stocks (monetary easing for Fiordelisi et al., 2014 and Ricci, 2015 and liquidity provision for Fiordelisi and Gallopo, 2018).

### 4.5 Robustness tests

As a robustness check, we use market adjusted procedure in which expected-normal returns are equal to market returns[56]. Hence abnormal returns are calculated as actual returns minus market returns (see equation 3.6 in chapter 3). In our case, market returns are proxied by national indices returns.

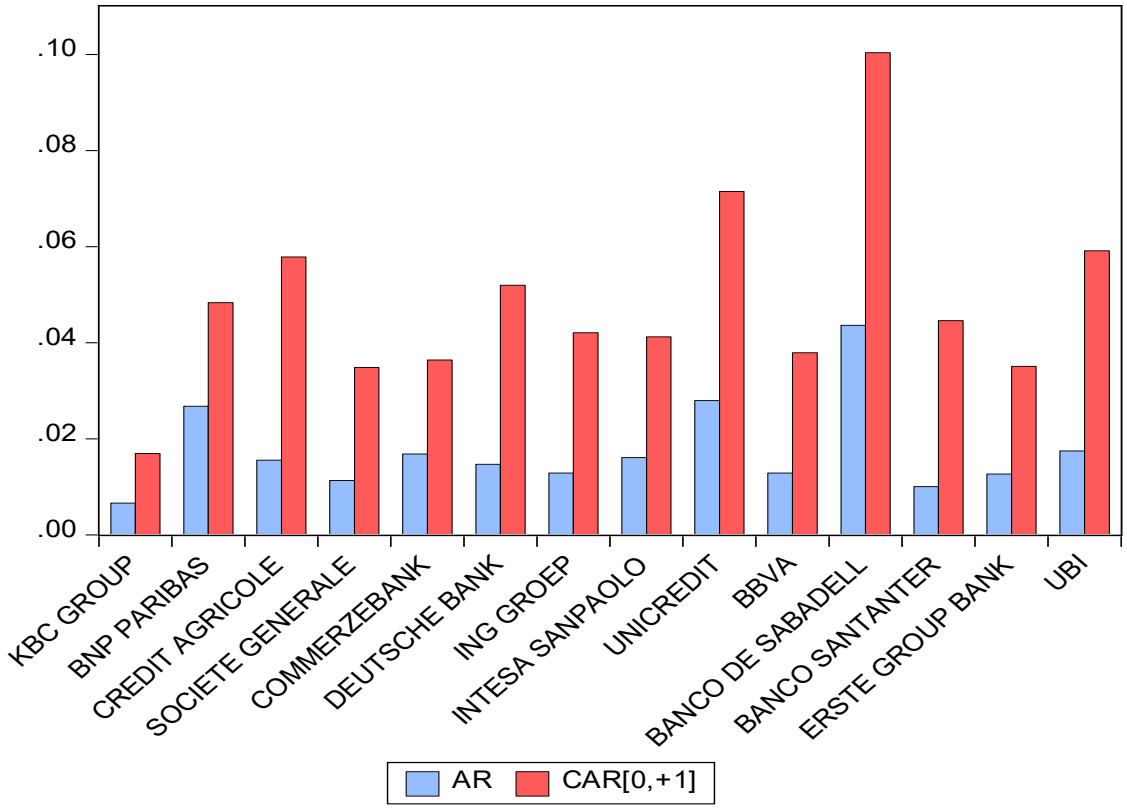



**Figure 4.2** ARs and two-day CARs for twelve large European banks on March 10, 2016, using market adjusted approach to proxy expected returns.

Figure 4.2 presents ARs and the two-day CARs of fourteen large European banks around March 10, 2016, using market adjusted procedure. All banks present ARs

[56] For details about different models of the return-generating processes see Brown and Warner (1985).

between 0.7 percent and 4.4 percent on the day of the announcement, and CARs between 1.7 percent and 10 percent over a two-day event window. The market adjusted procedure has been applied in several research studies dealing with bank returns in periods of crises (Kosmidou et. al., 2015; Fiordelisi and Ricci, 2016) to reduce possible bias of market model which uses data from the estimation window to calculate expected returns in the event window. More specifically, the market model's returns could have been affected by policy interventions already announced during the estimation period.

Results from the estimation of equation (4.1) are presented in Table 4.4. As previous, official announcements of interest rate cuts exhibit a statistically significant and positive influence on bank returns over one-to-three-day event windows ([0], [0,+1], [−1,+1]). The higher coefficient estimate for INTC is at 2-day event window (2.35) percent). Liquidity provision interventions display positive impact on bank stock in two day and three day event windows.

**Table 4.4.** European banks' stock response to expansionary measures announced by the ECB using OLS regression with PCSEs and the market adjusted procedure to calculate CARs.

| | **Dependent variable** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **CAR[0]** | | **CAR[0,+1]** | | **CAR[-1,+1]** | | **CAR[-1,+3]** | |
| **Explanatory variables** | **coeff.** | **stand. err.** | **coeff.** | **stand. err.** | **coeff.** | **stand. err.** | **coeff.** | **stand. err.** |
| CONS | -0.006035 | 0.003691 | -0.027883* | 0.005029 | -0.029642* | 0.006002 | -0.017505** | 0.008160 |
| INTC | 0.006139*** | 0.003664 | 0.023495* | 0.004990 | 0.019921* | 0.005957 | -0.013058 | 0.008100 |
| ASSP | 0.011405* | 0.003714 | 0.037517* | 0.005060 | 0.045477* | 0.006039 | 0.027440* | 0.008211 |
| LIQP | 0.000332 | 0.003828 | 0.016691** | 0.005215 | 0.018263* | 0.006224 | -0.000133 | 0.008463 |
| FWG | -0.001184 | 0.004139 | 0.004434 | 0.005247 | 0.004328 | 0.006730 | -0.013320 | 0.009151 |
| MUL | -0.004916 | 0.004424 | -0.022750* | 0.006025 | -0.021058* | 0.007194 | 0.015236 | 0.009782 |
| R squared | 3.31% | | 8.72% | | 10.14% | | 6.97% | |

Note: This table reports European banks' stock responce to expansionary measures announced by the ECB from July 2007 to December 2020. We use the same dependent and explanatory variables as in Table 3. *, ** and *** denote significance at the 1%, 5% and 10% levels, respectively.

Asset purchase interventions not only have a stronger positive impact on the equity returns of large European banks, but also over the longer, 5-day event period. In panel regression estimates, the coefficient of ASSP is statistically significant at the 1% level in

all four respective event windows, from 1 day to 5-day window. The magnitude of the coefficient is higher in the 3-day event window (4.55 percent) and is generally larger than those of the other expansionary measures in the corresponding event windows. This result confirms that announcements about asset purchases generate stronger and longer cumulative abnormal returns in comparison with other expansionary policy measures.

We must point out that in our new estimations, compared to those in table 4.3, the coefficients of dummy variables have on average higher magnitude.

Table D.3 in Appendix D shows our empirical results using GLS estimation procedure. The corresponding findings are consistent with those in table 4.4. Overall, our robustness tests support the main results reported above.

## 4.6 Conclusion

Global capital markets and developed economies experienced significant shocks with the onset of financial crisis. Capital markets froze, and economic activity contracted, as negative spillovers from the financial sector to the real economy took place, resulting in an economic recession and a sovereign debt crisis later. The ECB reacted decisively to financial and real sector shocks by combining regular and non-regular policy measures to support credit expansion of MFIs and revive capital markets and economic activity in the eurozone.

According to the literature, capital markets give considerable attention to the actions of central banks, as monetary authorities can reduce agent's uncertainty and shape their future expectations (Falagiarda and Reitz, 2015; Fratzscher et. al., 2016; Kashyap and Stein 2023). Our research aims to shed light to this hypothesis by examining the reaction of bank stocks to the announcement of the ECB's expansionary policy interventions from July 2007 to December 2020. First, we constructed a sample of 77 crucial policy interventions and classified them to four categories. Subsequently, we applied an event study to assess cumulative abnormal returns around the announcement dates using different event windows and finally we employed a multivariate panel regression model to estimate the impact of the ECB's policy interventions on stocks.

Our results suggest that both traditional and nontraditional expansionary policies have a strong positive impact on stocks of large European banks in different event windows. More specifically, interest rate cuts and extraordinary liquidity provision measures influence stocks in short event windows up to three days [-1,+1]. Announcements about asset purchase interventions produce positive response to banks over longer event windows up to 5 days [-1,+3]. Also, in each multivariate panel regression the coefficient of asset purchases has the higher magnitude and therefore this type of expansionary policy has the largest and the longest impact on bank stock returns. ECB's key interest rate cuts reduce banks' future net cash flows discount rate while non-conventional measures reduce the probability of default and the risk premiums of banks and thus jointly enhance stock returns.

Regarding policy implications, our study contributes to a deeper understanding of the intricate relationship between expansionary monetary policy announcements and capital market dynamics, helping policy makers, investors and portfolio managers to take more effective decisions.

Our findings suggest that markets responded positively to the ECB's standard and nonstandard expansionary policy announcements so, understanding the impact of information embedded in the ECB's expansionary policy interventions could be useful for investors and portfolio managers in their dynamic portfolio selection. Also, as our study reveals that agents should consider the difference in the magnitude of the market response among expansionary measures in their investment decisions.

Furthermore, our results show that policy makers can positively influence capital markets through conventional and non-conventional interventions and restore agents' confidence about their ability to enhance equity prices during crises periods. In addition, our findings suggest that decision makers should combine standard and non-conventional measures to stabilize financial markets as these measures are complementary. To design more effective measures policy makers should take seriously into account transition channels through which monetary policy interventions impact capital markets and real economy. To strengthen also the impact

of their policies, decision makers should intensify their efforts to communicate their policy decisions with accuracy and clarity.

We recognize some limitations that could have influenced our findings as did not analyze other relevant information (e.g., macroeconomic and fiscal data, or financial support measures) released in the sampling period and we did not extend our research in non-banking sectors. Also, assessing the persistence of these expansionary measures over longer time horizons through VAR models can be a topic of future research.

# Chapter 5

# The impact of the ECB's non-regular operations on bank credit: cross-country evidence[57]

## 5.1 Introduction

Events since the onset of the financial market turmoil and the bankruptcy of Lehman Brothers triggered significant shocks to financial markets and to global economies. Over time, euro area monetary financial institutions (MFIs) reduced credit supply in firms and households as they started to suffer from liquidity shortage due to the collapse in interbank and other funding markets. The macroeconomic environment of euro area member states also began to deteriorate as consumption, investment, and output declined sharply (Hartman and Smets 2018). European governments adopted expansionary fiscal policies to support the banking sector and to recover from the recession, causing budget deficits, acceleration of debt stock, and increase in government bond yields, especially in peripheral countries.

In April 2010, Greece lost access to bond markets as investors doubted the government's ability to repay its debt, prompting the Greek authorities to request a bailout package to avoid default. Other peripheral countries (Ireland, Cyprus, Portugal, and Spain) also temporarily lost access to capital markets and had to launch adjustment programs to obtain financial support (Petrakis et al. 2022a). In addition, Italian and Slovenian bond yields increased significantly. The sharpness and severity of the financial and debt crisis weakened banking institutions, especially those in distressed countries, which restricted credit supply and entered a deleveraging process.

To enhance credit supply, revive economic activity, and stabilize capital markets in the eurozone, the European Central Bank (ECB) launched non-regular interventions when traditional measures reached the effective lower bound in the first phase of the crisis. The scope of the non-regular measures in the initial phase of the crisis was to remedy

[57] A version of this chapter was published in Operational Research, an International Journal https://link.springer.com/article/10.1007/s12351-024-00860-7

impairments in the transition of monetary policy by providing flexible liquidity to MFIs and by conducting small security purchases in malfunctioning segments of financial markets. Subsequently, the ECB implemented targeted liquidity provision to banks at longer maturities as well as large scale security purchases of private and public assets to reinforce and to ease the transmission of monetary policy.

This paper explores the effectiveness of non-regular measures in stimulating bank lending in the eurozone after controlling for several vital determinants. Recent previous studies have examined the efficiency of the ECB's non-conventional operations on loan supply (see, among others, Gambacorta and Marques-Ibanez 2014; Boechx et al. 2017; Martins et al. 2019; Grandi 2019; Gibson et al. 2020; Boechx et al. 2020; Benetton and Fantino 2021; Burietz and Picault 2023). Our study employs monthly aggregate loan data for fifteen (15) euro area economies for the period July 2007 to June 2021, covering the financial turmoil caused by the fall in the US subprime mortgage market, the global economic crisis, the European sovereign debt crisis, the low inflation period, and the coronavirus pandemic crisis.

We refer herein the testable hypotheses processed within the framework of this research .

***H1.*** *The impact of the ECB's non-regular interventions on bank credit is positive.*

***H2.*** *The effect of non-conventional measures on bank credit is limited during the pre-zero lower bound subperiod.*

***H3.*** *The effectiveness of non-regular policies on bank lending varies across euro area countries.*

This research contributes to the literature in various manners. To the best of our knowledge, this is the first paper to demonstrate a structural change in the impact of non-regular interventions on credit as it finds a limited effect in the pre zero bound subperiod. It also processes country-level credit data and complements the previous literature on the credit channel that analyzes bank-level credit data (see, among others Gambacorta 2005; Gambacorta and Marques-Ibanez 2014; Boechx et al. 2020, Burietz and Picault 2023). Moreover, our study highlights heterogeneous effects of the

accommodative non-regular policies as it recognizes significant differences in loan growth rates between core and distressed countries due to country's intrinsic characteristics.

The remainder of this chapter is organized as follows. Next section describes recent literature on the research topic. Section 5.3 analyzes the dataset and the econometric methodology adopted to study testable hypotheses. In section 5.4 we present main results, robustness tests and cross-country specific effects. Finally, our conclusions are in section 5.5.

## 5.2 Related literature

A vast amount of literature on the efficacy of the ECB's non-regular interventions has emerged in the last years. Several economists surveyed the effect of non-regular policies on macroeconomic variables using various vector autoregressive procedures (VAR) and reported that expansionary policy led to an increase in inflation and output (see, among others Peersman 2011; Kucharcuková et al. 2016; Boeckx et al. 2017; Fiorelli and Meliciani 2019, Evgenidis and Papadamou 2021)[58]. In addition, recent studies examined the influence of the ECB's non-regular interventions on the bond spreads of distressed peripheral countries and found that both the SMP (Falagiarda and Reitz 2015; Ghysels et al. 2017; Trebesch and Zettelmeyer 2018) and the OMT (Altavilla et al. 2016; Acharya et al. 2019) led to a significant contraction of sovereign bond spreads within the eurozone. Furthermore, a large body of research emphasized on the impact of the ECB´s expansionary policy announcements on equity markets (see Rogers et al. 2014; Fratzsher et al. 2016; Pacicco et al. 2019 and Petrakis et al. 2022a).

The literature is more recent regarding the impact of the ECB's non-regular policy actions on bank credit. Lenza et al. (2010) reported that non-conventional monetary policy interventions positively and significantly impacted bank lending due to the narrowing of interest rate spreads. Peersman et al. (2011), using structural VAR

[58] Kucharcuková et al. (2016) used factor augmented VAR approach; Boeckx et al. (2017) used structural VAR model; Fiorelli and Meliciani (2019) applied factor augmented VAR econometric analysis, and Evgenidis and Papadamou (2021) used Bayesian VAR.

approach and monthly data from 1999 to 2009, found a positive relationship between expansionary monetary shocks and the provision of bank credit. Adelino and Ferreira (2016) studied the period from 1989 to 2012 and conveyed the reduction in lending with bank rating downgrades, limited access to funding and increases in the cost of funding. Salachas et al. (2017) suggested that in the post-crisis phase the application of non-regular measures by major central banks boosted credit growth.

Boechx et al. (2017) concluded that non-conventional balance sheet policies supported the expansion of bank lending to households and corporations during the crisis period while lending rates declined. Grandi (2019) examined the transition of the ECB's policy interventions for the period 2007 to 2016 and concluded that the effects of regular and non-regular policies on bank lending were weaker for institutions located in distressed economies. Martins et al. (2019) processed aggregate loan data in country level for the period 2008 to 2016 using event studies and panel regression analysis. They concluded that unconventional policy interventions had a lagged positive effect on bank loans. Boeckx et al. (2020) studied the efficacy of unconventional balance sheet measures on bank credit supply by processing a detailed panel dataset of 131 eurozone MFIs with monthly data for the period August 2007 to October 2015, local projection methods and bank specific characteristics. Their results showed that the ECB's non-regular credit support measures effectively boost bank credit to firms and households while bank specific characteristics (size, liquidity, and capital ratios) could affect the pass-through of these measures to bank credit supply. Gibson et al. (2020) used gross loan data from 57 banks from five core and five peripheral euro area countries for the period 2008 to 2016 and a spatial econometric modeling framework and concluded that the ECB's financing measures contributed significantly to limiting the damaging effects of the crises by boosting bank lending. Altavilla et al. (2020) examined how ECB policy innovations affected household and non-financial corporate lending rates and found that non-conventional measures reduced heterogeneity in lending rates between MFIs in core and distressed euro area countries. Burietz and Picault (2023) investigated the syndicated loan market for the period 2008 to 2014 using cross section regression analysis. They reported that both traditional and non-traditional measures supported the provision of this hybrid type

of loans. Sleibi et al. (2023) processed quarterly data for the period 2008 to 2021 and for 12 eurozone economies using VAR approach and concluded that non-conventional monetary interventions increased private credit co-movement in eurozone.

Also, the impact of the ECB's non-standard operations on bank credit has been extensively studied in the academic realm, particularly in the context of the economic crisis and the subsequent need for extraordinary liquidity provision. Darracq Paries and De Santis (2015) delved into the effects of the ECB's 36-month LTROs on credit supply. Their research provides a nuanced understanding of how such unconventional measures can impact market liquidity and credit dynamics. Adrande et al. (2018) also found that VLTROs improved bank lending to firms, while Crosignani et al. (2020) showed that the provision of liquidity by the three-year VLTROs led Portuguese local MFIs to engage in collateral trading by acquiring high-yield short-term eligible securities to pledge them to obtain ECB's liquidity. Caprinelli and Crosignani (2021) reported that the maturity extension of ECB's liquidity operations through VLTROs supported the credit supply of Italian banks and that Italian banks used this liquidity to purchase local government securities to replace the lack of wholesale funding. Benetton and Fantino (2021) assessed the impact of the first targeted refinancing operations (TLTROs-I) on Italian banks' lending to firms and concluded that they had a significant positive effect. Laine (2021) also found that the second targeted operations (TLTROs-II) increased lending to non-financial firms. In addition, Andreeva and García-Posada (2021) conducted a study focusing on the impact of the ECB's TLTROs-I on banks' lending policies, specifically examining the role of competition. Their research provides insights into how these operations influence bank behavior in terms of credit standards and loan margins.

To examine the impact of the ECB non-regular operations on bank credit across different countries, it is crucial to consider various operational factors influencing bank profitability, risk management, and monetary policy transmission mechanisms. The study by Athanasoglou et al. (2008) on bank profitability determinants provides a foundational understanding of how industry-specific, bank-specific, and macroeconomic factors interact to shape banks' financial performance, which is essential in assessing the outcomes of the ECB's non-traditional measures on bank

credit. Gambacorta and Marques-Ibanez (2014) examined the transmission of regular and non-regular policies on aggregate bank credit using a panel regression approach under the generalized method of moments. They concluded that not only bank-specific variables but also market funding, securitization and banks' risk-taking incentives could have a significant impact in the transition of monetary policy on credit provision.

The research by Harb et al. (2022) on risk management and bank performance in the MENA region offers insights into how non-linearities in risk interactions can impact financial stability. Understanding the implications of liquidity and credit risk interactions is relevant when evaluating the effectiveness of the ECB's non-regular operations on bank credit across different countries in the euro area. Moreover, Koju et al. (2018) examined the impact of banking management on credit risk in the Indian banking system, emphasizing the importance of analyzing banking management indicators in assessing credit risk. This approach can be valuable in evaluating how the ECB's non-traditional measures influence credit risk across various euro area banks. Furthermore, the study by Islam and Nishiyama (2016) on bank net interest margins in South Asian countries provides insights into the determinants of interest margins, including operational costs, credit risk, and management quality. Understanding how these factors influence bank profitability can illuminate the potential effects of the ECB's non-regular operations on bank credit in different countries within the euro area.

