Universidade de Lisboa

Lisbon School of Economics & Management


# Essays on International Economics: External balances cyclical adjustment and cross-border financial linkages

João Miguel Falcão Pinto da Silva

Supervisors:

Prof. Doutor João Luis Morais Amador

Prof. Doutor Miguel Pedro Brito St. Aubyn

Thesis specially designed to obtain the doctor's degree in Economics.

2022

Universidade de Lisboa

Lisbon School of Economics & Management



# Essays on International Economics: External balances cyclical adjustment and cross-border financial linkages

João Miguel Falcão Pinto da Silva

Supervisors:

Prof. Doutor João Luis Morais Amador

Prof. Doutor Miguel Pedro Brito St. Aubyn

Thesis specially designed to obtain the doctor's degree in Economics

Júri:

Presidente:

Doutor Nuno João de Oliveira Valério

Professor Catedrático e Presidente do Conselho Científico

Instituto Superior de Economia e Gestão da Universidade de Lisboa

Vogais:

Doctor Aurel Schubert

Honorary Professor

Vienna University of Economics and Business, Wien

Doutor Luís Manuel Moreira de Campos e Cunha

Professor Catedrático

Nova School of Business and Economics da Universidade de Lisboa

Doutor António Manuel Pedro Afonso

Professor Catedrático

Instituto Superior de Economia e Gestão da Universidade de Lisboa

Doutor Miguel Pedro Brito St. Aubyn

Professor Catedrático

Instituto Superior de Economia e Gestão da Universidade de Lisboa

Doutora Ana Paula Ferreira Ribeiro

Professora Auxiliar

Faculdade de Economia da Univeridade do Porto

2022

**Abstract**

International economics focuses on the linkages among economic agents who are resident in different countries. The analysis of external interactions has become more important over the last decades with the increase of the economic interdependence as a result of the globalization phenomenon. These connections are summarized in international accounts and are classified as transactions when both parties (a resident and a non-resident economy) agree on the creation, transformation, exchange, transfer, or extinction of economic value, involving changes in ownership of goods and/or financial assets, the provision of services, or the provision of labour and capital.

Moreover, the international transactions are distinguished between non-financial and financial transactions. The non-financial transactions are related with the trade in goods and services, the payments to non-resident production factors or simply transfers, under which different countries exchange 'something for nothing' (e.g., migrants' remittances). The exchange of financial assets/liabilities between two different countries is considered a financial transaction (e.g., the issuance/redemption of a bond). This type of transactions give rise to an end-of-period stock, the International Investment Position. The International Investment Position is also influenced by other economic flows, such as revaluations (price changes or exchange rate changes) and other adjustments. Although transactions are characterized by the existence of an agreement (or compulsory transfers), other flows are driven by market conditions in the case of revaluations (the exchange rate market, for e.g.), or by other factors like the existence of a bankruptcy, defined as other adjustments.

The globalization has created very strong interdependences between nations based on economic linkages as, for example, international trade, among residents in different countries. Understanding the economic interactions established between one country and the rest of the world is crucial to support good policy making decisions and to prevent global economic and financial crises. Nevertheless, analysing economic links at an aggregate level, may not reflect the existence of asymmetries at an individual level (between one country and its trade partners). Therefore, it is essential to complement the aggre-

gate analysis, with an individual perspective focused on bilateral relationships between each economy and its partners.

Since 2020, due to the pandemic Covid-19, international linkages like travel have

diminished due to the existence of mobility restrictions, and new forms were strengthened (the e-Commerce for e.g.). Nevertheless, these restrictions will not last forever and new forms of international economic and financial interactions will certainly exist in the future. The analysis of international linkages is crucial to (re)design the international trade and to promote the economic welfare. This thesis focuses on the aggregate and bilateral perspective of financial and non-financial interactions among the world economies and contributes to the literature in three different ways.

Chapter 1 uses the methodology suggested by Fabiani *et al.* (2016) to compute cyclically-adjusted current account balances for the Portuguese economy in the period 1995-2017. The methodology makes use of domestic and foreign output gaps, export elasticities and the import content of domestic demand, distinguishing between cyclically-adjusted exports and imports. In addition, we compute the cyclically-adjusted bilateral exports and imports relative to the main Portuguese trade partners. We conclude that the strong current account adjustment observed in the Portuguese economy after 2010 was mainly non-cyclical, though a positive effect resulting from cyclical developments was also observed.

Chapter 2 computes the cyclical-adjusted trade account balances for a set of economies focusing on two distinct periods: before the 2008 global economic and financial crisis and during this crisis. The methodology goes beyond the Chapter 1 methodology and uses a bilateral approach to measure the cyclically adjusted trade accounts. The results suggest that, although global imbalances reduced at a global level, there are asymmetric adjustments across countries. Moreover, the cyclical adjustment of the current account during the financial crisis period was higher than in the previous years for many countries. On an individual basis, the United States plays the most important role of the bilateral cyclical adjustment.

Finally, Chapter 3 considers cross-country linkages between banking sys-

tems to assess the cascading effects that emerge from shocks. Stylized shocks involve a reduction of liabilities from a banking system in a country towards others. The negative effects on the net assets of other banking systems, if beyond a given threshold, will trigger a reduction of their own liabilities and the sequential propagation of the initial shock. No other endogenous economic effects are considered. The stylized exercise uses data for cross-border assets and liabilities in a sample of twenty-four countries in 2018. Results highlight the United Kingdom as the most affected country in the event of a systemic shock in each of the G7 plus China group. Moreover, the stylized simulations indicate that the United States is the country whose potential shocks are the most powerful to affect aggregate world cross-border claims of banking systems.

**Keywords: Cyclical adjustment, Bilateral adjustment, External Balance, Financial crisis, Systemic shocks**

# Resumo

A economia internacional centra-se nas interações entre agentes económicos residentes em diferentes países. A importância da análise das relações externas entre os vários países, tem vindo a ganhar maior importância ao longo das últimas décadas, com o aumento da interdependência económica em virtude do fenómeno da globalização. Estas ligações encontram-se espelhadas nas estatísticas externas sendo classificadas como transações sempre que ocorre a criação, transformação, troca, transferência ou extinção de valor económico, ou alterações de propriedade entre bens e/ou ativos financeiros, na prestação de serviços ou na prestação de mão-de-obra e capital entre duas entidades residentes em países diferentes.

De acordo com a classificação existente, as transações internacionais distinguem-se entre transações não-financeiras e transações financeiras. As transações não-financeiras estão relacionadas com o comércio de bens e serviços, com os pagamentos a fatores de produção não residentes ou simplesmente com transferências, não existindo necessariamente uma compensação dessas trocas como, por exemplo, as transferências efetuadas por emigrantes (remessas). A troca de ativos/passivos financeiros realizada entre dois ou mais países diferentes, é considerada como operação financeira (por exemplo, a emissão/reembolso de uma obrigação). Estas transações dão origem a uma posição no final de cada período designada por Posição de Investimento Internacional. A Posição de Investimento Internacional é também influenciada por outros fluxos económicos além das transações, designadamente as reavaliações (variações de preço ou variações cambiais) e outros ajustamentos. Embora as transações se caracterizem pela existência de um acordo (ou assumem um carácter obrigatório), os outros fluxos são influenciados por condições de mercado

como, por exemplo, no caso das reavaliações (o mercado cambial), ou por outros fatores, como a existência de uma falência, designados como outros ajustamentos.

A globalização criou interdependências fortes baseadas em ligações económicas, nomeadamente associadas ao comércio internacional entre entidades residentes em diferentes países. Consequentemente, a compreensão das interações económicas estabelecidas entre um país e o resto do mundo, é crucial para apoiar boas decisões de política e antecipar futuras crises económicas e financeiras. No entanto, e uma vez que a análise das ligações económicas, a nível agregado, pode não refletir as assimetrias que se verificam na relação de um país com cada um dos seus parceiros, torna-se essencial complementar a análise agregada com uma perspetiva individual, focada na relação bilateral dos vários países com cada um dos seus parceiros comerciais.

Desde 2020, devido à pandemia Covid-19, as ligações internacionais (como o turismo, por exemplo) diminuíram devido à existência de restrições à mobilidade, ou novas formas de comércio internacional ganharam maior importância, como o caso do comércio online. No entanto, estas restrições não irão durar sempre e, no futuro, existirão seguramente novas formas de interações económicas internacionais. Por conseguinte, a análise das ligações externas é crucial para (re)configurar o comércio internacional e promover o bem-estar económico. Esta tese centra-se, assim, na perspetiva agregada e bilateral das relações financeiras e não financeiras entre as economias e contribui para a literatura de três maneiras diferentes.