Finnegan and Kapoor (2023) contributed to understanding the relationship between the ECB's non-traditional monetary policy and small and medium-sized enterprises' (SMEs) access to funding. Their study, covering the period from 2014 to 2019, highlights the importance of non-regular monetary policy interventions in facilitating funding conditions for SMEs during economic challenges. Tercero-Lucas (2021) offered insights into the impact of non-conventional policies interventions on bank profitability, focusing on the case of Spain. By analyzing a panel of Spanish banks over a significant period, the study provides empirical evidence on how the ECB's non-traditional measures relate to bank profitability metrics.

In the broader context of monetary policy transmission mechanisms, Borio and Zhu (2008) explored the interplay between capital regulation, risk-taking, and monetary

policy, emphasizing the evolving nature of these relationships in the financial system. Understanding these dynamics is crucial for policymakers and financial institutions to effectively navigate the changing landscape of monetary policy. Additionally, the research by Fata and Arifin (2024) on the impact of green credit distribution on bank performance underscores the importance of considering factors beyond traditional monetary policy tools. Analyzing how green credit initiatives influence bank performance can offer a broader perspective on the potential impacts of non-regular operations on bank credit across countries.

### 5.3 Empirical approach

Via the bank credit channel, expansionary non-regular measures can enhance lending in the euro area by facilitating MFIs' access to various sources of financing and easing credit conditions (Boechx et al. 2017; Salachas et al. 2017; Martins et al. 2019; Gibson et al. 2020; Boechx et al. 2020; Burietz and Picault 2023). Nevertheless, the channel may not be homogenous across eurozone economies (Ehrmann et al. 2002; De Santis 2015; Grandi 2019). Based on previous literature, our study seeks to research (i) if there is a positive effect of the ECB's expansionary non-regular measures on bank credit, (ii) if it exists a structural change in the impact of non-regular interventions on credit during the investigated period and (iii) whether the effectiveness of non-conventional policies on credit varies across euro area countries.

In the next two subsections, we describe the dataset and the econometric approach adopted in our research.

#### 5.3.1 Data

Our research studies the efficacy of the ECB's non-regular monetary interventions on bank lending in fifteen (15) euro area countries from July 2007 to June 2021 after controlling for other significant determinants. Countries under investigation are Germany, France, Austria, Belgium, Luxembourg, Finland, the Netherlands, and Malta, as well as the distressed countries Greece, Ireland, Portugal, Spain, Cyprus, Italy, and

Slovenia59,60. Our sampling period covers the financial turmoil caused by the fall in the US subprime mortgage market, the global economic crisis, the European debt crisis, the low inflation period, and the coronavirus pandemic crisis. In contrast to previous studies, we process monthly aggregate loan data at the country level61. Within this extended sample with monthly aggregate loan data for 14 years and 15 economies, it is possible to draw safe results about the efficacy of the ECB's non-regular operations on credit supply.

#### 5.3.1.1 Dependent variables

This study processes monthly aggregate loan data of the MFIs to euro area (EA) residents at the country level. Three main categories of aggregate loans are under investigation, and more specifically, total loans to euro area residents, both public and private (TOT), loans to the private sector excluding interbank loans (PRSEC), and loans to non-financial corporations (NFC)[62]. Figures 5.1 to 5.3 indicate the path of three categories of loans in the eurozone, from contraction during the debt crisis to recovery afterward.

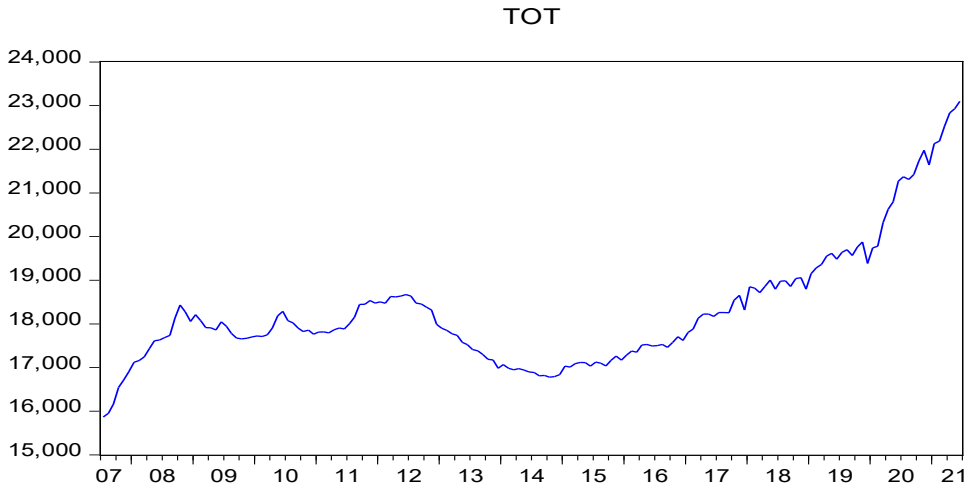



**Figure 5.1** Volume of MFIs total loans (TOT) to euro area, for the period July 2007 to June 2021,in billion euros. Source: Balance Sheet Items (BSI) database of the ECB.

[59] We excluded four countries (Slovakia, Estonia, Latvia, and Lithuania) because they entered the eurozone later. For example, Latvia and Lithuania joined the euro area in 2014 and 2015 respectively.

[60] Following Altavilla et al. (2017) we define as distressed, these countries whose ten-year sovereign bond yield exceeded 6% for at least four months in our examination period.

[61]Most of the previous research used loan data in banking level, see for example Gambacorta and Marques-Ibanez (2014), Grandi 2019, Boeckx et al. (2020), Burietz and Picault (2023) while only Martins et al. (2019) used country level loan data.

[62] To calculate loans to private sector we removed from total loans the loans to general governments as well as the interbank loans.

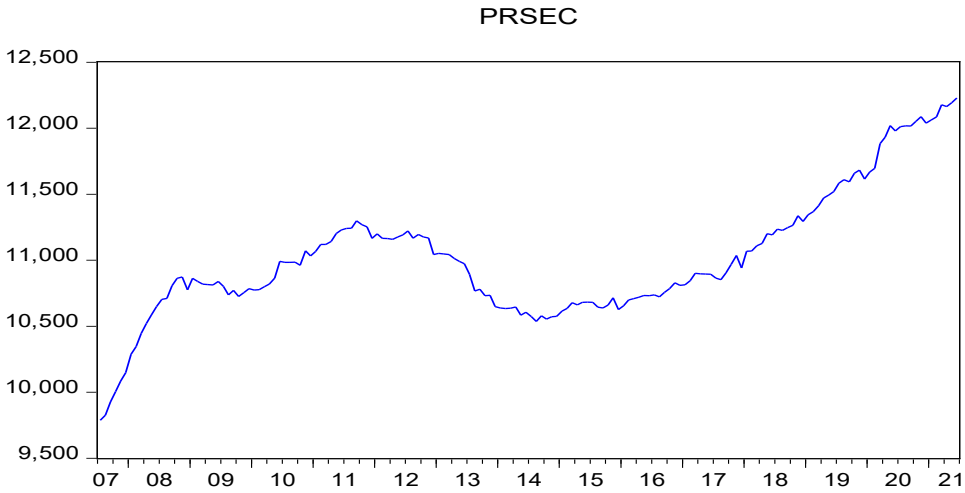



**Figure 5.2** Volume of MFIs loans to private sector (PRSEC) for the period July 2007 to June 2021, in billion euros. Source: Balance Sheet Items (BSI) database of the ECB.

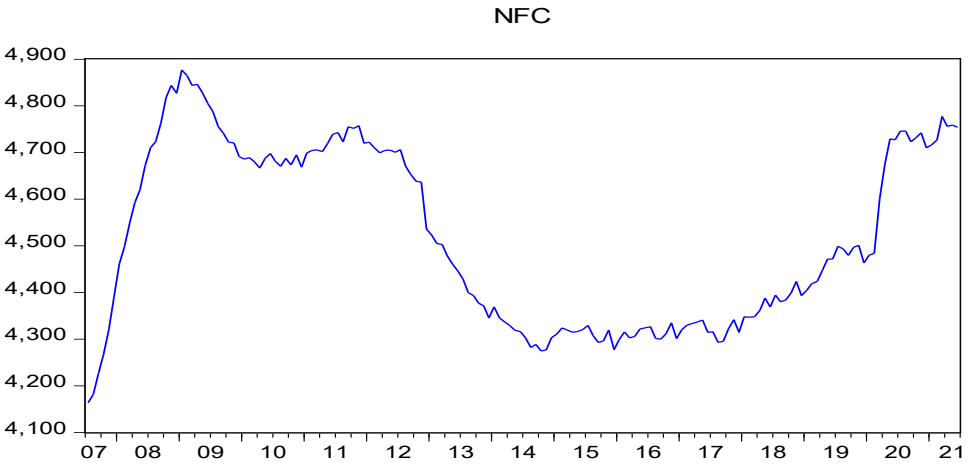



**Figure 5.3** Volume of MFIs loans to non-financial corporations (NFC) for the period July 2007 to June 2021, in billion euros. Source: Balance Sheet Items (BSI) database of the ECB.

Table 5.1 presents the mean values of loan volumes (TOT, PRSEC, NFC) per country for the period under investigation in descending order. The broader the country's economy is, the greater credit is required. The panel unit root tests showed that each dependent variable (TOT, PRSEC and NFC) was nonstationary. For this reason, we used the monthly loan growth rate through logs' first difference[63].

**Table 5.1** Mean loan volumes per country in million euros. Descending classification by total loans.

| Country | TOT | PRSEC | NFC |
|---|---|---|---|
| Germany | 4,813,450.0 | 2,684,622.0 | 957,279.8 |
| France | 4,683,820.0 | 2,295,674.0 | 939,266.4 |

[63] Table E.1 of appendix E presents strong evidence against non-stationarity for the growth rate of each category of loans.

| | | | |
|---|---|---|---|
| Italy | 2,439,980.0 | 1,623,053.0 | 803,904.2 |
| Spain | 1,922,606.0 | 1,516,551.0 | 675,598.6 |
| Netherlands | 1,355,724.0 | 1,041,621.0 | 368,068.6 |
| Belgium | 585,501.4 | 339,431.0 | 123,859.2 |
| Austria | 579,096.5 | 347,643.4 | 166,017.3 |
| Luxembourg | 463,212.2 | 147,023.1 | 61,629.92 |
| Ireland | 446,660.0 | 243,539.8 | 95,203.64 |
| Finland | 297,143.7 | 195,494.1 | 72,482.39 |
| Portugal | 284,330.3 | 234,402.1 | 95,514.26 |
| Greece | 238,198.7 | 200,716.3 | 91,738.41 |
| Cyprus | 63,544.48 | 44,507.15 | 20,971.79 |
| Slovenia | 32,648.21 | 25,506.52 | 14,661.03 |
| Malta | 15,678.76 | 10,811.06 | 4,941.88 |

Table 5.2 presents the descriptive statistics for each dependent variable from June 2007 to June 2021. We notice particularly low growth rates because, as it can be seen in table 5.3, peripheral euro area countries present almost zero or negative growth rates.

**Table 5.2** Descriptive statistics of each dependent variable.

| Variable | Mean | Median | Stand.dev. | Obs. |
|---|---|---|---|---|
| ΔlnTOT | 0.001759 | 0.000902 | 0.022287 | 2,520 |
| ΔlnPRSEC | 0.000848 | 0.000982 | 0.013752 | 2,520 |
| ΔlnNFC | 0.000213 | 0.000598 | 0.016833 | 2,520 |

Note: ΔlnTOT, ΔlnPRSEC and ΔlnNFC are defined as the monthly growth rate of total loans, loans to private sector (excluding interbank loans) and loans to non-financial corporations, respectively.

**Table 5.3.** Descriptive statistics for ΔlnTOT, ΔlnPRSEC and ΔlnNFC per country.

| Country | ΔlnTOT | | ΔlnPRSEC | | ΔlnNFC | |
|---|---|---|---|---|---|---|
| | Mean | Stand.dev. | Mean | Stand.dev. | Mean | Stand.dev. |
| Austria | 0.002206 | 0.016725 | 0.002330 | 0.005696 | 0.002609 | 0.007269 |
| Belgium | 0.001719 | 0.026690 | 0.002606 | 0.011873 | 0.002471 | 0.014098 |
| Finland | 0.007039 | 0.036656 | 0.003793 | 0.006366 | 0.004406 | 0.009086 |
| France | 0.004386 | 0.012390 | 0.003543 | 0.007183 | 0.003390 | 0.007038 |
| Germany | 0.002043 | 0.010561 | 0.001963 | 0.005553 | 0.002145 | 0.006180 |
| Luxembourg | 0.001946 | 0.025115 | 0.002847 | 0.017215 | 0.002522 | 0.021477 |
| Malta | 0.005150 | 0.030027 | 0.004089 | 0.012664 | 0.000991 | 0.016871 |
| Netherands | 0.002198 | 0.019779 | 0.000923 | 0.012210 | 0.001670 | 0.021630 |
| Cyprus | -0.000147 | 0.031050 | -0.001190 | 0.023029 | -0.001067 | 0.024173 |
| Greece | -0.001022 | 0.024755 | -0.001883 | 0.026162 | -0.001594 | 0.026234 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ireland | -0.001455 | 0.024243 | -0.004080 | 0.016317 | -0.006117 | 0.022678 |
| Italy | 0.001365 | 0.015055 | 0.000409 | 0.009153 | -0.000739 | 0.009874 |
| Portugal | -0.000334 | 0.010011 | -0.000758 | 0.005603 | -0.001541 | 0.010185 |
| Slovenia | 0.001755 | 0.016586 | -0.000145 | 0.014127 | -0.002704 | 0.020104 |
| Spain | -0.000470 | 0.011069 | -0.001729 | 0.008433 | -0.003239 | 0.011206 |
| All | 0.001759 | 0.022287 | 0.000848 | 0.013752 | 0.000213 | 0.016833 |

Note: ΔlnTOT, ΔlnPRSEC and ΔlnNFC are defined as the monthly growth of total loans, loans to private sector (excluding interbank loans) and loans to non-financial corporations respectively.

#### 5.3.1.2 Independent variables

Based on previous studies (see table 5.4) we consider the following independent variables:

Non-standard measures. We use the ECB's total balance sheet assets (**BS**) to capture the influence of the non-regular monetary policy on aggregate bank credit. Since the BS variable is integrated of order one, we use monthly growth rate through the first differences of logarithms.

Rate of inflation (**INF**) measured as the HICP (Harmonized Index of Consumer Prices) annual percentage change. According to Im et al. (2003), PP-Fisher and ADF-Fisher panel unit root tests, the variable in level is stationary. During our sampling period the average inflation was 1.38%, below the 2% threshold, which is the target for the eurozone monetary authority[64].

**Table 5.4** Sample of selected papers analyzing bank credit classified by explanatory variable used in our study

| **Explanatory variables** | **Author(s)** |
|---|---|
| ECB's total balance sheet assets (BS) as a proxy for non-regular measures | Gambacorta and Marques-Ibanez 2014; Boechx et al. 2017; Salachas et al. 2017; Evgenidis and Salachas 2019; Boeckx et al. 2020; Evgenidis and Papadamou 2021; Burietz and Picault 2023, Sleibi et al. 2023. |
| Inflation rate (INFL) | Ehrmann et al. 2002; Gambacorta 2005; Ashcraft 2006; Egert et al. 2007; Grandi 2019; Martins et al. 2019. |

[64] Figure E.1 in appendix E shows the path of inflation rate in the eurozone during the period July 2007 to June 2021. We observe that inflation started to decline with the onset of the economic crisis, followed by an upward path with the eruption of the sovereign debt crisis. Still, in the middle of the debt crisis it started to decline until it slowly recovered in mid-2016.

| | |
|---|---|
| Output proxied by GDP or Industrial Production (IP) | Ehrmann et al. 2002; Calza et al. 2003; Gambacorta 2005; Ashcraft 2006; Egert et al. 2007; De Santis 2015; Salachas 2017; Martins et al. 2019; Grandi 2019; Burietz and Picault 2023. |
| Deposits (DEP) | Ehrmann et al. 2002; Gambacorta 2005; Ashcraft 2006; Ivashina and Scharftein 2010; Jimenez et al. 2014; Naqvi and Pungaliya (2023) |

Seasonally adjusted Industrial Production (**IP**) is incorporated as a proxy for aggregate output in logarithmic form[65]. According to previous studies, the relationship between output growth and credit growth is positive because when output increases, firms and agents need more credit (Gambacorta 2005; Egert et al. 2007; Martins et al. 2019; Grandi 2019). Panel unit root tests showed that the log of IP is a stationary variable.

We include these two variables to our analysis (inflation and industrial production as a proxy for output) in order to control for cyclical effects (Ashcraft 2006; Gambacorta 2005, Grandi 2019) and to capture the macroeconomic fluctuations that could influence credit supply (Boechx et al. 2020).

The deposit (**DEP**) variable comprises households and non-financial firms deposits to monetary financial institutions (country-level data). According to Gambacorta (2005), monetary policy tightening could lead to a decrease in deposits and loans, especially for small MFIs with limited access to uninsured deposits. In addition, MFIs with limited access to funds such as deposits tend to reduce lending and rely on central bank liquidity provision (Jimenez et al. 2014). Moreover, Ivashina and Scharftein (2010) found that MFIs with easier access to deposit funding were less likely to curtail their lending during the crisis. Due to the nonstationarity of the variable, we used the growth rate of deposits by the first difference of logarithms[66].

[65] Some studies use GDP to measure aggregate production (Ehrmann et al. 2002; Calza et al. 2003; Gambacorta 2005; Egert et al. 2007; Gambacorta et al. 2014; Salachas 2017; Grandi 2019) while others use industrial production (Galariotis et al. 2018; Martins et al. 2019; Fiorelli and Meliciani 2019; Evgenidis and Salachas 2019; Evgenidis and Papadamou 2021). We selected industrial production because we are processing monthly datasets.

[66] Table E.2 of Appendix E presents panel unit root tests for each explanatory variable.

Pre zero lower bound (**PZLB**) is a time dummy variable that equals to one (1) for the subperiod before the zero lower bound (July 2007 to June 2012) and zero (0) otherwise. We introduced this dummy variable to consider a possible structural change in the non-regular monetary policy. Before the effective lower bound, the size of unconventional policy measures was relatively smaller while the non-regular monetary operations completed the standard monetary measures and vice versa (Fiorelli and Meliciani 2019). As the traditional policy measures approached zero lower bound and reached their limits, the ECB had to increase its non-regular monetary policy operations to support credit growth.

Our paper employs three databases. Data for volume of total loans (TOT), loans to the private sector excluding interbank loans (PRSEC), loans to non-financial corporations (NFC) and volume of deposits (DEP) were retrieved from the balance sheet items (BSI) database of the ECB. Data for the ECB's total balance sheet assets (BS), LTROs, MROs and securities held for monetary policy purposes (SHMPP) were extracted from the internal liquidity management (ILM) database of the ECB. For HICP and industrial production index we used the Eurostat database.

### 5.3.2 Methodology

To examine the impact of the ECB 's accommodative non-regular interventions on lending, we use a panel data regression method. We process monthly aggregate loan data for 15 eurozone economies from July 2007 to June 2021 (cross sections c=1,2,…,N and periods t=1,2,…,T with N=15 and T=168).

The panel model we consider has the following representation:

$$\Delta \ln Loans_{c,t} = \gamma_c + \gamma_1 \Delta \ln Loans_{c,t-1} + \gamma_2 \Delta \ln BS_t + \gamma_3 INF_{c,t} + \gamma_4 IP_{c,t} + \gamma_5 \Delta \ln DEP_{c,t} + u_{c,t} \quad (5.1)$$

The growth rate of each of the three main categories of aggregate loans per country, total loans (TOT), loans to private sector excluding interbank loans (PRSEC) and loans to non-financial corporations (NFC) is considered as dependent variable ($\Delta \ln Loans_{c,t}$). Independent variables are previous period growth rate of loans ($\Delta \ln Loans_{c,t-1}$), the growth rate of the ECB's total assets ($\Delta \ln BS_t$, same for all countries), inflation rate ($INFL_{c,t}$), the Industrial Production

($IP_{c,t}$) in logarithm form and the monthly growth rate of deposits ($\Delta lnDEP_{c,t}$), while $u_{c,t}$ is the error term[67].

Model equation (5.1) is estimated with cross sectional time series data. To adjust for cross sectional clustering, we estimate regressions with panel corrected standard errors (pcse)[68].