O Capítulo 1 utiliza a metodologia sugerida por Fabiani *et al.* (2016) para calcular o saldo da balança corrente ajustada do ciclo económico para a economia portuguesa no período 1995-2017. A metodologia utiliza os hiatos do produto domésticos e externos, elasticidades de exportações e o conteúdo importado da procura interna, distinguindo entre exportações e importações ajustadas do ciclo económico. Adicionalmente, calcula-se o ajustamento cíclico para as exportações e importações bilaterais face aos principais parceiros comerciais de Portugal. Concluímos que o forte ajustamento registado no saldo da balança corrente Portuguesa após 2010 teve uma natureza eminentemente estrutural, embora também tenha existido um efeito positivo resultante dos desenvolvimentos cíclicos.

O Capítulo 2 calcula o saldo da balança corrente ajustada do ciclo económico para um conjunto de economias considerando, para o efeito, dois períodos distintos: antes da crise económica e financeira global de 2008 e durante esta crise. A metodologia utilizada neste capítulo complementa a que foi considerada no Capítulo 1, contemplando uma abordagem bilateral no apuramento do ajustamento ao ciclo económico. Os resultados sugerem que, embora os desequilíbrios globais diminuam a nível global entre os dois períodos considerados, existem ajustamentos assimétricos entre os vários países. Adicionalmente, durante o período de crise financeira o ajustamento da balança corrente ao ciclo económico foi maior do que nos anos anteriores para muitos países. Numa perspetiva individual, os Estados Unidos desempenham o papel mais importante no ajustamento da balança corrente ao ciclo económico para a maior parte dos países considerados.

Finalmente, o Capítulo 3 foca-se numa perspetiva financeira e considera as ligações entre os sistemas bancários para avaliar os efeitos em cascata que emergem dos choques. A existência de choques nos sistemas bancários envolve uma redução do passivo de um sistema bancário num país relativamente aos outros. Os efeitos negativos sobre os ativos líquidos de outros sistemas bancários, irão potencialmente (se ultrapassarem um determinado limite) desencadear subsequentes reduções do seu passivo e a propagação do choque inicial por vários países e vários períodos. Na metodologia desenvolvida, não são considerados outros impactos económicos que poderiam ocorrer com os choques no sistema bancário como, por exemplo, no Produto Interno Bruto dos vários países. O exercício estilizado utiliza dados para ativos e passivos externos numa amostra de vinte e quatro países, para o ano de 2018. Os resultados destacam o Reino Unido como o país mais afetado em caso de choque sistémico em cada um dos países pertencentes ao grupo dos G7 mais China. As simulações estilizadas indicam, ainda, que os Estados Unidos são o país onde a existência de um choque no sistema bancário irá provocar perdas maiores dos ativos a nível dos sistemas bancários mundiais.

**Palavras-chave: Ajustamento cíclico, Ajustamento bilateral, Equilíbrio externo, Crise financeira, Choques sistémicos**

# Acknowledgements

The conclusion of my PHD thesis was one of my big projects, which includes an important part of my life during the past years. Nevertheless, I was not alone, and I want to dedicate this work to many people who I will never forget. I believe that the conclusion of this work is not the end, but the beginning of something...

Firstly, I must express my gratitude to my supervisors João Amador and Miguel St. Aubyn for supporting me during all this process. All the contributions, comments, discussions, corrections, and suggestions that we maintained during the preparation of this thesis were crucial to conclude this stage. Your motivation was also very important to the completeness of this work.

Secondly, I would like to thank ISEG for supporting me during all this process.

I am grateful to Filipa Lima for all the critical readings and insights. Filipa always motivated me, read one by one all the pages of this thesis, and reminded me that 'there is always a friend who tell us that everything will be ok!' Thank you for being such a good friend.

I would like also to thank to Vitor Silveira and Mar Viana for their important contributions in some specific parts of this thesis and for guiding me in the 'right direction'. Thank you also Vitor for being my friend and for your patience and presence in the good and bad moments.

I do not forget how important was João Cadete de Matos for my PHD thesis. He advised me to take this thesis in International Economics and was fundamental for my decision. As always, a very good advice! It represents the perfect match between my academic work and my experience at the Banco de Portugal. Thank

you!