To calculate pcse we can rewrite the main equation (1) in matrix form as:

$$y = X\gamma + u \qquad (5.2)$$

y is a NT × 1 column vector of dependent variable observations, X is a NT × (k+1) matrix of independent variables' observations with k=5, γ is a (k+1) × 1 column vector of unknown parameters and u is a NT × 1 column vector of errors . As stated above in equation (1), we included the lagged dependent variable, $y_{c,t-1}$ in the set of regressors to count for the errors' temporal dependence[69].

We first use the OLS residuals from the second equation to estimate an N × N (i.e. 15 × 15) matrix of contemporaneous covariances, $\Sigma$,with typical element $E_t(u_{c,t}, u_{j,t})$.

Subsequently we estimate Ω, the covariance matrix of the residuals, which is an NT × NT (i.e. 2,520 × 2,520) block diagonal matrix with $\Sigma$, the matrix of contemporaneous covariances along the diagonal, as:

$$\hat{\Omega} = \hat{\Sigma} \otimes I_T \quad (5.3)$$

where $I_T$ is a T element identity matrix and $\otimes$ is the Kronecker product.

Panel corrected standard errors are calculated by the square roots of the diagonal terms of

$$pcse = (X^TX)^{-1}\{X^T\hat{\Omega}X\}(X^TX)^{-1} \quad (5.4)$$

[67] Our model allows for fixed effects, as Hausman test indicates, to count for country specific loan characteristics. Gambacorta and Marques-Ibanez (2014), Martins et al. (2019), Grandi (2019), Kenourgios and Ntaikou (2021), Burietz and Picault (2023) also used fixed effects to research the impact of monetary measures on bank credit.

[68] According to Beck and Katz (1995), in the appearance of complicated error structures due to cross sectional clustering, the OLS procedure with panel corrected standard errors leads to superior results than the GLS.

[69] See Bailey and Katz (2011) page 3. For more details about the estimation of pcse see also Beck and Katz (1995).

where X denotes the matrix of independent variables for all observations and $X^T$ its transpose.

The simple OLS estimates of γ are given by

$$\hat{\gamma} = (X^TX)^{-1}((X^Ty) \quad (5.5)$$

In case of a fixed effects model the OLS estimates of γ can be written as:

$$\hat{\gamma} = (X^TQX)^{-1}((X^TQy) \quad (5.6)$$

where Q is the is the fixed effects transformation operator[70].

To consider a possible structural change in unconventional monetary policy we re-estimate equation (1) including the pre zero lower bound (PZLB) time dummy variable as follows:

$$\Delta lnLoans_{c,t} = \gamma_c + \beta_1 PZLB_t + \gamma_1 \Delta lnLoans_{c,t-1} + \gamma_2 \Delta lnBS_t + \beta_2 PZLB_t \Delta lnBS_t + \gamma_3 INF_{c,t} + \gamma_4 IP_{c,t} + \gamma_5 \Delta lnDEP_{c,t} + u_{c,t} \quad (5.7)$$

Before the zero lower bound, the two monetary regimes (traditional and non-standard) acted alongside and complementary (Fioreli and Meliciani 2019). In the ZLB situations, regular measures reach their limits and central banks emphasized on unconventional measures.

### 5.4 Empirical results

In the following subsections, we present and discuss our empirical findings, perform robustness checks, and introduce cross-country specific effects. We must point out that the cross correlations between independent variables are relatively low so there is no multicollinearity[71].

#### 5.4.1 Main results

Table 5.5 presents the estimation results for our baseline model, which tests the effectiveness of the ECB's non-regular interventions on lending, considering other significant determinants.

[70] For more details about fixed effects estimation procedure see Baltagi (2013) and Wooldridge (2010).
[71] Table E.3 in appendix E provides the cross-correlation matrix of all variables.

Our results suggest that the implementation of the ECB's non-regular interventions indeed support credit supply. The coefficient of ΔlnBS ($\gamma_2$) has the expected positive sign and is statistically significant at 1% level when the dependent variable is the growth rate of TOT or NFC, and at the 5% level when the dependent variable is the growth rate of PRSEC. In our estimations, the coefficients range from 0.0166 (PRSEC) to 0.076 (TOT), i.e., a one percentage point (1%) increase in the ECB's total assets leads to a 0.076% increase in total credit per month. Non-conventional accommodative measures ease financial market tensions, extend the maturity of refinancing operations, depress the cost of ECB liquidity provision to banks, reduce the cost of external funding, improve interest rate spreads, promote interbank operations, facilitate MFIs access to various sources of financing, ease credit conditions, lower lending rates, and thus promote bank lending. Moreover, our results add to the previous literature showing that the ECB's non-traditional policy actions are effective in stimulating bank lending in the euro area.

More specifically, we apply panel regression analysis, and our findings are in line with those of Peersman et al. 2011, Boechx et al. 2017, Evgenidis and Salachas 2019, Evgenidis and Papadamou 2021 who used various VAR approaches and found that non-regular measures boosting credit growth in eurozone for different sampling periods. Furthermore, we utilize country-level loan data for fifteen euro area economies and our results are in accordance with Gambacorta and Marques-Ibanez 2014, Salachas et al. 2017, Gradi 2019, Boechx et al. 2020, Gibson et al. 2020, Burietz and Picault 2023 who processed bank-level credit data with different time periods and econometric methods. Finally, the following two studies used loan data in country level. Martins et al. (2019) examined the period 2008 to 2016 for 19 eurozone countries using panel regression analysis and two dummy variables to capture announcements of the ECB's standard and non-standard measures. They reported that unconventional policy interventions had a lagged positive effect on bank credit. Sleidi et al. (2023) analyzed the period 2008-2021 for 12 eurozone countries using quarterly data and a Bayesian VAR model. They provided evidence that non-conventional monetary interventions enhanced private credit co-movement in eurozone.

**Table 5.5** Estimation results detailed in equation (5.1) using the monthly growth rate of the ECB's total assets as a proxy for non-regular measures.

| Independent Variables | Dependent Variable $\Delta lnLOANS_{c,t}$ | | | | | |
|---|---|---|---|---|---|---|
| | TOT | | PRSEC | | NFC | |
| | coef. | Stand. error | coef. | Stand. Error | coef. | Stand. error |
| $\gamma_c$ | -0.110222* | 0.019314 | -0.054366* | 0.013112 | -0.042952* | 0.016486 |
| $\Delta lnLOANS_{c,t-1}$ | -0.150280* | 0.024080 | 0.022615 | 0.028239 | 0.059395** | 0.024875 |
| $\Delta lnBS_t$ | 0.075931* | 0.010514 | 0.016596** | 0.006535 | 0.021919* | 0.007976 |
| $INF_{c,t}$ | 0.073422** | 0.032209 | 0.153387* | 0.022634 | 0.195691* | 0.026711 |
| $IP_{c,t}$ | 0.023670* | 0.004196 | 0.011374* | 0.002845 | 0.008586** | 0.003582 |
| $\Delta lnDEP_{c,t}$ | 0.256129* | 0.034040 | 0.077055* | 0.023769 | 0.143291* | 0.028356 |
| R squared | 9.63% | | 8.54% | | 9.32% | |

Note: This table presents the estimation results regarding equation (5.1) for the July 2007-June 2021 period. The monthly growth rate of each of the three main categories of aggregate loans per country, total loans (TOT), loans to private sector excluding interbank loans (PRSEC) and loans to non-financial firms (NFC) is considered as dependent variable ($\Delta lnLOANS_{c,t}$) respectively. Independent variables are previous period growth rate of loans ($\Delta lnLOANS_{c,t-1}$), the monthly growth rate of the ECB's total assets ($\Delta lnBS_t$), the inflation rate ($INFL_{c,t}$), the logarithm of industrial production ($IP_{c,t}$) and the monthly growth rate of deposits ($\Delta lnDEP_{c,t}$). **,* indicate 5% and 1% significance levels, respectively.

Regarding the output (proxied by industrial production) and the loan supply, we document a positive and significant relationship. The coefficient of IP ($\gamma_4$) has the expected positive and significant sign at 1% level when the dependent variable is either ΔlnTOT or ΔlnPRSEC, and at 5% level when the dependent variable is ΔlnNFC. This result consistent with previous empirical results (Ehrmann et al. 2002; Calza et al. 2003; Gambacorta 2005; Grandi 2019; Martis et al. 2019) and with the theory that firms and agents need more credit when output increases.

We also examine the impact of inflation on MFIs lending and find a positive significant result in line with previous studies (Ehrmann et al. 2002; Gambacorta 2005; Grandi 2019; Martis et al. 2019). In what follows, we further research the relationship between inflation rate and credit growth.

The outcomes for industrial production and inflation rate demonstrate that bank credit is cyclical, as higher output and inflation are related with faster lending (Grandi 2019).

Finally, we research the monthly relationship between deposits growth and loan growth. We report, as expected, a positive and statistically significant effect at the 1%

level for all three dependent variables (ΔlnTOT, ΔlnPRSEC, ΔlnNFC). In our estimations, the coefficients ($\gamma_5$) range from 0.077 (PRSEC) to 0.25 (TOT) so, a one percentage point (1%) increase in the retail deposits causes a 0.25% increase in total loans per month. So, our findings predict that the easier the access to deposit founding, the higher the credit supply, in accordance with Ivashina and Scharftein (2010) and, Jimenez et al. (2014).

In conclusion, the estimated coefficients of ΔlnBS, INFL, IP and ΔlnDEP (($\gamma_2$ , $\gamma_3$, $\gamma_4$, $\gamma_5$) are statistically significant at 5% level (or lower) and, therefore, all these explanatory variables should be included to the panel regression model.

To account for a possible structural change in unconventional policy operations during our sampling period, we introduced in our model the time dummy variable PZLB which takes the value of one (1) for the subperiod before the zero lower bound (July 2007 to June 2012) and zero (0) otherwise. Table 5.6 presents the estimation results for our seventh equation. We find that the effectiveness of the ECB's non-traditional policy actions on bank lending is limited during the pre-zero lower bound period. More specifically, the coefficient of $\Delta lnBS_t$ ($\gamma_2$) remains positive and statistically significant at 1% level for all three corresponding categories of loans. In comparison, the coefficient of the independent variable $PZLB_t\Delta lnBS_t$ ($\beta_2$) is negative and statistically significant at the 1% level when the dependent variable is the growth rate of TOT or NFC, and at the 5% level when the dependent variable is the growth rate of PRSEC. Therefore, the effect of non-standard interventions before the zero lower bound is smaller and more precisely estimated at 0.0504 (=0.15404-0.10363) for total loans, at 0.0077 for loans to private sector, and at 0.0089 for loans to non-financial firms on monthly basis.

**Table 5.6** Estimation results detailed in equation (5.7) using the monthly growth rate of the ECB's total assets as a proxy for non-regular measures.

| **Independent Variables** | **Dependent Variable $\Delta lnLOANS_{c,t}$** | | | | | |
|---|---|---|---|---|---|---|
| | **TOT** | | **PRSEC** | | **NFC** | |
| | **coef.** | **Stand. error** | **coef.** | **Stand. Error** | **coef.** | **Stand. error** |
| $\gamma_c$ | -0.112317* | 0.019693 | -0.05874* | 0.013466 | -0.046173* | 0.016807 |
| $PZLB_t$ | 0.002999* | 0.001003 | 0.002078* | 0.000609 | 0.002148* | 0.000762 |
| $\Delta lnLOANS_{c,t-1}$ | -0.156844* | 0.024128 | 0.014969 | 0.028431 | 0.049930** | 0.025156 |
| $\Delta lnBS_t$ | 0.154035* | 0.022085 | 0.040366* | 0.013914 | 0.060001* | 0.016940 |

| | | | | | | |
|---|---|---|---|---|---|---|
| $PZLB_t\Delta lnBS_t$ | -0.103627* | 0.025223 | -0.03270** | 0.015897 | -0.051118* | 0.019347 |
| $INF_{c,t}$ | 0.069852*** | 0.037055 | 0.134327* | 0.025818 | 0.184315* | 0.031003 |
| $IP_{c,t}$ | 0.023847* | 0.004275 | 0.012203* | 0.002918 | 0.009123** | 0.003649 |
| $\Delta lnDEP_{c,t}$ | 0.248665* | 0.034075 | 0.075486* | 0.023807 | 0.140459* | 0.028370 |
| R squared | 10.45% | | 9.03% | | 9.79% | |

Note: This table presents the estimation results regarding equation (5.7) for the July 2007-June 2021 period. Same variables used as in Table 4.5. We introduce $PZLB_t$, a time dummy variable to consider the period before the zero lower bound. *, ** and *** denote significance at the 1%, 5% and 10% levels, respectively.

In the subperiod before zero lower bound, the size of unconventional policy was relatively smaller as the ECB provided flexible liquidity to MFIs and conducted limited security purchases. ECB's total assets increased by about two trillion euros in the period before pre zero lower bound. Moreover, the euro area monetary authority combined traditional and non-regular measures to support economic activity, (Fiorelli and Meliciani;2019). When its key short maturity rates approached the effective lower bound, the ECB was forced to resort to non-conventional policy instruments to a much larger extent, in an effort to boost credit supply and to revive eurozone's real economy. The ECB injected larger amounts of liquidity to MFIs through the three series of TLTROs and conducted large scale security purchases of public and private assets through APP and PEPP. These monetary operations increased excessively its total balance sheet assets by around five trillion euros strengthening the effectiveness of non-regular operations on credit supply.

Moreover, by contrasting the results of table 4.6 with those of table 4.5, we observe that the respective coefficients of other determinants continue to be statistically significant with almost similar size.

Furthermore, to research more analytically the effect of inflation rate on bank credit provision, we insert in equation (5.7) as independent variable the product of PZLB multiplied by INF ($PZLB_tINF_{c,t}$)[72]. We find that inflation rate impacts on credit only in the pre zero lower bound period. According to Gambacorta (2005), the coefficient of

[72] The equation 5.7 is modified as: $\Delta lnLoans_{c,t} = \gamma_c + \beta_1 PZLB_t + \gamma_1 \Delta lnLoans_{c,t-1} + \gamma_2 \Delta lnBS_t + \beta_2 PZLB_t \Delta lnBS_t + \gamma_3 INF_{c,t} + \beta_3 PZLB_t INF_{c,t} + \gamma_4 IP_{c,t} + \gamma_5 \Delta lnDEP_{c,t} + u_{c,t}$. Results are presented in table E.4 of appendix E. Coefficient $\gamma_3$ is not statistically significant while coefficient $\beta_3$ is positive and statistically significant at 1% level when the dependent variable is ΔlnPRSEC or ΔlnNFC and at 10% when the dependent variable is ΔlnTOT.

inflation incorporates both the positive impact of inflation and the potential negative impact of higher interest rates on credit growth. The second effect is also important in the pre-zero bound subperiod as the ECB decreased its key interest rates to the zero bound, reducing the cost of funding for banks (see figure E.1 in appendix E). Martins et al. (2019) examined the period 2008 to 2016 and found a positive impact of inflation on credit only for the subperiod January 2008 to December 2012, which almost coincided with our PZLB subperiod.

### 5.4.2 Robustness tests

In our baseline of equations, we proxy the non-traditional measures by the growth rate of the ECB's total balance sheet assets ($\Delta \ln BS_t$). Nevertheless, this variable includes MROs, which are regarded as regular measures. For this reason, we construct a more restrictive independent variable (NR) to proxy non-regular measures, consisting only by the sum of the securities held for monetary policy purposes (SHMPP) and LTROs (A070100 and A050200 accounts of the Eurosystem's balance sheet) excluding MROs[73].

Tables 5.7 and 5.8 report empirical results for equations (5.1) and (5.7) respectively using the growth rate of NR as an independent variable[74].

In table 5.7, our results also support that the ECB's non-regular interventions are effective in boosting the credit flow of MFIs to the economy. The coefficient of $\Delta \ln NR_t$ ($\gamma_2$) has the expected positive sign and is statistically significant at 1% level for total loans (TOT) and at 10% level for loans to PRSEC and to NFC. In our new estimations, compared to those in table 4, the coefficient of $\Delta \ln NR_t$ has a smaller magnitude, it ranges from 0.005 (PRSEC) to 0.024 (TOT) as we used a more restrictive proxy for non-regular measures. Also, the respective coefficients of other determinants continue to be statistically significant with almost comparable size.

[73] The same procedure has been used by Burietz and Picault (2023)

[74] Because NR variable is integrated of order one, we use its growth rate through the first difference of logs.

**Table 5.7** Estimation results detailed in equation (5.1) using the monthly growth rate of the ECB's sum of LTROs and securities held for monetary policy purposes as an alternative proxy for non-regular measures.

| Independent Variables | Dependent Variable $\Delta lnLOANS_{c,t}$ | | | | | |
|---|---|---|---|---|---|---|
| | TOT | | PRSEC | | NFC | |
| | coef. | Stand. error | coef. | Stand. Error | coef. | Stand. error |
| $\gamma_c$ | -0.109873* | 0.019368 | -0.054437* | 0.013103 | -0.043195* | 0.016488 |
| $\Delta lnLOANS_{c,t-1}$ | -0.140078* | 0.024008 | 0.024771 | 0.028181 | 0.061619** | 0.024848 |
| $\Delta lnNR_t$ | 0.024431* | 0.004110 | 0.00485*** | 0.002540 | 0.00536*** | 0.003109 |
| $INF_{c,t}$ | 0.080486** | 0.032272 | 0.154796* | 0.022627 | 0.197684* | 0.026705 |
| $IP_{c,t}$ | 0.023625* | 0.004208 | 0.011399* | 0.002843 | 0.008656** | 0.003582 |
| $\Delta lnDEP_{c,t}$ | 0.270553* | 0.034077 | 0.080385* | 0.023636 | 0.148099* | 0.028180 |
| R squared | 9.02% | | 8.44% | | 9.15% | |

Note: This table presents the estimation results regarding equation (5.1) for the July 2007-June 2021 period. The monthly growth rate of each of the three main categories of aggregate loans per country, total loans (TOT), loans to private sector excluding interbank loans (PRSEC) and loans to non-financial corporations (NFC) is considered as dependent variable ($\Delta lnLOANS_{c,t}$) respectively. Independent variables are previous period growth rate of loans (ΔlnLOANSc,t-1), the monthly growth rate of the ECB's sum of LTROs and SHMPP ($\Delta lnNR_t$), the inflation rate ($INFL_{c,t}$), the logarithm of industrial production ($IP_{c,t}$) and the monthly growth rate of deposits ($\Delta lnDEP_{c,t}$). *, ** and *** denote significance at the 1%, 5% and 10% levels, respectively.

Table 5.8 confirms that the impact of unconventional policies on bank credit is smaller in the pre-zero interest rate period. The coefficient of ΔlnNR ($\gamma_2$) remains positive and statistically significant at 1% level when the dependent variable is ΔlnTOT and at 5% level when the dependent variable is ΔlnPRSEC or ΔlnNFC. In comparison, the coefficient of the independent variable $PZLB_t\Delta lnNR_t$ ($\beta_2$) has a negative sign and is statistically significant at 1% level when the dependent variable is the ΔlnTOT, and at 10% level when dependent variable is ΔlnPRSEC or ΔlnNFC. Therefore, the effect of non-standard interventions before zero lower bound, proxied by NR, is smaller and more specifically is estimated at 0.01737 for total loans, at 0.0019 for loans to private sector and at 0.0020 for loans to non-financial corporations on monthly basis. Comparing these results with those of table 5.6, we notice marginally more limited effects of non-regular measures on bank lending as we use a new, more restrictive, proxy for non-traditional measures. Regarding the respective coefficients of other determinants, they continue to be statistically significant with almost comparable size with those of table 5.6.

**Table 5.8** Estimation results detailed in equation (5.7) using the monthly growth rate of the ECB's total assets as a proxy for non-regular measures.

| Independent Variables | Dependent Variable $\Delta lnLOANS_{c,t}$ | | | | | |
|---|---|---|---|---|---|---|
| | TOT | | PRSEC | | NFC | |
| | coef. | Stand. error | coef. | Stand. Error | coef. | Stand. error |
| $\delta_c$ | -0.113557* | 0.019748 | -0.059336* | 0.013490 | -0.047740* | 0.016844 |
| $PZLB_t$ | 0.002724* | 0.001010 | 0.002039* | 0.000609 | 0.002062* | 0.000764 |
| $\Delta lnLOANS_{c,t-1}$ | -0.144293* | 0.023997 | 0.019121 | 0.028238 | 0.055889** | 0.024978 |
| $\Delta lnNR_t$ | 0.056586* | 0.010489 | 0.015164** | 0.006540 | 0.018147** | 0.007989 |
| $PZLB_t\Delta lnNR_t$ | -0.039226* | 0.011403 | -0.01323*** | 0.007113 | -0.01610*** | 0.008675 |
| $INF_{c,t}$ | 0.061836*** | 0.036530 | 0.130413* | 0.025244 | 0.175080* | 0.030385 |
| $IP_{c,t}$ | 0.024227* | 0.004286 | 0.012363* | 0.002923 | 0.009531** | 0.003656 |
| $\Delta lnDEP_{c,t}$ | 0.265310* | 0.034143 | 0.079314* | 0.023667 | 0.146735* | 0.028203 |
| R squared | 9.63% | | 8.89% | | 9.49% | |

Note: This table presents the estimation results regarding equation (4.7) for the July 2007-June 2021 period. Same variables used as in Table 4.7. We introduce $PZLB_t$, a time dummy variable to consider the period before the zero lower bound. *, ** and *** indicate significance at the 1%, 5% and 10% levels, respectively.