Although I cannot mention here all their names, I would like also to express my gratitude to my friends. Thank you for supporting me and for being 'there' always and always. To my colleagues and many Professors (also friends) from Nova School of Business and Economics thank you for your support and motivation. I cannot also forget my students who play a very important role in this process by motivating me in each and every class.

Finally, but very important I want to dedicate this PHD thesis to my family and particularly to my sister, Ana, to my brother-in-law, Vitor, to my nephews, Maria Inês, João Francisco and Manuel Duarte, and specially to the unique parents, Abílio and Paula. They supported and cared about me every day. They were there for all my needs, all my doubts and all my certainties, always providing me the best of them. Mum and Dad, I do not have words to express how much important you are to me. During all this process many aspects of our life changed. However, we were able to resist and to succeed in all the moments together and always together. Thank you for all your love!

# Contents

**Introduction** **1**

**1 Cyclically-Adjusted Current Account - Balances in Portugal** **6**

1.1 Introduction . . . . . 6

1.2 Methodology . . . . . 11

1.2.1 Aggregate adjustment . . . . . 11

1.2.2 Bilateral adjustment . . . . . 16

1.3 Data . . . . . 17

1.4 Results . . . . . 18

1.4.1 Cyclically-adjusted exports and imports . . . . . 18

1.4.2 Detail for the main trade partners . . . . . 21

1.4.3 Robustness . . . . . 24

1.5 Final Remarks . . . . . 25

1.5.1 Elasticity of home exports to foreign GDP . . . . . 27

1.5.2 Elasticity of imports to the Imported Adjusted Demand (IAD) 29

1.5.3 Observed and cyclically adjusted exports and imports . . . . . 31

**2 Bilateral Cyclically Adjusted Trade Accounts - Before and During the Financial Crisis** **33**

2.1 Introduction . . . . . 33

2.2 Related literature . . . 40
2.3 Cyclical adjustment of the trade account . . . 45
2.3.1 Bilateral trade assumption . . . 45
2.3.2 Bilateral trade elasticities . . . 46
2.3.3 Bilateral adjustment . . . 52
2.4 Data sources . . . 53
2.5 Results . . . 55
2.5.1 Bilateral cyclical adjustment of the trade account . . . 55
2.5.2 Bilateral vs Aggregate cyclical adjustment . . . 61
2.6 Concluding remarks . . . 62

**3 Cross-Border Banking Linkages and the Cascading Effects of Crisis 65**

3.1 Introduction . . . 65
3.2 Related literature . . . 69
3.3 Data sources . . . 71
3.4 Methodology . . . 73
3.5 Results . . . 75
3.5.1 Cascading effects from crisis . . . 75
3.5.2 Robustness . . . 80
3.5.3 Network changes . . . 84
3.6 Conclusions . . . 88
3.7 Concentration of cross-border banks assets and liabilities . . . 90
3.8 Network properties . . . 92

# Introduction

Over the last decades, economic theory has pretended to analyse how countries should interact among themselves. Accordingly, international trade should exist to promote product differentiation and to produce goods / provide services in the most efficient way. One important contribution to the literature is from David Ricardo who developed the theory of comparative advantages of international trade. According to the author, countries should design the patterns of international trade based on the comparative advantages. The Ricardian model is formulated using an example with two countries Portugal and England that produce cloth and wine. According to this model, England should specialize in cloth, while Portugal in wine. The opportunity cost concept is one of the key aspects behind comparative advantages and economic specialization. According to its definition, the opportunity cost measures the relative efficiency and states that all countries can benefit if each of them specialize in the production of goods / provision of services that are relatively more efficient. By promoting economic efficiency, international trade will increase the global economic welfare.

Although the complete specialisation in international trade is unrealistic, there are important aspects in the Ricardian theory that should be considered. One of the most important aspects is to concentrate efforts to produce commodities that are costless, and to import goods or services where there is no comparative advantage. In addition, economic literature provides more contributions as for example, the Heckscher-Ohlin-Samuelson model. This model relies on the assumption of two countries, two goods and two inputs with different endowments, to explain and identify the potential winners and the losers from trade.

In the previous decades international trade has assumed a crucial role in the economic decision and it has been accelerated by the globalization phenomenon, which is one of the most challenging but also interesting economic process. It involves many players and different international linkages, that change over time. Analysing international linkages is very important to identify the strengths and weaknesses of each economy, and to promote economic prosperity.