Finally, we use an even more restrictive approach by proxying non-regular measures only by LTROs (A050200 account of the Eurosystem's balance sheet).

**Table 5.9** Estimation results detailed in equation (5.1) using the monthly growth rate of the ECB's LTROs as an alternative proxy for non-regular measures.

| Independent Variables | Dependent Variable $\Delta lnLOANS_{c,t}$ | | | | | |
|---|---|---|---|---|---|---|
| | TOT | | PRSEC | | NFC | |
| | coef. | Stand. error | coef. | Stand. Error | coef. | Stand. error |
| $\delta_c$ | -0.111734* | 0.019385 | -0.05558* | 0.013023 | -0.043655* | 0.016474 |
| $\Delta lnLOANS_{c,t-1}$ | -0.138713* | 0.024010 | 0.029731 | 0.028020 | 0.060999** | 0.024874 |
| $\Delta lnLTRO_t$ | 0.020669* | 0.003317 | 0.0036*** | 0.002055 | 0.00493*** | 0.002518 |
| $INF_{c,t}$ | 0.075571** | 0.032296 | 0.156378* | 0.022597 | 0.196624* | 0.026715 |
| $IP_{c,t}$ | 0.024092* | 0.004212 | 0.011662* | 0.002825 | 0.008768** | 0.003579 |
| $\Delta lnDEP_{c,t}$ | 0.263630* | 0.034135 | 0.083986* | 0.023562 | 0.146260* | 0.028254 |
| R squared | 9.15% | | 8.59% | | 9.18% | |

Note: This table presents the estimation results regarding equation (5.1) for the July 2007-June 2021 period. The monthly growth rate of each of the three main categories of aggregate loans per country, total loans (TOT), loans to private sector excluding interbank loans (PRSEC) and loans to non-financial corporations (NFC) is considered as dependent variable ($\Delta lnLOANS_{c,t}$) respectively. Independent variables are previous period growth rate of loans ($\Delta lnLOANS_{c,t-1}$), the monthly growth rate of the ECB's LTROs ($\Delta lnLTRO_t$), the inflation rate (INFLc,t), the logarithm of Industrial Production ($IP_{c,t}$) and the monthly growth rate of deposits ($\Delta lnDEP_{c,t}$). . *, ** and *** indicate significance at the 1%, 5% and 10% levels, respectively.

Tables 5.9 and 5.10 report our findings for equations (1) and (7) respectively using the growth rate of LTROs as an independent variable[75].

In table 5.9, our results validate that non-standard policy, proxied by LTROs, indeed enhances credit supply.

This finding from robustness test is in accordance with Darracq Paries and De Santis (2015), and Adrande et al. (2018) who found that the provision of liquidity by 36 month VLTROs enhanced bank lending. It is also, in line with Benetton and Fantino (2021) and, Laine (2021) who reported that first and second tranche of targeted operations (TLTROs-I and TLTROs-II) increased credit to non-financial firms.

In table 5.10, our conclusion regarding the smaller effect of non-regular interventions on credit during the PZLB subperiod remains the same.

**Table 5.10** Estimation results detailed in equation (5.7) using the monthly growth rate of the ECB's LTROs as an alternative proxy for non-regular measures.

| **Independent Variables** | **Dependent Variable $\Delta lnLOANS_{c,t}$** | | | | | |
|---|---|---|---|---|---|---|
| | **TOT** | | **PRSEC** | | **NFC** | |
| | **coef.** | **Stand. error** | **coef.** | **Stand. Error** | **coef.** | **Stand. error** |
| $\delta_c$ | -0.118474* | 0.019710 | -0.060729* | 0.013471 | -0.049323* | 0.016812 |
| $PZLB_t$ | 0.002605* | 0.001000 | 0.001992* | 0.000603 | 0.001992* | 0.000757 |
| $\Delta lnLOANS_{c,t-1}$ | -0.141996* | 0.024012 | 0.019172 | 0.028246 | 0.055376** | 0.024983 |
| $\Delta lnLTRO_t$ | 0.037643* | 0.006187 | 0.009172** | 0.003858 | 0.012343* | 0.004723 |
| $PZLB_t\Delta lnLTRO_t$ | -0.024804* | 0.007319 | -0.00837*** | 0.004559 | -0.011158** | 0.005567 |
| $INF_{c,t}$ | 0.045068 | 0.036135 | 0.125775* | 0.024923 | 0.170093* | 0.030013 |
| $IP_{c,t}$ | 0.025448* | 0.004275 | 0.012707* | 0.002918 | 0.009923* | 0.003648 |
| $\Delta lnDEP_{c,t}$ | 0.257537* | 0.034227 | 0.077979* | 0.023758 | 0.144266* | 0.028309 |
| R squared | 9.76% | | 8.89% | | 9.55% | |

Note: This table presents the estimation results regarding equation (4.7) for the July 2007-June 2021 period. Same variables used as in Table 4.9. We introduce $PZLB_t$, a time dummy variable to consider the period before the zero lower bound. *, ** and *** indicate significance at the 1%, 5% and 10% levels, respectively.

[75] LTRO variable is integrated of order one, therefore we use its growth rate through the first differences of logs.

### 5.4.3 Country effects

We have already suggested that the ECB's non-regular operations have successfully supported lending to euro area economies. In this section we present cross-country effects to specify the impact of non-regular accommodative policy on bank credit across economies and identify important differences among them due to country-intrinsic characteristics[76]. Table 5.11 shows our estimations for country specific effects regarding growth rates for the respective loan categories (TOT, PRSEC, NFC) for the period July 2007 to June 2021 in descending order[77].

For total loans (TOT), there is a significant monthly difference between the highest (0.6009% above average for Finland) and the lowest (0.3641% below average for Ireland) growth rate, estimated at 0.965%. For loans to the private sector (PRSEC), the highest monthly growth rate is recorded for Malta (+0.3019%) and the lowest for Ireland (-0.4585%)[78]. For loans to non-financial firms (NFC), the monthly difference between maximum and minimum growth rate is 0.945%.

**Table 5.11** Estimated country specific effects in terms of growth rates per respective category of loans (TOT, PRSEC, NFC) in descending classification.

| Country | TOT | Country | PRSEC | Country | NFC |
|---|---|---|---|---|---|
| Finland | 0.006009 | Malta | 0.003019 | Finland | 0.003769 |
| Malta | 0.003810 | Finland | 0.002741 | France | 0.002858 |
| France | 0.002973 | France | 0.002512 | Austria | 0.002147 |
| Austria | 0.000526 | Luxembourg | 0.001862 | Luxembourg | 0.002101 |
| Netherands | 0.000501 | Belgium | 0.001643 | Belgium | 0.002052 |
| Germany | 0.000324 | Austria | 0.001382 | Germany | 0.001742 |
| Luxembourg | 0.000201 | Germany | 0.001042 | Netherands | 0.001301 |
| Slovenia | -0.00002 | Netherands | 0.000070 | Malta | 0.000696 |
| Belgium | -0.00005 | Italy | -0.000408 | Italy | -0.000857 |
| Italy | -0.000437 | Slovenia | -0.000926 | Cyprus | -0.001193 |
| Cyprus | -0.002154 | Portugal | -0.001490 | Portugal | -0.001572 |
| Portugal | -0.002366 | Cyprus | -0.001929 | Greece | -0.001642 |
| Spain | -0.002522 | Spain | -0.002392 | Slovenia | -0.002623 |
| Greece | -0.003153 | Greece | -0.002542 | Spain | -0.003099 |

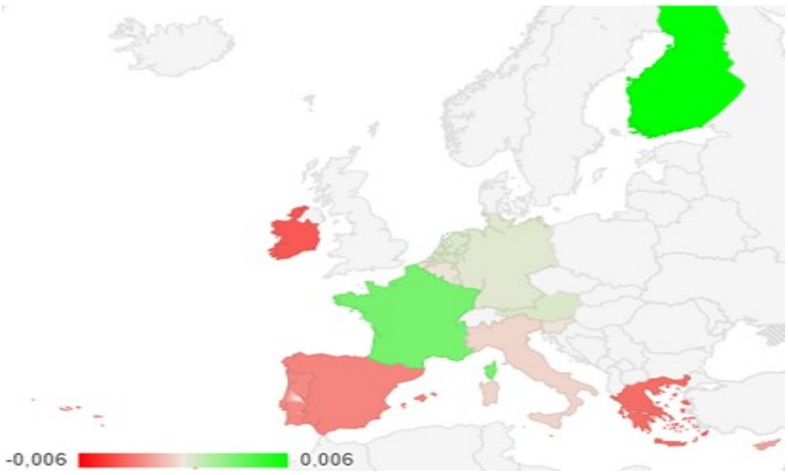
[76] From the panel estimation approach, we have the facility to obtain cross sectional effects for our sample of 15 economies.

[77] To derive cross-country effects based only on non-regular policy interventions we removed the independent variables INF, IP, and ΔlnDEP from our baseline model (equation 5.1).

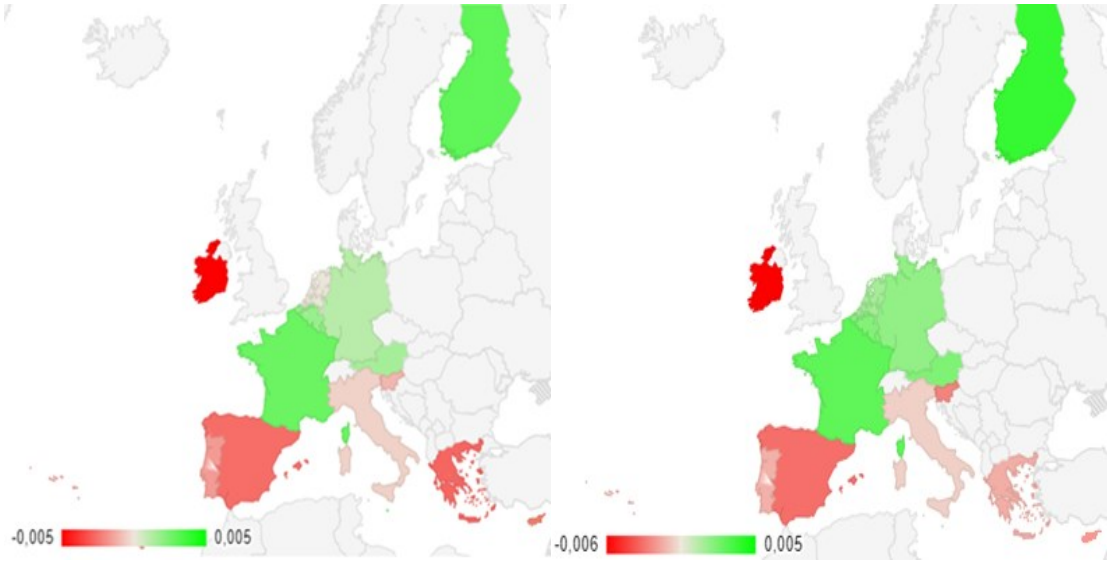
[78] Malta's specific effect is higher for loans to private sector than for loans to non-financial firms. The difference arises from loans to households.

| | | | | | |
|---|---|---|---|---|---|
| Ireland | -0.003641 | Ireland | -0.004585 | Ireland | -0.005679 |

We can see heterogeneous effects in the transmission of non-regular operations on credit as, in general, non-stressed euro area countries present loan growth rates above average. On the other hand, seven distressed countries (Italy, Portugal, Greece, Ireland, Spain, Cyprus, and Slovenia) present loan growth rates below the average for total loans, loans to private sector and loans to non-financial firms.




a) Total loans (TOT)




b) Loans to private sector (PRSEC) c) Loans to non-financial corporations (NFC)

**Figure 5.4** Heterogeneous effects of non-regular operations on loan growth of the three respective categories ( a) TOT, b) PRSEC and c) NFC).

Figure 5.4 provides a preliminary sense of the extent of heterogeneity in effects of non-conventional operations on credit growth per country.

Grandi (2019) concluded that the effect of non-regular interventions on bank credit provision was weaker for institutions located in sovereign stressed economies. Our results are also in line with Ehrmann et al. (2002) and De Santis (2015), who studied the bank credit channel in largest four countries of the euro area, in the period before European debt crisis, and reported considerable heterogeneity across countries.

Finally, Boeckx et al. (2017) as well as Burriel and Galesi (2018) reported a cross-country heterogeneity in the efficacy of non-conventional operations on GDP and inflation.

The economies of these countries were hit harder by the economic and the European debt crisis and went into deeper recession. To recover from recession their governments adopted expansionary fiscal policies causing budget deficits, credit rating downgrades and increases in sovereign bond yields. Ten-year government bond yields of these distressed countries exceeded 6% for a period of time (Altavilla et al. 2017) causing market worries about public debt refinancing. Ireland (2010), Portugal (2011), Spain and Cyprus (2012) requested financial support from the EFSF/ESM to recapitalize and restructure their banks. Greece launched three economic and adjustment programs (from May 2010 to August 2018) to receive financial assistance in order to recapitalize local banks and refinance public debt (Petrakis et al. 2022b). Also, Italian, and Slovenian MFIs became seriously distressed during the crisis period.

MFIs located in distressed countries restricted loan supply as they struggled with liquidity and capital adequacy problems (Burriel and Galesi 2018; Boechx et al, 2017) and were highly exposed in domestic government bonds with higher default risk (Gradi 2019). Also, the deterioration of macroeconomic conditions and the launch of economic and adjustment programs from peripheral countries caused reduction in loan provision from local banks due to nonperforming loans and their subsequent needs for recapitalization. (Anastasiou et al. 2019)

Furthermore, credit rating downgrades especially for Greece, Portugal, Ireland and Cyprus deteriorate the value of securities provided by local MFIs as collateral in

refinancing operations and therefore limited MFIs' ability to absorb liquidity from the ECB. Besides this, PSPP requires bond purchases for each country to comply with the respective share of the ECB capital key. During the implementation of the program downgrade deviations appeared for Greece, Portugal, Ireland, Slovenia and Cyprus affecting liquidity inflows of local banks and loan growth to corporations (ECB 2019).

To sum up, the severe consequences of the financial and debt crisis weakened banking institutions in distressed economies which faced the need to deleverage and, in many cases, to implement restructuring plans to recover.

The adjustment of MFIs balance sheets in distressed countries is shown in figure E.2 in appendix E. The volume of loans to non-financial firms declined substantially during the global economic and debt crisis, then declined further and remained well below pre-crisis levels. In the non-stressed countries, particularly France, Finland, Germany, Austria, Belgium, and Luxembourg, the volume of loans to non-financial firms declined at the beginning of the crisis. Still, it recovered, grew steadily, and was well above the pre-crisis level (see figure E.3 in Appendix E)[79].

### 5.5 Conclusion

The eruption of the financial market turmoil and the economic crisis caused significant uncertainty in global financial markets and led to liquidity shortages at MFIs worldwide due to the collapse of interbank and other funding markets. Global trade, consumption, investment, and production also collapsed, leading to an economic recession. To ensure the robustness of the banking system in the euro area and to revive economic activity, the ECB introduced new, non-regular measures, as traditional measures had been exhausted in the first phase of the crisis.

The objective of this study is to research the effectiveness of non-regular interventions on bank lending using panel data regression analysis. We process monthly data of aggregate loans at the country level for fifteen euro area economies and a sample period from the onset of the financial market turmoil to the coronavirus pandemic crisis (July 2007 to June 2021).

[79] Figures E.4 and E.6 in appendix E present the MFIs volume of total loans (TOT) and loans to private sector (PRSEC) for distressed countries while figures E.5 and E.7 present the MFIs volume of total loans (TOT) and loans to private sector (PRSEC) for non-stressed countries.

The empirical findings show that the ECB's non-regular measures support bank credit supply by facilitating access to funding markets, lowering funding costs, improving interbank transactions, and lowering lending rates. This result adds to the previous literature that recognizes that bank lending is positively affected by non-regular measures (see, among others, Boechx et al. 2017; Martins et al. 2019; Gibson et al. 2020; Boechx et al. 2020; Evgenidis and Papadamou 2021; Burietz and Picault 2023; Sleibi et al. 2023).

Regarding other determinants, we have shown that output (represented by industrial production) and deposits have a strong positive significant effect on lending, which is consistent with previous literature (Gambacorta 2005; Égert et al. 2007; Ivashina and Scharftein 2010; Jimenez et al. 2014; Grandi 2019; Martis et al. 2019), while inflation positively affected lending only in the pre-zero lower bound period when the ECB's short-term interest rates declined to zero levels.

We also demonstrated that there is a structural change in the impact of non-regular interventions on lending, as we found that the effect of unconventional interventions on lending was limited in the pre-zero lower bound period due to the smaller size of these interventions, as the ECB provided flexible liquidity to MFIs and engaged in limited securities purchases. When traditional measures approached effective lower bound, the ECB was forced to resort only to non-regular operations to boost bank credit and stimulate economic activity in euro area member states. The ECB provided larger amounts of liquidity to MFIs through TLTROs and conducted large-scale security purchases through APP and PEPP, reinforcing the effectiveness of non-traditional operations on bank credit.

We also analyzed the cross-country impact of non-regular measures on the credit growth rates of 15 euro area economies and found significant differences. Distressed eurozone economies had lower than average credit growth rates because they were more affected by the financial and debt crisis (Boechx et al. 2017; Grandi 2019). Their MFIs suffered from liquidity shortage, non-performing loans and low capital adequacy ratios (Burriel and Galesi 2018; Anastasiou et al. 2019) and had to deleverage and implement restructuring plans to recover.

In terms of policy implications, our study supports the effectiveness of the ECB's non-regular operations in boosting bank credit eurozone. Non-regular operations constitutes and additional policy tool that helps ECB to fulfil its mandate and more specifically to enhance economic activity and limit the damaging effects of the financial, sovereign debt and coronavirus crisis in the eurozone . Still, our research points to heterogeneous effects, finding significant differences in credit growth rates between non-stressed and distressed member countries. This result provide evidence that the ECB's non-regular measures were less effective in stimulating bank lending in distressed economies which suffered more from the economic turmoil and the subsequent recession. Policymakers and regulators should consider the degree of efficiency of the non-regular operations between core and distressed eurozone member states and try to balance when determining future regulatory framework of monetary policy interventions. A deeper integration of the eurozone banking sector through the enhancement of Banking Union with a single legislative framework for all members states and stronger prudential requirements for all banks could limit regional heterogeneity.

A further extension of this research could combine macroeconomic variables with micro firm data by analyzing both macroeconomic developments and bank specific characteristics in order to approach better the transmission of non-traditional interventions on bank credit.

# General Conclusion

European economies, capital markets and financial institutions experienced significant shocks from the onset of economic crisis to the coronavirus pandemic. From the eruption of the financial crisis, euro area MFIs started to reduce lending to firms and households while economic activity was disrupted as negative spillovers emerged from the financial sector to real economy leading to economic recession. European governments engaged in fiscal loosening to support the banking sector and to recover from the recession, causing credit rating downgrades and sovereign bond yields increases mainly in fiscally weaker peripheral countries. ECB reacted decisively by combining regular and non-regular policy measures to enhance credit supply, stabilize capital markets, revive economic activity and support distressed eurozone member states.

During the financial and sovereign debt crisis the ECB reduced its key interest rates to zero lower bound, provided flexible liquidity to MFIs with extended maturities through SLTROs and VLTROs and conducted limited security purchases via the CBPPI-II and the SMP. When conventional measures approached the effective lower bound, the ECB was forced to resort to non-conventional policy instruments to a much larger extent, to address the risks from deflation and the covid-19 pandemic. The ECB injected larger amounts of liquidity into MFIs through the three series of TLTROs and conducted large scale security purchases of public and private assets through APP and PEPP. These new non-conventional monetary policy measures (introduced also by other major central banks) were a milestone in global monetary policy history having contributed to the stability of the whole financial system.

Several pioneer research papers have explored the impact of the ECB's monetary policy decisions on stock prices using either event study and panel econometric analysis (see among other Rogers et al. 2014; Ricci 2015; Fiordelisi and Ricci 2016; Georgiadis and Gräb 2016; Haitsma et al. 2016; Fratzscher et al. 2016; Pacicco et al. 2019; Chebbi 2019) or VAR models (Boechx et al. 2017; Lewis and Roth 2019; Evgenidis and Papadamou 2021; Weale and Wieladek 2022; Zwan van der et al. 2024).

In contrast, there are few surveys exploring the impact of the ECB's monetary interventions on stock returns of monetary financial institutions (Fiordelisi et al. 2014; Ricci 2015; Fiordelisi and Ricci 2016; Fiordelisi and Galloppo 2018).

On the other hand, various prominent recent studies have examined the efficiency of the ECB's non-conventional operations on credit supply (see, among others, Gambacorta and Marques-Ibanez 2014; Boechx et al. 2017; Martins et al. 2019; Grandi 2019; Gibson et al. 2020; Boechx et al. 2020; Benetton and Fantino 2021; Burietz and Picault 2023; Sleibi et al. 2023).

The aim of this doctoral thesis is to contribute to the literature by investigating as well as by explaining the impact of the ECB's monetary policy interventions on stock prices and on bank credit expansion. To fulfil this goal, in relation with previous studies, we use different datasets and apply alternative econometric methods. In the last years the effectiveness of ECB's monetary policy has become crucial to the research field because the single monetary policy carried out by the ECB concerns member states with different business cycles, separate fiscal policy and heterogeneous economic systems.

The first chapter of this thesis analytically presents ECB's unconventional monetary policy measures from the onset of the financial crisis to the coronavirus pandemic crisis.

The first empirical research is presented in the second chapter and concerns the impact of the ECB's expansionary monetary interventions on market indices of eight eurozone countries (core and peripheral). Also, two main macroeconomic variables (inflation and production) and a sentiment indicator are included in the panel regression model as explanatory factors. Two dummy variables are constructed to capture the effect of regular and nonregular expansionary measures on index returns. Findings suggest that conventional and non-standard monetary policy innovations had a positive lagged impact on equity returns of euro area monetary markets. More specifically, interest rate cuts influenced market indices of core and peripheral countries by activating the interest rate transmission channel. Non-conventional actions mainly affected core eurozone countries that were less affected by the crisis

via the portfolio rebalancing and the bank lending channels. Vortelinos and Gkillas (2019) also found that eurozone member states that faced debt crisis ( i.e. peripheral countries) do not show significant response to ECB's non-conventional interventions while stock markets of countries with no fiscal problems (i.e. core countries) showed a positive response. We also document a strong negative relationship between inflation rates and market returns and a positive effect of sentiment indicator on returns as this indicator contains information that is not incorporated into other macro variables.

In comparison with previous papers, this study uses panel regression analysis with monthly data and the dummy variables procedure to explore the medium run effect of expansionary monetary policy on market indices returns (i.e. a two-month lag effect). Previous papers either use daily data with event study and panel regression analysis (Georgiadis and Gräb 2016; Rici 2015; Haitsma et al. 2016; Fiordelisi and Galloppo 2018; Pacicco et al. 2019; Chebbi 2019) to investigate the very short run effect of policy measures on returns or use VAR models to explore mainly the long run relationship (Boechx et. al. 2017; Lewis and Roth 2019; Evgenidis and Papadamou 2021; Weale and Wieladek 2022; Van der Zwan et al. 2024). Regarding the policy implications, this study helps to better understand how capital markets function. Core stock markets seem to be more affected by unconventional measures than peripheral markets. Another contribution of this study is that, except from monetary policy and macroeconomic factors, it incorporates a behavioral variable (sentiment indictor) to study the determinants of market returns. By considering the aforementioned results regarding the different impact of non-regular interventions on core and peripheral stock markets, decision-makers could design more effective monetary policy measures. Also, findings are useful for investors and portfolio managers as they should consider a broader set of monetary policy measures, macroeconomic and sentiment (behavioral) variables in order to determine their financial strategies.

The second empirical study explores the impact of the euro area monetary authority policy interventions on equity returns of four systemic Greek banks from January 2007 to August 2018 covering the period from the beginning of market financial turmoil to the end of the three Greek Economic Adjustment Programs. In the first step, we collect

and classify 103 significant monetary policy interventions into four categories. Then, an event study analysis is carried out to calculate CARs using both the market model and the market adjusted procedure. In the second step, a panel regression analysis is performed to identify CARs determinants. Results suggest that expansionary conventional monetary policy interventions (introduced mainly in the first stages of crisis) significantly affect equity returns of Greek banking institutions and are in line with previous studies (Kiley 2014; Fiordelisi and Ricci 2016, Fiordelisi and Gallopo 2018). On the contrary the Greek debt crisis, the possibility of a sovereign default, the public debt restructuring and the recapitalization of local MFIs, the ineligibility of Greek debt securities in the APP operations resulted in the gradual loss of investors' confidence towards Greek economy and local capital market eliminating the impact of non-regular measures.

This study contributes to the literature because-in the best of my knowledge-there is no exclusive research that concerns the effect of monetary policy on the stock prices of the four systemic Greek banks. These banks operated in a stressed national economy which was in recession over a long period of time, faced significant budget deficits, and had to implement three fiscal adjustment programs to avoid exiting the eurozone. The findings of this study raise concerns about the evaluation of the effectiveness of non-standard measures in Greek MFIs by the investors operating in the Greek stock market. As highlighted in the fourth empirical research ECB's non-regular operations were not effective in loan recovering of Greek MFIs due to NPLs, liquidity shortage and their subsequent needs for recapitalization. Investors recognized the financial fragility of Greek MFIs and the higher systemic risk of the local economy and shifted their holdings towards core countries. The continuous interventions by the european monetary authority could not restore investors' confidence and trust, as they paid attention to the bleak prospects of the Greek economy and the troubled local banking system. Further evidence is required to specify whether our results can be generalized to other banks located in distressed eurozone member states. Nevertheless, results are useful for policy makers and investors who are interested to assess stock performance of Greek regional banks during stressed periods.

The third study assesses the impact of the ECB's expansionary policy measures on stock prices of fourteen large European banks by employing event study and panel econometric approach similar to the second study. What differentiates this study from the previous papers is that it does not use subjective criteria to select the most relevant measure when an overlapping announcement of two or more measures is announced. To keep all expansionary measures in the sample without losing a significant number of observations we use a specific set of dummy variables in the multivariate panel econometric model. Previous papers that used subjective criteria to treat overlapping announcements suggested that only one type of unconventional monetary policy impacts on banking stocks (monetary easing for Fiordelisi et al., 2014 and Ricci, 2015 and liquidity provision for Fiordelisi and Gallopo, 2018). Our results show that that two categories of unconventional policy (both asset purchases and liquidity provision) affect bank stock prices.

Comparing the results of this study with the results of the previous study in chapter 3 we can notice that the ECB's unconventional expansionary monetary policy announcements significantly affect equity prices of large European banks in contrast with stock prices of Greek systemic banks.

In conclusion our findings suggest that both traditional and non-traditional expansionary policies have a strong positive impact on stocks of large European banks as interest rate cuts reduce banks' future net cash flows discount rate while unconventional measures reduce the probability of default and the risk premiums of banks and thus jointly enhance stock returns. Understanding the impact of the ECB's expansionary policy interventions on stock prices could be useful for investors and portfolio managers in their dynamic portfolio selection.

This empirical research contributes to literature by considering the impact of each standard non-standard program separately. Also, in the best of my knowledge, it is the first study that analyzes and compares the persistence and strength of these measures across various event windows. While key interest rate cuts and extraordinary liquidity provision affect stocks over short event windows, asset purchases produce stronger positive effects and over longer event periods as they ease bank funding, strengthen banks' balance sheets, restore investors' confidence, enhance investors to reallocate

their portfolios towards stocks, reduce market risk premiums and so boost equity prices (Fratzscher et al., 2016; Kashyap and Stein, 2023). Agents should consider this difference in the magnitude of the market response among expansionary measures in their investment decisions. Also, our results reveal that decision makers can positively influence capital markets by combining traditional and non-traditional measures, as these measures are complementary. Furthermore, policy makers should consider transmission channels through which monetary policy interventions affect capital markets to design more effective measures and try to communicate these policy measures with accuracy and clarity in order to enhance their impact on financial markets.

The fourth empirical study researches the efficacy of the ECB's non-regular measures on bank credit expansion using panel data regression analysis with country level monthly data of aggregate loans for fifteen euro area economies and a sample period from July 2007 to June 2021. Empirical findings show that the ECB's non-regular measures (proxied by alternative variables) support bank credit expansion in the euro area and are in agreement with previous literature (Boechx et al. 2017; Martins et al. 2019; Boechx et al. 2020; Evgenidis and Papadamou 2021; Burietz and Picault 2023; Sleibi et al. 2023) Also, output and deposits have a strong positive significant effect on lending while inflation positively affect lending only in the pre zero lower bound subperiod.

This study contributes to literature because it is the first research to demonstrate a structural change in the impact of non-regular operations on credit as it finds a limited (smaller) effect in the pre zero lower bound subperiod. In the subperiod before zero lower bound, the size of unconventional policy was relatively smaller as the ECB combined regular and non-regular measures to support credit expansion. When the regular monetary policy approached the effective lower bound, the ECB was forced to resort to non-conventional policy instruments to a much larger extent and injected larger amounts of liquidity into MFIs through the three series of TLTROs and conducted large scale security purchases through APP and PEPP enhancing the effectiveness of non-regular operations on credit. Another noteworthy finding of this study is the existence of heterogeneity in the transmission of non-regular monetary policy

measures on bank credit across different eurozone economies as we observe that distressed eurozone economies exhibit weaker effects of these measures on their credit. MFIs located in distressed countries restricted loan supply as they suffered from liquidity shortage, non-performing loans and low capital adequacy ratios and had to deleverage and implement restructuring plans to recover. This revelation carries significant implications for policymakers and regulators as they should tailor the regulatory framework to address the different challenges faced by MFIs of the member states in the euro area euro in order to increase the effectiveness of the non-regular interventions in the future.

Overall, this doctoral dissertation contributes to a deeper understanding of the intricate relationship between monetary policy and financial asset dynamics, helping central bank governors, policy makers, investors, portfolio and bank managers to take more effective decisions.

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# Appendix A

## Appendix to chapter 1

**Table A.1** ECB's unconventional monetary programs in chronological order. Source: ECB.

| Unconventional programs | First announcement | Implementation period | Maximum amount (billions) |
|---|---|---|---|
| FRFA | 8/10/2008 | October 2008 to- | |
| CBPP | 7/5/2009 | 7/2009–6/2010 | 60 |
| SLTROs | 7/5/2009 | 6/2009–10/2012 | 668 |
| CBPP-II | 6/10/2011 | 1/2011– 10/2012 | 16 |
| SMP | 10/5/2010 | 5/2010– 9/2012 | 220 |
| VLTROs | 8/12/2011 | 12/2011-3/2015 | 1,018 |
| OMT | 2/8/2012 | Not implemented | - |
| TLTROs-I | 5/6/2014 | 9/2014–9/2018 | 425 |
| ABSPP | 6/6/2014 | 11/2014-7/2022 | 31 |
| CBPP-III | 4/11/2014 | 10/2014-7/2022 | 302 |
| PSPP | 22/1/2015 | 3/2015-7/2022 | 2,593 |
| CSPP | 10/3/2016 | 6/2016-7/2022 | 435 |
| TLTROs-II | 10/3/2016 | 6/2017-3/2021 | 740 |
| TLTROs-III | 7/3/2019 | 9/2019-12/2024 | 2,214 |
| PEPP | 18/3/2020 | 3/2020-3/2022 | 1,718 |
| PELTROs | 30/4/2020 | 5/2020-12/2021 | 25 |

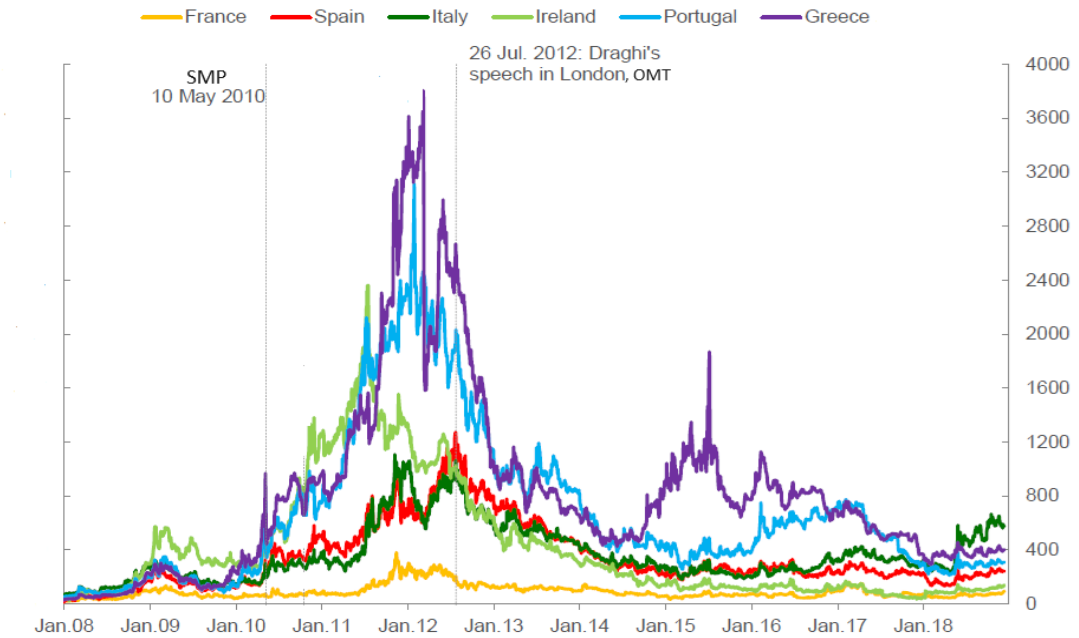



**Figure A.1** Ten-year bond yield spreads of selected eurozone countries. Source: ECB, Jäger and Grigoriadis, 2017; Rostango et al. 2019.

# Appendix B

## Appendix to chapter 2

**Table B.1** MRO rate reduction announcement dates.

| Date | MRO Rate Change |
|---|---|
| 8-Oct-2008 | −0.5 |
| 6-Nov-2008 | −0.5 |
| 4-Dec-2008 | −0.75 |
| 15-Jan-2009 | −0.5 |
| 5-Mar-2009 | −0.5 |
| 2-Apr-2009 | −0.25 |
| 7-May-2009 | −0.25 |
| 3-Nov-2011 | −0.25 |
| 8-Dec-2011 | −0.25 |
| 5-Jul-2012 | −0.25 |
| 2-May-2013 | −0.25 |
| 7-Nov-2013 | −0.25 |
| 5-Jun-2014 | −0.1 |
| 4-Sep-2014 | −0.1 |
| 10-Mar-2016 | −0.05 |

Note: The IRC dummy variable takes the value of one (=1) in the month in which ECB announced the reduction of the policy rate and zero otherwise (15 months). Source: ECB's press conferences and press releases.

**Table B.2** Announcement dates of ECB's non-standard measures.

| Date | Description |
|---|---|
| 22-Aug-2007 | Supplementary LTROs |
| 28-Mar-2008 | 6 month Supplementary LTROs |
| 7-May-2009 | One year LTROs and purchases of covered bonds |
| 4-Jun-2009 | Details for CBPP1 |
| 3-Dec-2009 | LTROs enhancement |
| 4-Mar-2010 | LTROs enhancement |
| 10-May-2010 | SMP and other liquidity measures |
| 3-Mar-2011 | Fixed-rate full allotment procedure for MROs and LTROs |

| | |
|---|---|
| 4-Aug-2011 | 6-month Supplementary LTROs at fixed rate full allotment procedure and other measures |
| 6-Oct-2011 | CBPP2 and 12-month Supplementary LTROs launched |
| 8-Dec-2011 | Two 3-year LTROs and other measures |
| 9-Feb-2012 | Approval of National credit claims criteria |
| 26-Jul-2012 | Draghi's speech "whatever it takes" |
| 2-Aug-2012 | Outright open market transactions (OMT) |
| 6-Sep-2012 | Details for OMT |
| 22-Mar-2013 | Collateral rule amendments |
| 5-Jun-2014 | Targeted LTROs launched and other measures |
| 3-Jul-2014 | Details for first series of T-LTROs |
| 4-Sep-2014 | CBPP3 and ABSPP |
| 22-Jan-2015 | Expanded Asset Purchase Programme (APP) and other measures |
| 5-Mar-2015 | Public Sector Purchase Programme details |
| 23-Sep-2015 | ECB adjusts purchase process in ABSPP |
| 9-Nov-2015 | ECB increases the PSPP share limit |
| 3-Dec-2015 | Extension of APP until the end of March 2017. |
| 10-Mar-2016 | ECB's decision to increase monthly purchases under APP, to launch second series of Targeted LTROs and Corporate Sector PP |
| 21-Apr-2016 | Details for CSPP |
| 3-May-2016 | Legal acts for the second series of T-LTROs |
| 2-Jun-2016 | The Eurosystem will start making purchases under CSPP |
| 8-Dec-2016 | ECB's decision to continue net asset purchases at a monthly pace of €60 billion until the end of December 2017, starting from April 2017. |
| 26-Oct-2017 | ECB's decision to continue net asset purchases at a monthly pace of €30 billion until the end of September 2018, starting from January 2018 |

Notes: The UNC dummy variable takes the value of one (=1) in the month in which ECB announced a non-standard expansionary policy measure and zero otherwise (30 months). Source: ECB's press conferences, press releases, and key speeches; Cross-checking with previous research was also carried out (Rogers et al. 2014; Falagiarda et al. 2015; Haitsma et al. 2016; Martins et al. 2019).

**Table B.3** Panel unit root tests for each explanatory variable.

| Method | IPI | | INFL | | DESI | | GESI | |
|---|---|---|---|---|---|---|---|---|
| | Statist. | Prob. | Statist. | Prob. | Statist. | Prob. | Statist | Prob |
| Null: Unit root | | | | | | | | |
| Im,Pesaran and Shin W-st | -9.71* | 0.000 | -2.91* | 0.001 | -6.56* | 0.00 | -15.23* | 0.00 |
| ADF - Fisher Chi-square | 135.85* | 0.000 | 33.69* | 0.006 | 77.03* | 0.00 | 252.03* | 0.00 |
| PP - Fisher Chi-square | 642.74* | 0.000 | 29.30** | 0.02 | 515.38* | 0.000 | 508.19* | 0.00 |

Note: This table includes the results for panel unit root tests for the monthly growth rate of Industrial Production index (IPI), the inflation rate (INFL), the first difference of Economic Sentiment Indicator (DESI) and the monthly percentage change Economic Sentiment Indicator (GESI). *,** indicates statistical significance at 1% and 5% level respectively.

**Table B.4** Results for full sample of eight countries using the monthly percentage change of economic sentiment indicator instead of its first difference.

| Dependent Variable RET | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Panel OLS | | Random Effects | | Fixed Effects | | Panel OLS with PCSEs | |
| Independent Variables | coeff. | std.error | coeff. | std.error | coeff. | std.error | coeff. | std.error |
| C | 0.001010 | 0.003099 | 0.001010 | 0.003099 | 0.001300 | 0.003113 | 0.001010 | 0.003336 |
| IPI | 0.072761 | 0.088126 | 0.072761 | 0.088119 | 0.058867 | 0.088310 | 0.072761 | 0.096819 |
| INFL | -0.476170* | 0.136128 | -0.476170* | 0.136118 | -0.494015* | 0.137318 | -0.476170* | 0.155633 |
| IRC(-2) | 0.016646* | 0.005994 | 0.016646* | 0.005993 | 0.016429* | 0.005995 | 0.016646* | 0.006024 |
| UNC(-2) | 0.005801 | 0.004455 | 0.005801 | 0.004455 | 0.005758 | 0.004455 | 0.005801 | 0.004449 |
| GESI | 0.602338* | 0.073425 | 0.602338* | 0.073419 | 0.602269* | 0.073457 | 0.602338* | 0.072264 |
| R squared | 10.42% | | 10.42% | | 11.04% | | 10.42% | |
| Hausman test RE/FE | | | 6.24 | | | | | |
| LM test for no cross-sectional dependence | 1793.53* | | | | | | | |
| LR test for cross-sectional heteroskedasticity | 125.21* | | | | | | | |

Notes: Table reports equity reaction of eight eurozone markets to ECB's expansionary monetary policy announcements, two main macroeconomic variables, and sentiment indicator. Monthly market return is dependent variable of panel regression. We use two dummy variables: IRC, which specifies announcements for interest rate cuts, and UNC, which specifies announcements for non-traditional monetary policy innovations. Remaining independent variables are: monthly percentage change of Industrial Production Index (IPI), inflation rate (INFL), and monthly percentage change of economic sentiment indicator (GESI). IRC(-2), UNC(-2) denote two months lagged dummy variables. * indicate statistical significance at 1% level.