In the context of international trade, economic decisions should not consider only the self-decision of the domestic country, but also external actions from other players. In this respect, to fully understand the different perspectives involved, two main approaches (aggregate and bilateral) should be considered. The aggregate approach enables to analyse the international linkages from a country perspective vis-à-vis the rest of the world. Complementary, the bilateral perspective permits to identify the effectiveness of the international trade through a bilateral analysis of one country vis-à-vis its trade partners. These two approaches are also important to determine the level of macroeconomic imbalances which affects also the economic and financial stability. According to Alesina & Perotti (1995), "bad" macroeconomic imbalances are partly brought about by policy choices and indicated by large current account deficits, among other indicators. They can be considered a form of suboptimal redistribution of wealth from future to current generations, as well as from the future to the present within the same generation. Before the 2008 great recession, many countries were characterized by relevant macroeconomic imbalances in relation to their Gross Domestic Product (GDP). After the financial crisis, although there was a reduction of the aggregate macroeconomic imbalances, there existed economic discrepancies at an individual level, many countries maintained or even increased their imbalances. Another consequence of the great recession was the concern about macroprudential stability with the increase of banks' exposures to external and domestic financial risks.

Finally, one important aspect to be considered for an effective economic decision is the existence of good, reliable, and comparable statistics. As mentioned previously, the representation of the international economics is made through the

international accounts. The measurement of the international activity is considered both on the Balance of Payments that includes the current and capital balance (non-financial items) and the financial account balance (the financial components). The current and capital balance represents if a country is a net external lender or borrower corresponding to the external deficit / surplus vis-à-vis the rest of the world. In addition to the transactions recorded in the Balance of Payments, the financial account considers also other flows such as revaluations (price changes and exchange rate changes) and other adjustments. The financial transactions and other flows will determine the end-of-period stock which is defined as the International Investment Position. This indicator shows if a country is a financial creditor (if positive) or debtor (if negative) of the rest of the world. The existence of statistical data on a bilateral perspective enables to complement the aggregate analysis, with the information by trade partner country and provides the main sources/uses of financial lending/borrowing.

The need to analyse the macroeconomic imbalances and financial stability, motivated the three chapters of this document: Chapter 1 and Chapter 2 are closely related with the non-financial account of the Balance of Payments related with macroeconomic imbalances, while Chapter 3 focuses on the financial claims and financial stability aspects.

Chapter 1 addresses the cyclical adjustment of the exports and imports of goods and services - the main drivers of the current account at an aggregate level, considering the Portuguese case between 1996 and 2017. The measurement of the cyclical adjustment of the trade account uses aggregate trade elasticities for both Portuguese exports and imports of goods and services. In addition, it calculates bilateral trade elasticities to determine the cyclical adjustment of Portugal vis-à-vis some important trade partners. The results suggest that the strong current account adjustment observed in the Portuguese economy after 2010 was mainly non-cyclical, though a positive effect from cyclical developments is also observable. Taking the average of the period 2012-2017, the cyclically adjusted current account balance lies 1.2 p.p. below the observed balance.

On a country level, Chapter 2 assesses if the financial crisis impact on the correction of global imbalances is also observable on a bilateral trade account dimension (bilateral exports and imports of each country vis-à-vis the main trade partners) by using a set of twenty-five countries. This analysis focuses on two main periods before the financial crisis (between 1996 and 2006) and during the financial crisis (2007-2011). The results suggest that during the financial crisis the cyclical adjustment was higher for most of the twenty-five countries than the cyclical adjustment verified for the previous years. At a country level, the United States and Japan were the key drivers to the cyclical adjustment before and during the financial crisis within the set of G7+China economies. Chapter 2 includes also a comparison with the methodology used in Chapter 1 for Portugal, that illustrates that the two models are consistent.

Finally, Chapter 3 focuses on the financial side of the international linkages. It considers the financial interlinkages through banks' cross-border claims in 2018. In addition, it simulates the impact of shocks in bank's cross-border holdings in each of the G7+China countries and assesses the impact on others along time. The results show that United Kingdom is the most affected country in the event of shocks in each G7+China countries. In addition, the United States imposes the most relevant damages on international banking systems. Other interesting result is that when comparing the impacts of United States banking systems on others, China emerges as the country mostly affected.

# Chapter 1

# Cyclically-Adjusted Current Account - Balances in Portugal

## 1.1 Introduction

The increase of the current account balance after 2010 is one of the major features of the macroeconomic rebalancing of the Portuguese economy, which took place in the context of the Portuguese Economic and Financial Assistance Program, implemented in the aftermath of the sovereign debt crisis in the euro area. According to the statistics of the Balance of Payments, the Portuguese current account balance evolved from a deficit of approximately 10 per cent of GDP in 2010 to a surplus of 0.5 per cent of GDP in 2017. Sizable current account adjustments have also taken place in other European Union (EU) countries. In this context, an important question is whether such developments resulted from a structural adjustment or simply from cyclical developments. This article tries to answer this question for the Portuguese economy.

Current account imbalances and subsequent external financing difficulties have been recurrent in Portugal over the last six decades. In 1977-78 and 1983-84 Portugal underwent economic stabilization programs with the International Monetary

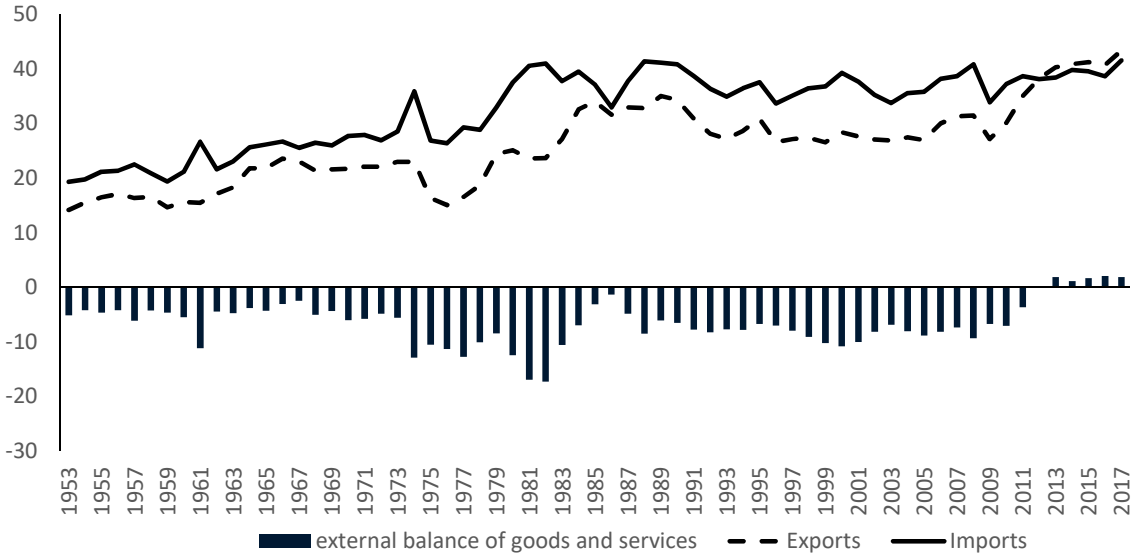
[0]This chapter was written in co-authorship with João Amador.

Fund (IMF). Low private savings, important investment needs and fiscal imbalances repeatedly boiled down to deficits in the external accounts and sizable external financing requirements.

Figure 1.1 plots the share of exports, imports and the balance of goods and services as a percentage of GDP in a historical perspective. Economic developments in the Portuguese economy in the nineties and in the first decade of this century were characterized by large current account deficits that led to a strong deterioration of the net International Investment Position, which reached -108 per cent of GDP in 2009. The decreasing interest rates associated to the transition to a low inflation regime, on the way to the accession to the monetary union, greatly expanded domestic demand and this was aggravated by a pro-cyclical fiscal stance. The higher imports associated with the growing domestic demand coincided with a reshuffling of comparative advantages that led to a sizable loss of export market. This was motivated by the EU enlargement to Central and Eastern European countries and strong Asian competition. Moreover, the sluggish adjustment to the macroeconomic imbalances and the slow shift of resources from the non-tradable into the tradable sector implied a prolonged exposure to external risks, which materialized with the 2008 economic and financial crisis. The sudden-stop of external financing in some euro area countries and the self-reinforcing loop between bank and sovereign debt risks threatened the monetary union (see, for example, Salto & Turrini (2010)). In Portugal, the strong difficulties to access external financing led to an external assistance program in 2011 involving the European Commission, European Central Bank, and the IMF, which included conditionality in several areas.