**Table B.5** Results for Core Countries using the monthly percentage change of economic sentiment indicator instead of its first difference.

| Dependent Variable RET | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Panel OLS | | Random Effects | | Fixed Effects | | Panel OLS with PCSEs | |
| Independent Variables | coeff. | Std.error | coeff. | Std.error | coeff. | Std.error | coeff. | Std.error |
| C | 0.006050 | 0.004024 | 0.006050 | 0.004032 | 0.006325 | 0.004092 | 0.006050 | 0.004000 |
| IPI | 0.173677*** | 0.103584 | 0.173677*** | 0.103784 | 0.170998 | 0.103841 | 0.173677*** | 0.101321 |
| INFL | -0.585464* | 0.195425 | -0.585464* | 0.195802 | -0.602198* | 0.200473 | -0.585464* | 0.190820 |
| IRC(-2) | 0.013938** | 0.006826 | 0.013938** | 0.006839 | 0.013827** | 0.006843 | 0.013938** | 0.006826 |
| UNC(-2) | 0.009549*** | 0.005073 | 0.009549*** | 0.005083 | 0.009526*** | 0.005084 | 0.009549*** | 0.005070 |
| GESI | 0.611119* | 0.086004 | 0.611119* | 0.086170 | 0.608359* | 0.086374 | 0.611119* | 0.083471 |
| R squared | 16.57% | | 16.57% | | 16.73% | | 16.57% | |
| Hausman test RE/FE | | | 0.963 | | | | | |

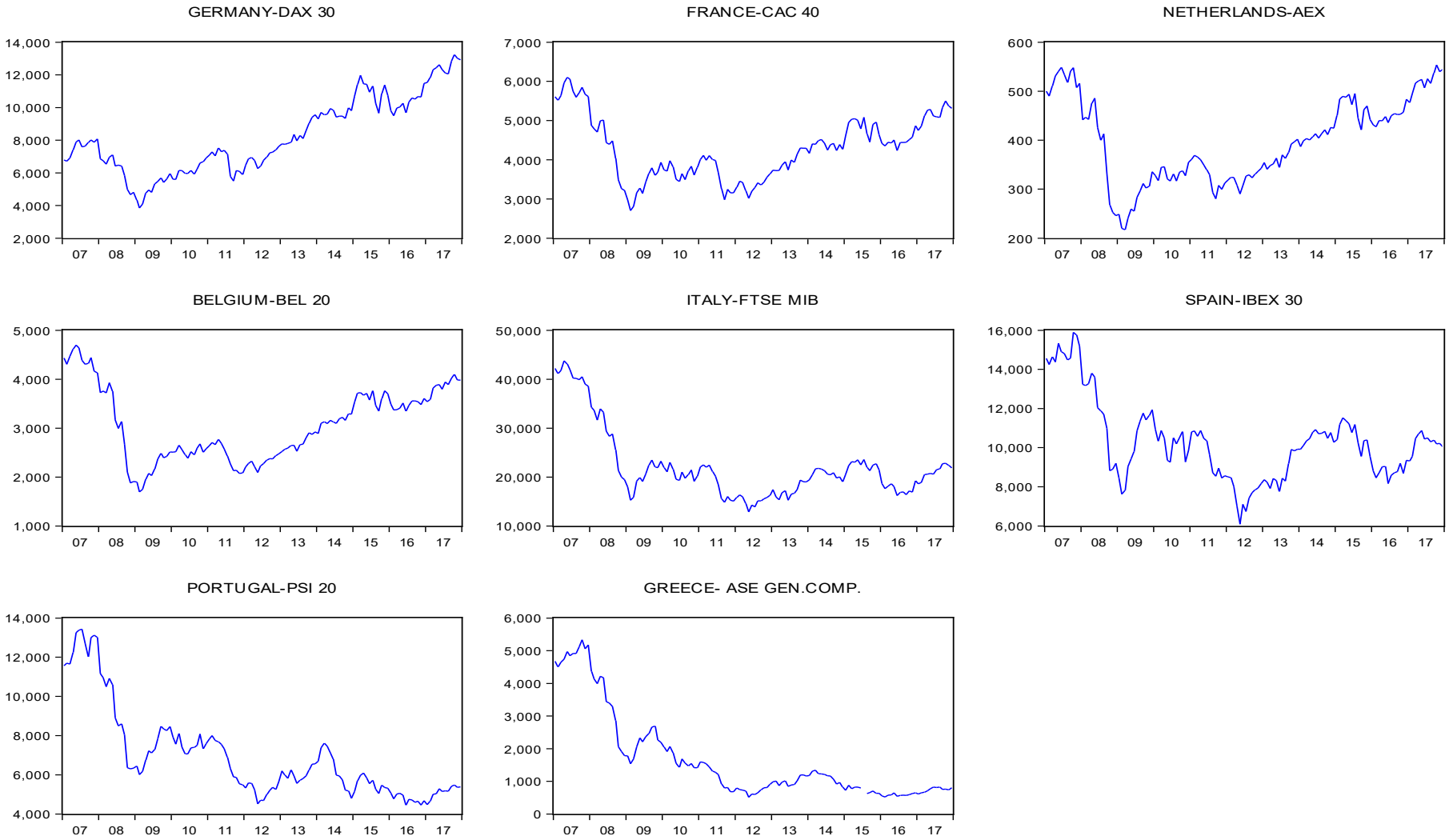
| | |
|---|---|
| LM test for no cross-sectional dependence | 491.20 * |
| LR test for cross-sectional heteroskedasticity | 6.58 |

Note: Same variables used as in Table B.4. *, **, *** indicate statistical significance at 1, 5 and 10% level, respectively.

**Table B.6** Results for peripheral countries using the monthly percentage change of economic sentiment indicator instead of its first difference.

| | Dependent Variable RET | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Panel OLS** | | **Random Effects** | | **Fixed Effects** | | **Panel OLS with PCSEs** | |
| **Independent Variables** | **coeff.** | **std.error** | **coeff.** | **std.error** | **coeff.** | **std.error** | **coeff.** | **std.error** |
| C | -0.002631 | 0.004738 | -0.002631 | 0.004745 | -0.002519 | 0.004748 | -0.002631 | 0.004934 |
| IPI | -0.041319 | 0.141615 | -0.041319 | 0.141835 | -0.046336 | 0.141922 | -0.041319 | 0.159758 |
| INFL | -0.457021** | 0.192119 | -0.457021** | 0.192418 | -0.464481** | 0.192664 | -0.457021** | 0.210920 |
| IRC(-2) | 0.018974*** | 0.009856 | 0.018974*** | 0.009872 | 0.018893*** | 0.009872 | 0.018974*** | 0.009927 |
| UNC(-2) | 0.001175 | 0.007355 | 0.001175 | 0.007367 | 0.001162 | 0.007367 | 0.001175 | 0.007339 |
| GESI | 0.577942* | 0.118876 | 0.577942* | 0.119061 | 0.578208* | 0.119067 | 0.577942* | 0.115775 |
| R squared | 7.67% | | 7.67% | | 7.92% | | 7.67% | |
| Hausman test RE/FE | | | 0.00 | | | | | |
| LM test for no cross-sectional dependence | 383.09* | | | | | | | |
| LR test for cross-sectional heteroskedasticity | 49.74* | | | | | | | |

Note: Same variables used as in Table A.3. *, **, *** indicate statistical significance at 1, 5 and 10% level, respectively.




**C**losing prices of main indices of the eight eurozone equity markets.

# Appendix C

## Appendix to chapter 3

**Table C.1** Announcement dates of ECB's monetary policy interventions (January 2007–August 2018).

| Date | Description | MRO Rate Change | Category of Policy |
|---|---|---|---|
| 8 March 2007 | G.C. meeting | +0.25 | IRIN |
| 6 June 2007 | G.C. meeting | +0.25 | IRIN |
| 22 August 2007 | Supplementary LTROs announcement | | LIQ |
| 6 September 2007 | Supplementary LTROs | | LIQ |
| 8 November 2007 | Renewal of supplementary LTROs | | LIQ |
| 10 January 2008 | US dollar liquidity providing operations | | LIQ |
| 7 February 2008 | Renewal of two supplementary LTROs | | LIQ |
| 11 March 2008 | US dollar liquidity operations | | LIQ |
| 28 March 2008 | Introduction of supplementary 6-month LTROs | | LIQ |
| 2 May 2008 | US dollar liquidity providing operations | | LIQ |
| 3 July 2008 | G.C. meeting | +0,25 | IRIN |
| 30 July 2008 | US dollar liquidity providing operations | | LIQ |
| 31 July 2008 | Renewal of two LTROs | | LIQ |
| 4 September 2008 | Renewal of LTROs | | LIQ |
| 18 September 2008 | US dollar liquidity providing operations | | LIQ |
| 26 September 2008 | US dollar liquidity providing operations | | LIQ |
| 29 September 2008 | Temporary swap lines with the Fed | | LIQ |
| 7 October 2008 | Enhance of LTROs and expansion of US dollar liquidity operations | | LIQ |
| 8 October 2008 | Fixed rate tender procedure with full allotment (FRTPFA) for MROs | −0.5 | IRC |
| 13 October 2008 | US dollar liquidity providing operations | | LIQ |
| 15 October 2008 | Expansion of assets eligible as collateral, enhancement of LTROs | | LIQ |
| 6 November 2008 | G.C. meeting | -0.5 | IRC |
| 4 December 2008 | G.C. meeting | −0.75 | IRC |
| 18 December 2008 | Fixed rate tender procedure with full allotment for MROs | | LIQ |
| 19 December 2008 | US dollar liquidity providing operations | | LIQ |
| 15 January 2009 | G.C. meeting | −0.5 | IRC |
| 3 February 2009 | Extension of temporary swap lines with the Fed | | LIQ |
| 5 March 2009 | Continuation of FRTPFA for MROs and LTROs | −0.5 | IRC |
| 19 March 2009 | US dollar liquidity providing operations | | LIQ |
| 2 April 2009 | G.C. meeting | −0.25 | IRC |

| | | | |
|---|---|---|---|
| 6 April 2009 | Establishment of a reciprocal currency arrangement with the Fed | | LIQ |
| 7 May 2009 | Covered bond purchases (CBPP1) and one-year LTROs | −0.25 | IRC |
| 4 June 2009 | Technical modalities of CBPP1 | | ME |
| 25 June 2009 | Extension of liquidity swap arrangements with the Fed | | LIQ |
| 24 September 2009 | GovC decided to continue US dollar liquidity operations | | LIQ |
| 3 December 2009 | Continuation of FRTFA for MROs, and enhancement of LTROs | | LIQ |
| 4 March 2010 | Continuation of FRTFA for MROs, and enhancement of LTROs | | LIQ |
| 3 May 2010 | Change in eligibility of Greek debt instruments | | LIQ |
| 10 May 2010 | Securities market programme (SMP) | | ME |
| 10 June 2010 | FRTPFA in the regular 3-month LTROs | | LIQ |
| 2 September 2010 | MROs and 3-month LTROs at FRTPFA | | LIQ |
| 2 December 2010 | MROs and 3-month LTROs at FRTPFA | | LIQ |
| 17 December 2010 | Temporary swap facility with the Bank of England | | LIQ |
| 21 December 2010 | Extension of liquidity swap arrangements with the Fed | | LIQ |
| 3 March 2011 | MROs and 3-month LTROs at FRTPFA | | LIQ |
| 7 April 2011 | G.C. meeting | +0.25 | IRIN |
| 9 June 2011 | MROs and 3-month LTROs at FRTPFA | | LIQ |
| 29 June 2011 | Extension of liquidity swap arrangements with the Fed | | LIQ |
| 7 July 2011 | GovC meeting | +0.25 | IRIN |
| 4 August 2011 | MROs, 3-month and 6-month LTROs at FRTPFA | | LIQ |
| 8 August 2011 | Reactivation of SMP for Italy and Spain | | ME |
| 25 August 2011 | Extension of liquidity swap arrangements with the Fed | | LIQ |
| 15 September 2011 | US dollar liquidity operations in coordination with other CB | | LIQ |
| 6 October 2011 | Launch of new covered bond purchase program (CBPP2) | | ME |
| 3 November 2011 | Technical modalities of CBPP2 | −0.25 | IRC |
| 30 November 2011 | Establishment of a temporary network of reciprocal swap lines | | LIQ |
| 8 December 2011 | Two 3-year LTROs, increase of collateral availability | −0.25 | IRC |
| 21 December 2011 | Results of first 3-year LTRO | | LIQ |
| 9 February 2012 | Approval of National credit claims criteria | | LIQ |
| 28 February 2012 | Results of second 3-year LTRO | | LIQ |
| 8 March 2012 | Eligibility of Greek bonds in Eurosystem credit operations | | LIQ |
| 6 June 2012 | MROs and 3-month LTROs at FRTPFA | | LIQ |
| 22 June 2012 | Increase of collateral availability for counterparties | | LIQ |
| 5 July 2012 | G.C. meeting | −0.25 | IRC |
| 26 July 2012 | Draghi's speech in London “whatever it takes …OMT” | | ME |
| 2 August 2012 | Outright monetary transactions-OMT | | ME |
| 6 September 2012 | Technical details of OMTs | | ME |
| 12 September 2012 | Extension of liquidity swap arrangements with the BoE | | LIQ |
| 6 December 2012 | MROs and 3-month LTROs at FRTPFA | | LIQ |
| 13 December 2012 | Extension of liquidity swap arrangements with the Fed | | LIQ |

| | | | |
|---|---|---|---|
| 19 December 2012 | Eligibility of Greek debt instruments | | LIQ |
| 21 February 2013 | Publishing of the Eurosystem's holdings acquired under SMP | | ME |
| 22 March 2013 | Collateral rules | | LIQ |
| 2 May 2013 | Extension of MROs and 3-month LTROs at FRTPFA | −0.25 | IRC |
| 16 September 2013 | Extension of liquidity swap arrangements with the BoE | | LIQ |
| 31 October 2013 | Standing swap arrangements with other central banks | | LIQ |
| 7 November 2013 | Extension of MROs and 3-month LTROs at FRTPFA | −0.25 | IRC |
| 5 June 2014 | Targeted LTROs launched and other measures | −0.1 | IRC |
| 17 June 2014 | US dollar liquidity providing operations | | LIQ |
| 3 July 2014 | Details for first series of TLTROs | | LIQ |
| 29 July 2014 | Legal acts for TLTROs | | LIQ |
| 04 September 2014 | CBPP3 and ABSPP announcement | −0.1 | IRC |
| 18 September 2014 | The ECB allots €82.6 billion in TLTRO1 | | LIQ |
| 2 October 2014 | Details for ABSPP and CBBP3 | | ME |
| 17 November 2014 | M. Draghi, speech at the E.P. | | ME |
| 4 December 2014 | Q.E. programme with sovereign bonds (Draghi's press conference) | | ME |
| 22 January 2015 | Expanded Asset Purchase Programme (APP) and other measures | | ME |
| 5 March 2015 | PSPP details and implementation | | ME |
| 3 September 2015 | Decision to increase the PSPP issue share limit | | ME |
| 23 September 2015 | ECB adjusts purchase process in ABSPP | | ME |
| 3 December 2015 | Extension of APP until the end of March 2017. | | ME |
| 10 March 2016 | Increase of monthly purchases under APP, launch of TLTRO2 and CSPP | −0.05 | IRC |
| 21 April 2016 | Details for CSPP | | ME |
| 3 May 2016 | Legal acts on the second series of TLTROs | | LIQ |
| 2 June 2016 | The Eurosystem will start making purchases under CSPP | | ME |
| 22 June 2016 | ECB reinstates waiver affecting the eligibility of Greek bonds | | LIQ |
| 5 October 2016 | Changes to collateral eligibility criteria | | LIQ |
| 3 November 2016 | ECB reviews its risk control framework for collateral assets | | LIQ |
| 8 December 2016 | APP calibration, EUR 60 billion monthly purchases until December 2017 | | ME |
| 19 January 2017 | Details for PSPP | | ME |
| 26 October 2017 | APP calibration, EUR 30 billion monthly purchases until September 2018 | | ME |
| 14 December 2017 | Changes to collateral eligibility criteria | | LIQ |
| 14 June 2018 | APP transition, EUR 15 billion monthly purchases until December 2018 | | ME |

Notes: This table presents announcements of the ECB's monetary policy measures for the period January 2007 to August 2018. We classify ECB's monetary interventions into four categories: interest rate increases (IRIN), interest rate cuts (IRC), monetary easing (ME), and liquidity provision (LIQ). When ECB declared more than

one category of intervention on the same day, to avoid overlapping events we adopted criteria following Fiordelisi and Galloppo (2018). (a) If all interventions belong to the same category, we encounter them as a single event, (b) ECB's decisions to change the rate of main refinancing operations are always considered as main events, (c) decisions to leave a current measure unchanged are considered less important than new measures, and (d) if the above criteria are not enough, we identify, in terms of significance, the main event.

# Appendix D

## Appendix to chapter 4

**Table D.1** Announcement dates of the ECB's expansionary policy measures (July 2007-December 2020).

| Date | Description | Policy rate cut | Type of policy |
|---|---|---|---|
| 22-Aug-2007 | Announcement of supplementary LTROs | | LIQP |
| 28-Mar-2008 | ECB introduces supplementary six-month LTROs | | LIQP |
| 8-Oct-2008 | Fixed rate/ full allotment (FRFA) tender procedure on MROs | -0.5% | INTC, LIQP |
| 6-Nov-2008 | Gov.C. meeting | -0.5% | INTC |
| 4-Dec-2008 | Gov.C. meeting | -0.75% | INTC |
| 18-Dec-2008 | MROs will continue to be executed at FRFA for as long as necessary | | LIQP |
| 15-Jan-2009 | Gov.C. meeting | -0.5% | INTC |
| 5-Mar-2009 | Decision to continue the FRFA for LTROs and MROs | -0.5% | INTC, LIQP |
| 2-Apr-2009 | Gov.C. meeting | -0.25% | INTC |
| 7-May-2009 | First covered bond purchase program (CBPP-I) and one-year maturity LTROs | -0.25% | INTC, ASSP, LIQP |
| 4-Jun-2009 | CBPP-I technical modalities announced | | ASSP |
| 3-Dec-2009 | Extension of FRFA for MROs and amendments to LTROs | | LIQP |
| 4-Mar-2010 | Extension of FRFA for MROs and amendments to LTROs | | LIQP |
| 10-May-2010 | Securities markets program (SMP) and new special LTROs | | LIQP, ASSP |
| 3-Mar-2011 | Extension of FRFA procedure | | LIQP |
| 8-Aug-2011 | SMP reactivation for Spanish and Italian bonds | | ASSP |
| 6-Oct-2011 | Announcement of a second covered bond program (CBPP-II) and two new LTROs with maturities of 12 and 13 months at FRFA procedure | | LIQP, ASSP |
| 3-Nov-2011 | Technical details for CBPP-II | -0.25% | INTC, ASSP |
| 8-Dec-2011 | Decision to increase collateral availability and two new three-year LTROs | -0.25% | INTC, LIQP |
| 9-Feb-2012 | National credit claims approval for credit operations | | LIQP |
| 5-Jul-2012 | Gov.C. meeting | -0.25% | INTC |
| 26-Jul-2012 | " Whatever it takes… " speech by Mario Draghi in London | | ASSP |
| 2-Aug-2012 | The Gov.C announced outright open market operations | | ASSP |
| 6-Sep-2012 | OMT – Technical details | | ASSP |
| 22-Mar-2013 | Amendments to collateral rules | | LIQP |
| 2-May-2013 | Extension of FRFA procedure for MROs and LTROs | -0.25% | INTC,LIQP |
| 4-Jul-2013 | The Gov.C. expects the key ECB interest rates "to remain at present or lower levels for an extended period of time". | | FWG |
| 7-Nov-2013 | Extension of FRFA procedure for MROs and LTROs | -0.25% | INTC, LIQP |
| 5-Jun-2014 | First series of targeted LTROs announcement | -0.10% | INTC, LIQP |
| 3-Jul-2014 | Technical details for first tranche of targeted LTROs | | LIQP |
| 4-Sep-2014 | ECB will purchase asset backed securities (ABSPP) and covered bonds (CBPP-III) | -0.10% | INTC, ASSP |
| 2-Oct-2014 | Operational details for CBPP-III and ABSPP | | ASSP |
| 17-Nov-2014 | Draghi's speech at the E.P. about additional asset purchases | | ASSP |

***APPENDIX D***

| | | | |
|---|---|---|---|
| 4-Dec-2014 | Draghi's press conference -Quantitative easing program with sovereign bond purchases | | ASSP |
| 22-Jan-2015 | ECB decided to purchase public sector securities to encompass CBPP-III and ABSPP | | ASSP |
| 5-Mar-2015 | Details for public sector purchase program (PSPP) | | ASSP |
| 3-Sep-2015 | Decision to raise issue share limit for PSPP | | ASSP |
| 23-Sep-2015 | The ABSPP purchase process was adjusted | | ASSP |
| 9-Nov-2015 | Amendments to PSPP | | ASSP |
| 3-Dec-2015 | APP extension until the end of first quarter 2017. | | ASSP |
| 10-Mar-2016 | ECB expands APP's monthly purchases to €80 billion. Launch of second series of targeted LTROs (TLTROs-II) & corporate sector purchase program (CSPP). Forward guidance recalibration | -0.05% | INTC, LIQP, ASSP, FWG |
| 21-Apr-2016 | Technical details upon CSPP | | ASSP |
| 2-Jun-2016 | The Eurosystem will conduct the first operation in TLTROs-II | | LIQP |
| 8-Dec-2016 | APP extension and recalibration, ECB reduces monthly asset purchases to €60 billion until December 2017 | | ASSP |
| 19-Jan-2017 | Further details for asset purchases under PSPP | | ASSP |
| 26-Oct-2017 | APP extension and recalibration, ECB reduces monthly asset purchases to €30 billion until September 2018 | | ASSP |
| 14-Jun-2018 | APP transition, ECB reduces monthly asset purchases to €15 billion until December 2018. Forward guidance restatement | | ASSP, FWG |
| 7-Mar-2019 | Announcement of third series of targeted LTROs (TLTROs-III) and forward guidance restatement | | LIQP, FWG |
| 6-Jun-2019 | Details for TLTROs-III and forward guidance restatement | | LIQP, FWG |
| 12-Sep-2019 | Reactivation of APP with monthly asset purchases of € 20 billion. TLTROs-III and forward guidance recalibration | | LIQP, ASSP, FWG |
| 12-Mar-2020 | APP's asset purchases are increased by €120 billion until the end of 2020. Additional LTROs and favorable terms for TLTROs-III. | | LIQP, ASSP |
| 19-Mar-2020 | ECB announced a new €0.75 trillion pandemic emergency asset purchase program (PEPP) | | ASSP |
| 30-Apr-2020 | Gov.C. decided to reduce the interest rate on TLTROs-III and announced pandemic emergency LTROs (PELTROs) | | LIQP |
| 4-Jun-2020 | PEPP envelope expanded to €1,350 trillion | | ASSP |
| 10-Dec-2020 | Gov.C. decided to increase PEPP envelope to 1.85 trillion, to recalibrate the conditions of TLTROs-III and to offer additional PELTROs | | LIQP, ASSP |

Notes: This table reports dates and related expansionary measures introduced by the ECB from July 2007 to December 2020. ECB's policy interventions are classified to four respective categories: interest rate cuts (INTC), liquidity provision (LIQP), asset purchases (ASSP) and forward guidance (FWG). Cross-checking was conducted with previous studies (Falagiarda et al., 2015; Martins et al., 2019; Fereira and Serra, 2022; Petrakis et al., 2022b).

**Table D.2** European banks' stock response to expansionary measures announced by the ECB using feasible GLS regression to estimate equation (4.1) and the market model to calculate CARs.

| | Dependent variable | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **CAR[0]** | | **CAR[0,+1]** | | **CAR[-1,+1]** | | **CAR[-1,+3]** | |
| **Explanatory variables** | **coeff.** | **stand. err.** | **coeff.** | **stand. err.** | **coeff.** | **stand. err.** | **coeff.** | **stand. err.** |
| CONS | -0.007436* | 0.002440 | -0.013750* | 0.003773 | -0.008766*** | 0.004520 | -0.006339 | 0.006021 |
| INTC | 0.010191* | 0.002421 | 0.015295* | 0.003744 | 0.007627*** | 0.004485 | -0.009332 | 0.005974 |
| ASSP | 0.010239* | 0.002455 | 0.018505* | 0.003797 | 0.019303* | 0.004548 | 0.014116** | 0.006058 |
| LIQP | 0.006054** | 0.002530 | 0.010148** | 0.003913 | 0.008358*** | 0.004688 | 0.003341 | 0.006244 |
| FWG | -0.001189 | 0.002734 | 0.006158 | 0.004228 | -0.001546 | 0.005065 | -0.008703 | 0.006747 |
| MUL | -0.007278** | 0.002922 | -0.012583* | 0.004520 | -0.010983** | 0.005414 | 0.004482 | 0.007212 |
| R squared | 4.05% | | 3.82% | | 3.80% | | 3.56% | |

Note: This table reports European banks' stock responce to expansionary measures announced by the ECB from July 2007 to December 2020. We use the same dependent and explanatory variables as in Table 3. *, ** and *** denote significance at the 1%, 5% and 10% levels, respectively.

**Table D.3** European banks' stock response to expansionary measures announced by the ECB using feasible GLS regression to estimate equation (4.1) and the market adjusted procedure to calculate CARs.

| | Dependent variable | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **CAR[0]** | | **CAR[0,+1]** | | **CAR[-1,+1]** | | **CAR[-1,+3]** | |
| **Explanatory variables** | **coeff.** | **stand. err.** | **coeff.** | **stand. err.** | **coeff.** | **stand. err.** | **coeff.** | **stand. err.** |
| CONS | -0.004965 | 0.003208 | -0.026375* | 0.004451 | -0.024609* | 0.005198 | -0.015936** | 0.006592 |
| INTCUT | 0.006200*** | 0.003184 | 0.024040* | 0.004417 | 0.018557* | 0.005159 | -0.006754 | 0.006542 |
| ASSPUR | 0.010272* | 0.003228 | 0.035363* | 0.004478 | 0.038945* | 0.005230 | 0.024985* | 0.006633 |
| LIQP | 0.000255 | 0.003327 | 0.016393* | 0.004616 | 0.016378* | 0.005390 | 0.002645 | 0.006836 |
| FWG | -0.001066 | 0.003597 | 0.005757 | 0.004335 | 0.004579 | 0.005827 | -0.010221 | 0.007390 |
| MUL | -0.005186 | 0.003845 | -0.023871* | 0.005334 | -0.020140* | 0.006229 | 0.009591 | 0.007900 |
| R squared | 3.68% | | 9.60% | | 9.59% | | 6.92% | |

Note: This table reports European bank's stock responce to expansionary measures announced by the ECB from July 2007 to December 2020. We use the same dependent and explanatory variables as in Table 4.3. *, ** and *** denote significance at the 1%, 5% and 10% levels, respectively.

# Appendix E

## Appendix to chapter 5

**Table E.1** Summary of panel unit root tests for each independent variable.

| Method | ΔlnTOT | | ΔlnNFC | | ΔlnPRSEC | |
|---|---|---|---|---|---|---|
| | Statist. | Prob. | Statist. | Prob. | Statist. | Prob. |
| Null: Unit root | | | | | | |
| Im,Pesaran and Shin W-st | -15.14* | 0.00 | -12.58* | 0.00 | -12.59* | 0.00 |
| ADF - Fisher Chi-square | 304.23* | 0.00 | 231.37* | 0.00 | 234.97* | 0.00 |
| PP - Fisher Chi-square | 1,472.07* | 0.00 | 1,257.90* | 0.00 | 1,316.4* | 0.00 |

Note: This table includes the results for panel unit root tests for the monthly growth of total loans (ΔlnTOT), loans to non-financial corporations (ΔlnNFC) and loans to private sector excluding interbank loans (ΔlnPRSEC). * indicates statistical significance at the 1% level.

**Table E.2** Summary of panel unit root tests for each explanatory variable.

| Method | ΔlnBS | | INFL | | IP | | ΔlnDEP | |
|---|---|---|---|---|---|---|---|---|
| | Statist. | Prob. | Statist. | Prob. | Statist. | Prob. | Statist | Prob |
| Null: Unit root | | | | | | | | |
| Im,Pesaran and Shin W-st | -16.57* | 0.000 | -5.71* | 0.00 | -3.04* | 0.0012 | -17.62* | 0.00 |
| ADF - Fisher Chi-square | 336.47* | 0.000 | 86.29* | 0.00 | 69.31* | 0.0001 | 377.14* | 0.00 |
| PP - Fisher Chi-square | 1321.4* | 0.000 | 68.01* | 0.00 | 104.47* | 0.000 | 1423.6* | 0.00 |

Note: This table includes the results for panel unit root tests for the monthly growth rate of the ECB's total balance sheet assets ($\Delta lnBS_t$), the inflation rate (INFL), the logarithm of Industrial Production (IP) and the monthly growth rate of deposits (ΔlnDEP). * indicates statistical significance at the 1% level.

**Table E.3** Cross correlation matrix of all variables

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.000 | | | | | | | | | | | |
| 2 | 0.441 | 1.000 | | | | | | | | | | |
| 3 | 0.328 | 0.7097 | 1.000 | | | | | | | | | |
| 4 | 0.1498 | 0.0727 | 0.083 | 1.000 | | | | | | | | |
| 5 | 0.1238 | 0.0481 | 0.0484 | 0.6887 | 1.000 | | | | | | | |
| 6 | 0.1353 | 0.0514 | 0.06 | 0.6733 | 0.9399 | 1.000 | | | | | | |
| 7 | 0.0883 | 0.2202 | 0.2204 | 0.0532 | 0.0194 | 0.0386 | 1.000 | | | | | |
| 8 | 0.1221 | 0.1422 | 0.1295 | 0.042 | 0.0294 | 0.0196 | 0.2408 | 1.000 | | | | |
| 9 | 0.1888 | 0.1028 | 0.1354 | 0.1128 | 0.0619 | 0.0916 | 0.0203 | 0.0811 | 1.000 | | | |
| 10 | -0.104 | 0.0844 | 0.0741 | 0.1068 | 0.0387 | 0.0256 | 0.096 | 0.108 | 0.0148 | 1.000 | | |
| 11 | 0.0589 | 0.1003 | 0.1166 | 0.0524 | 0.0024 | 0.0045 | 0.2313 | 0.1385 | 0.0351 | 0.4501 | 1.000 | |
| 12 | 0.0622 | 0.1282 | 0.1328 | 0.0771 | 0.0421 | 0.0571 | 0.2135 | 0.123 | 0.0515 | 0.3355 | 0.7109 | 1.000 |

Note: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 represent $\Delta lnTOT_{c,t}$, $\Delta lnPRSEC_{c,t}$, $\Delta lnNFC_{c,t}$, $\Delta lnBS_{c,t}$, $\Delta lnNR_{c,t}$, $\Delta lnLTRO_{c,t}$, $INFL_{c,t}$, $IP_{c,t}$, $\Delta lnDEP_{c,t}$, $\Delta lnTOT_{c,t-1}$, $\Delta lnPRSEC_{c,t-1}$, $\Delta lnNFC_{c,t-1}$ respectively. In each estimated model one out of $\Delta lnTOT_{c,t}$, $\Delta lnPRSEC_{c,t}$, $\Delta lnNFC_{c,t}$ is the dependent variable while the independent variables are one out of $\Delta lnTOT_{c,t-1}$, $\Delta lnPRSEC_{c,t-1}$, $\Delta lnNFC_{c,t-1}$ respectively $INFL_{c,t}$, $IP_{c,t}$, $\Delta lnDEP_{c,t}$ and one out of , $\Delta lnBS_{c,t}$, $\Delta lnNR_{c,t}$, $\Delta lnLTRO_{c,t}$ (see tables 4, 6 and 8).

**Table E.4** Estimation results of the equation: $\Delta lnLoans_{c,t} = \delta_c + \beta_1 PZLB_t + \gamma_1 \Delta lnLoans_{c,t-1} + \gamma_2 \Delta lnBS_t + \beta_2 PZLB_t \Delta lnBS_t + \gamma_3 INF_{c,t} + \beta_3 PZLB_t INF_{c,t} + \gamma_4 IP_{c,t} + \gamma_5 \Delta lnDEP_{c,t} + u_{c,t}$

| Independent Variables | Dependent Variable $\Delta lnLOANS_{c,t}$ | | | | | |
|---|---|---|---|---|---|---|
| | TOT | | PRSEC | | NFC | |
| | coef. | stadard error | coef. | stadard error | coef. | stadard error |
| $\delta_c$ | -0.108325* | 0.019863 | -0.053980* | 0.013587 | -0.038136** | 0.016848 |
| $PZLB_t$ | 0.001128 | 0.001470 | -0.000198 | 0.000985 | -0.001659 | 0.001195 |
| $\Delta lnLOANS_{c,t-1}$ | -0.158077* | 0.024156 | 0.010445 | 0.028302 | 0.041623*** | 0.025075 |
| $\Delta lnBS_t$ | 0.145807* | 0.022546 | 0.030468** | 0.014321 | 0.043873** | 0.017284 |
| $PZLB_t \Delta lnBS_t$ | -0.097771* | 0.025414 | -0.025778 | 0.016075 | -0.039967** | 0.019443 |
| $INF_{c,t}$ | 0.001679 | 0.055056 | 0.051789 | 0.038797 | 0.046487 | 0.045438 |
| $PZLB_t INF_{c,t}$ | 0.122579*** | 0.072516 | 0.149561* | 0.048969 | 0.250596* | 0.058754 |
| $IP_{c,t}$ | 0.023130* | 0.004301 | 0.011347* | 0.002935 | 0.007676** | 0.003650 |
| $\Delta lnDEP_{c,t}$ | 0.248665* | 0.034026 | 0.075554* | 0.023712 | 0.140794* | 0.028192 |
| R squared | 10.55% | | 9.55% | | 10.58% | |

Note: This table presents the estimation results for the July 2007-June 2021 period. The monthly growth rate of each of the three main categories of aggregate loans per country, total loans (TOT), loans to private sector excluding interbank loans (PRSEC) and loans to non-financial corporations (NFC) is considered as dependent variable ($\Delta lnLOANS_{c,t}$) respectively. Independent variables are previous period growth rate of loans ($\Delta lnLOANS_{c,t-1}$), the monthly growth rate of the ECB's total balance sheet assets ($\Delta lnBS_t$), the inflation rate ($INFL_{c,t}$), the logarithm of Industrial Production ($IP_{c,t}$) and the monthly growth rate of deposits ($\Delta lnDEP_{c,t}$). and $PZLB_t$ a time dummy variable to consider the period before the zero lower bound ***, **, * indicate 10%, 5% and 1% significance levels, respectively.

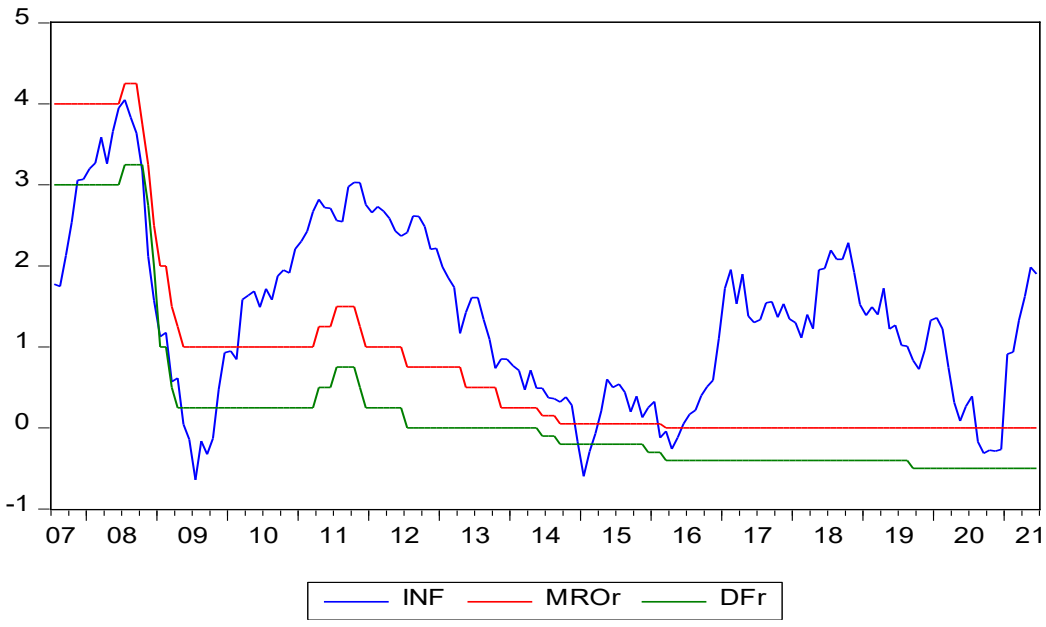



**Figure E.1** Euro area inflation rate (INF) and rates of main refinancing operations (MROr) and deposit facility (DFr) in percentage, for the period July 2007 to June 2021. Sources: ECB for DFr and MROr, and Eurostat for inflation rate.

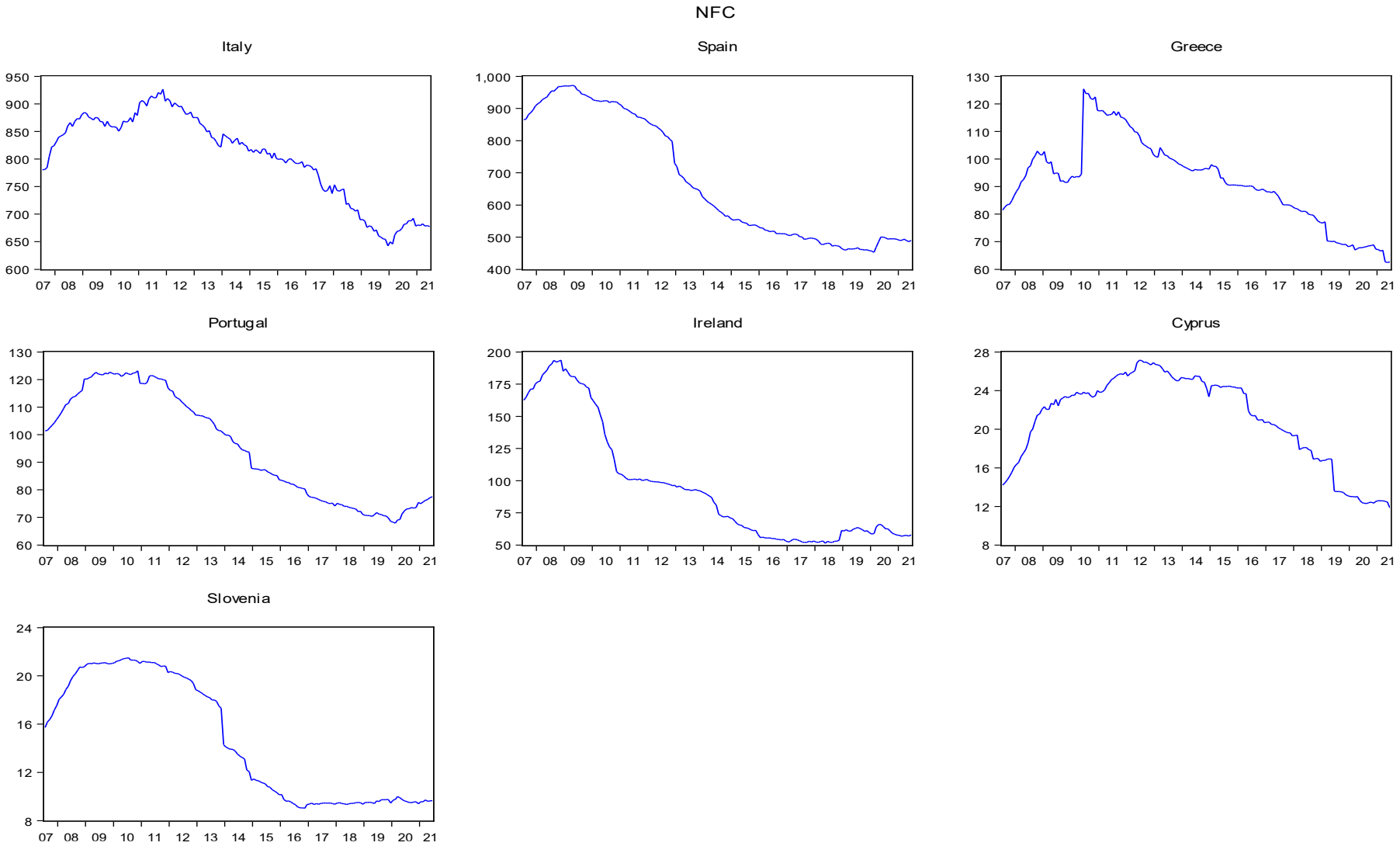



**Figure E.2** Loan stocks to non-financial corporations for each distressed country during the period July 2007 to June 2021, in billion euros. Source: Balance Sheet Items (BSI) database of the ECB.

## *APPENDIX E*

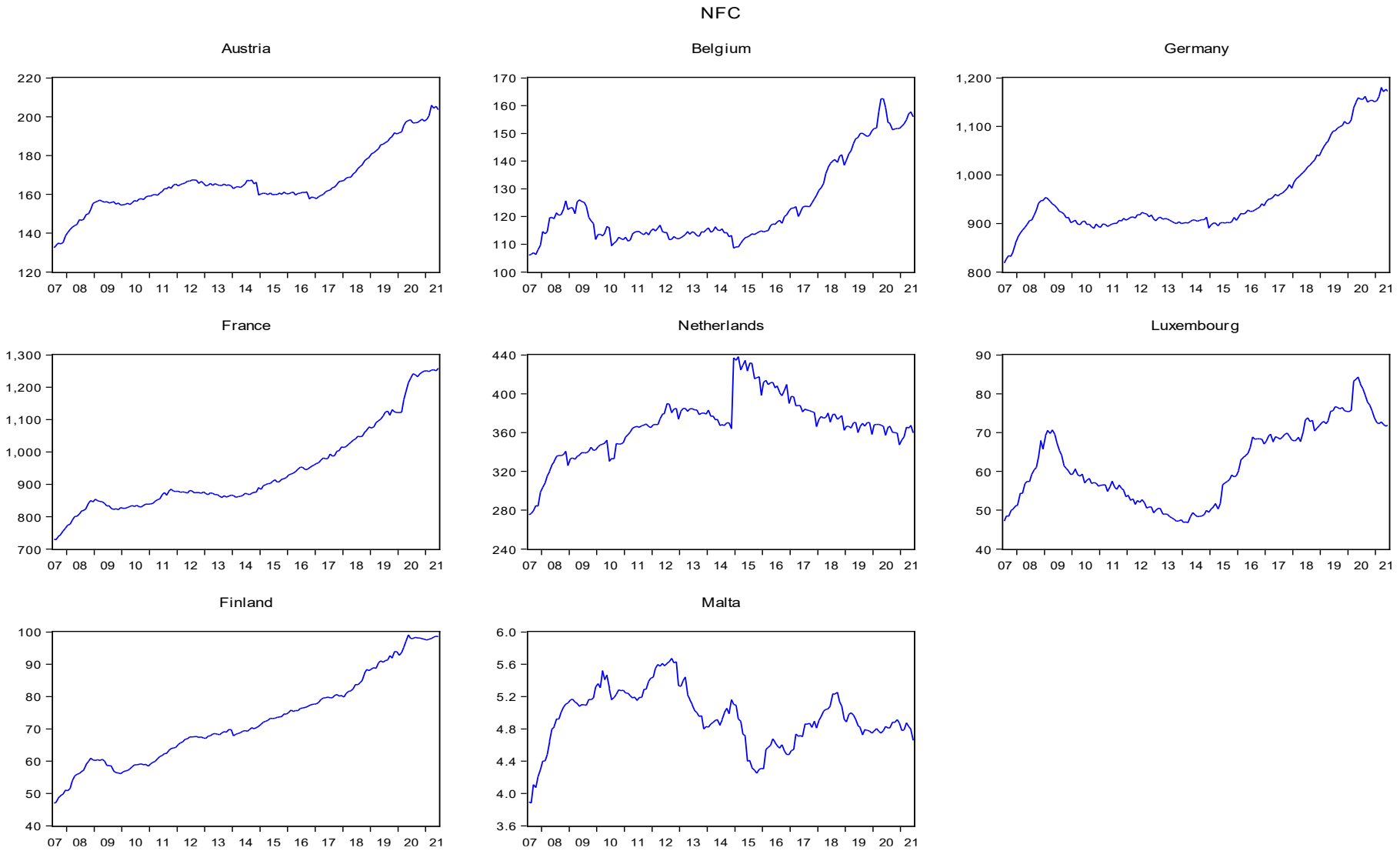



**Figure E.3** Loan stocks to non-financial corporations for each non-stressed country during the period July 2007 to June 2021, in billion euros. Source: Balance Sheet Items (BSI) database of the ECB.

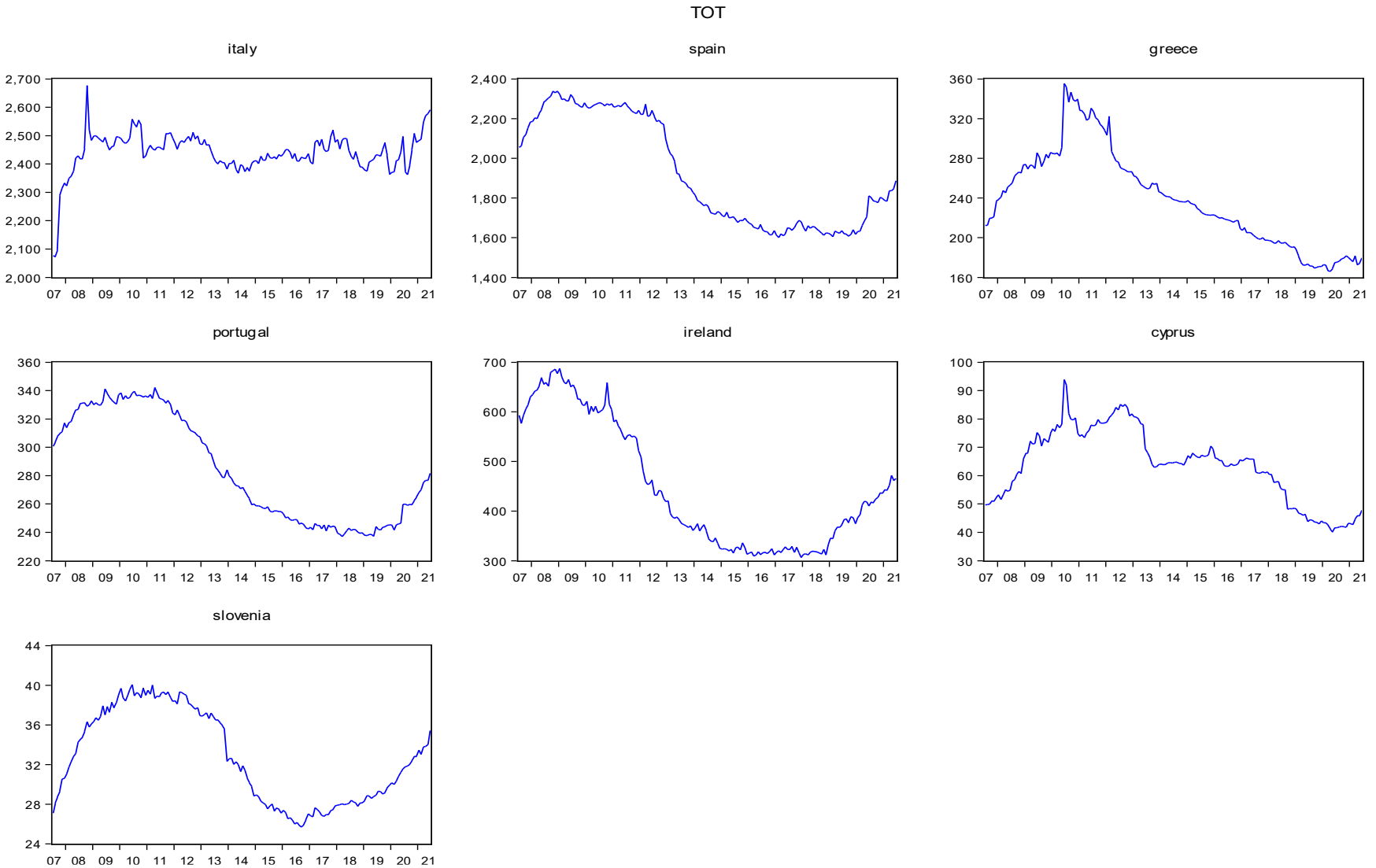



**Figure E.4** Total loan for each distressed country during the period July 2007 to June 2021, in billion euros. Source: Balance Sheet Items (BSI) database of the ECB.

## *APPENDIX E*

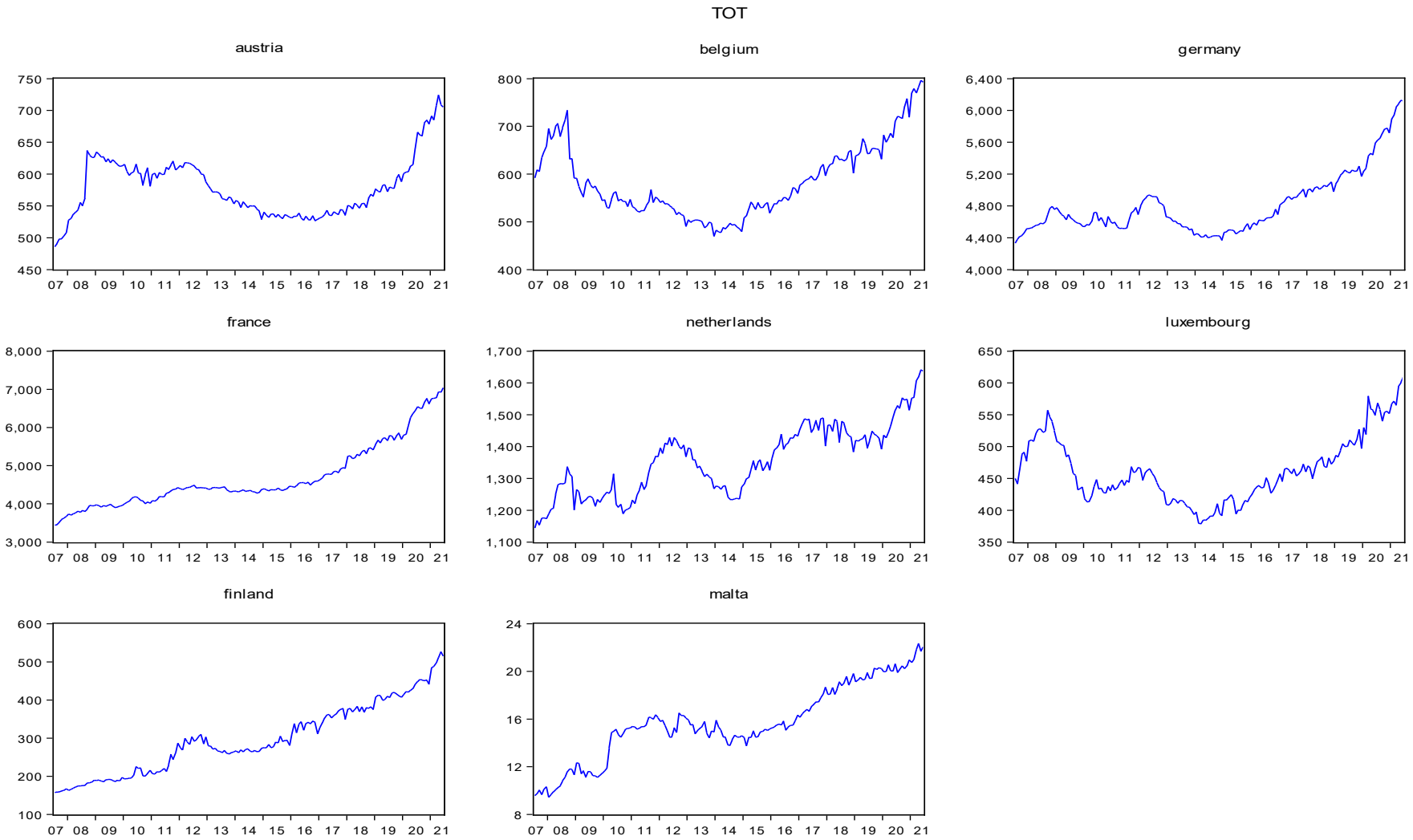



**Figure E.5** Total loan stocks for each non-stressed country during the period July 2007 to June 2021, in billion euros. Source: Balance Sheet Items (BSI) database of the ECB.

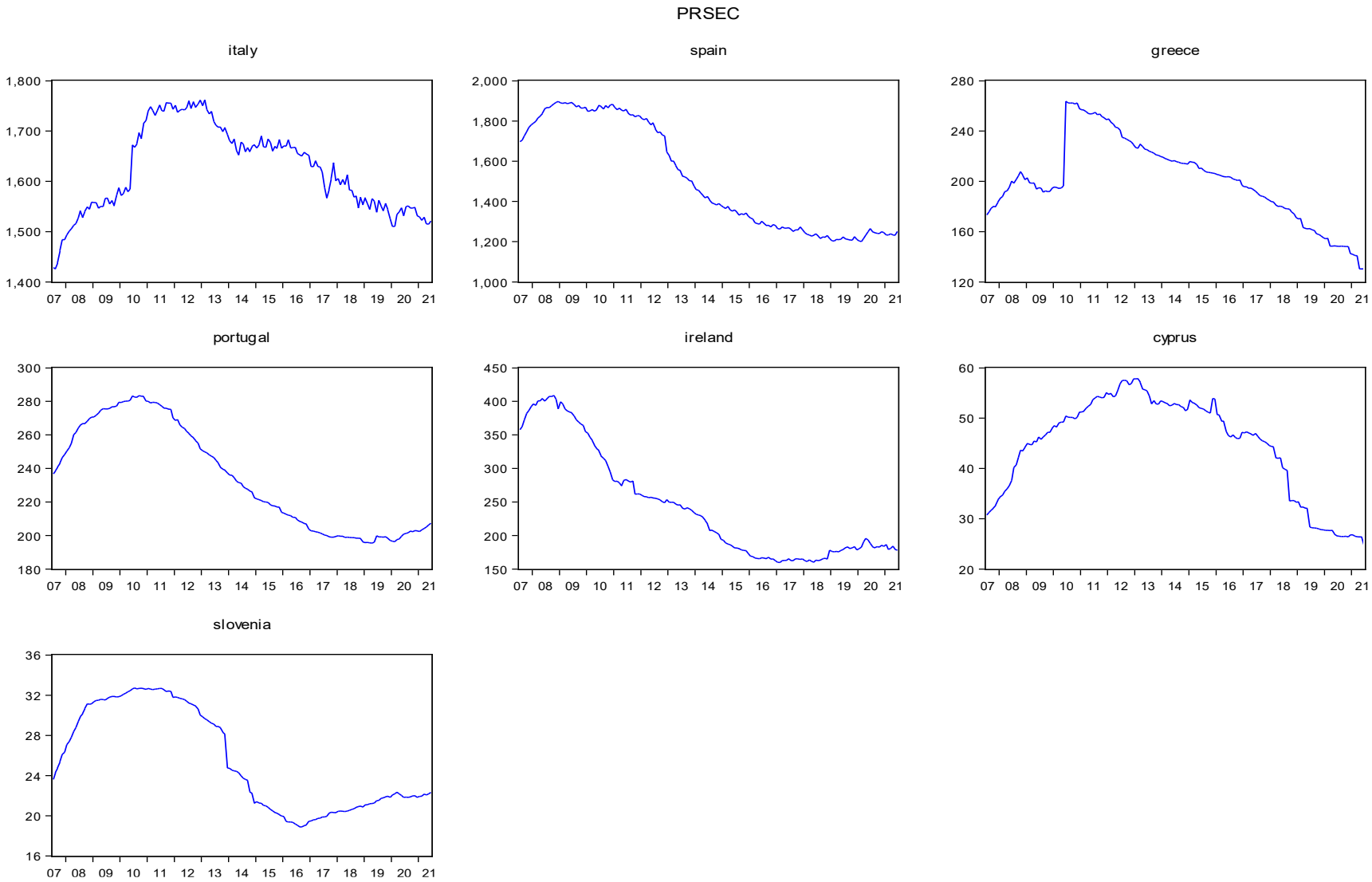



**Figure E.6** Loan stocks to private sector for each distressed country during the period July 2007 to June 2021, in billion euros. Source: Balance Sheet Items (BSI) database of the ECB.

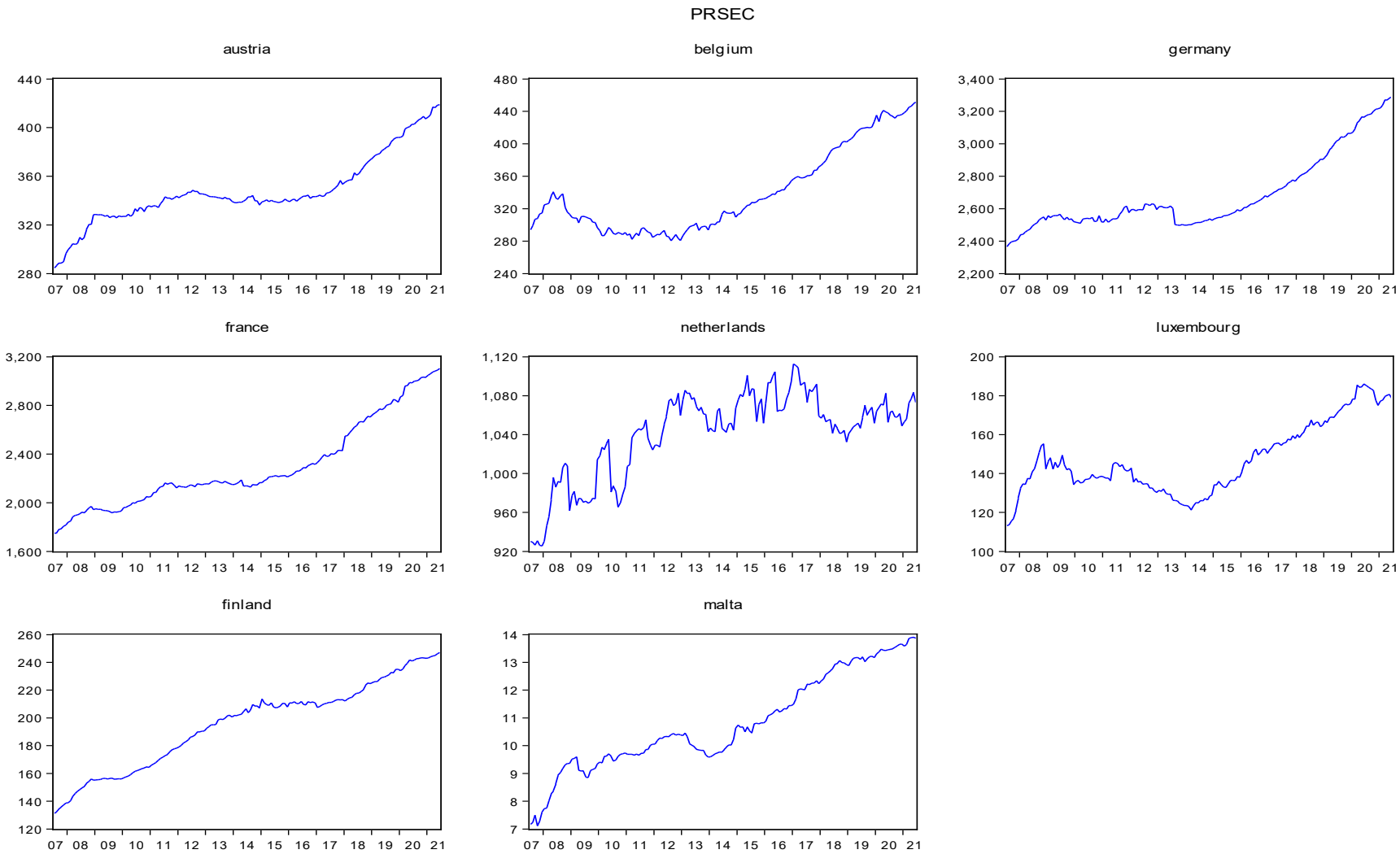



**Figure E.7** Loan stocks to private sector for each non-stressed country during the period July 2007 to June 2021, in billion euros. Source: Balance Sheet Items (BSI) database of the ECB.