The period after 2011 has been characterized by improvements in the Portuguese external balance. As visible in Figure 1.1, these developments have been quite significant in historical terms. The small surpluses recently recorded in the balance of goods and services are in striking contrast with the large deficits of the last decades. Nevertheless, the adjustment of the Portuguese external balance took place in a context of contraction of economic activity, thus raising concerns about its sustainability in the recovery phase of the cycle. A complementary issue is the

Figure 1.1: Balance of goods and services as a percentage of GDP in Portugal 1952-2017




Source: Banco de Portugal (Séries Longas and BPStat; Statistics of the Balance of Payments)

impact on the balance of goods and services of economic developments in the main trade partners, for example, to what extent the domestic adjustment in external accounts was made harder by parallel improvements in the current account balance of trade partners.

The literature comparing structural and cyclical current account balances has been growing in the last years. Initial methodological contributions were those of Sachs (1981) and Buiter (1981), while Obstfeld & Rogoff (1995) approached this topic from an intertemporal perspective. Several empirical applications, mostly basing on the relationship between external balances and the savings-investment gap, discuss the medium-term and long-term determinants of current account balances in industrial and developing external economies (e.g. Faruqee & Debelle, 1996, Chinn & Prasad, 2003, Gruber & Kamin, 2005, Ca' Zorzi *et al.*, 2009, Milesi-Ferretti & Blanchard, 2011). More recently, Serranito & Gossé (2014) concluded that the short-term determinants of the current account are different from the long-term determinants for the OECD countries. According to the authors, the fundamental determinants of current account balances for the OCED countries are the competitiveness effects, the oil prices and the productivity gaps. Although, in the long-run,

current account balances are driven by the fiscal balance and the level of financial market development among other determinants.

The literature presents two main methods of adjusting the current account balance for the impact of the cycle. The first method bases on the estimation of regressions where the current account balance is correlated with a set of demographic, macroeconomic, financial and institutional variables. The structural current account is obtained by applying the estimated coefficients to the (medium-term) trend values of the explanatory variables. This approach typically considers a panel of countries over a long period of time. Alternatively, it is possible to obtain the cyclical adjustment by estimating a short-run equation with the lagged current account balance and a set of variables that do not affect structural positions but have a short-run influence on the current account.

International organizations have been using and developing this type of methods. The IMF Consultative Group on Exchange Rates (CGER) and its most recent External Balance Assessment (EBA) method are a good example (see Phillips *et al.* (2013)). The European Commission has been using a method broadly similar to that of the IMF EBA, producing specific policy indicators. The OECD has also been using this type of methodology. In particular, Cheung & Rusticelli (2010) assess the link between structural and cyclical determinants of current account balances using panel data on dimensions like differences in demographics, fiscal positions, oil dependency and stage of economic development, amongst others. Tamara (2016) refers the caveats of this type of methodology, pointing out that current account balances are estimated directly, considering both fundamental and shorter-term factors. In addition, Ollivaud & Schwellnus (2013), estimate separately each current account component. They conclude that business and housing cycles represent half of the decline in international imbalances, while real exchange rate and fiscal adjustments are residual. Therefore, structural reforms can be important to stabilize the economy under a boom in the housing market for example. Although the EBA framework is considered a strongly integrated and robust current account predictor, it is sensitive to data sources and endogeneity problems between current account

balances and output gaps may arise. Moreover, this methodology does not consider the heterogeneity between countries neither, as mentioned by Sastre & Viani (2014), competitiveness factors.

The second method of computing structural current account balances focuses on the goods and services account and bases on international trade elasticities. A strong advantage of this approach is the possibility of adjusting separately the export and import components of the current account. Haltmaier (2014) quantifies the cyclical part of the current account balance for several countries by estimating a long-run (or trend) elasticity from a co-integration relationship between trade and income, as well as a short-run (or cyclical) elasticity.[1] The caveats of this approach lie on the uncertainty and revisions associated to output gaps and trade elasticities. In addition, it should be highlighted that the adjustments resulting from the methodology relate exclusively to the output gaps, i.e., all other changes in exports or imports attributable to temporary aspects are included in the structural component. This partly explains the moderate deviations between observed and cyclically-adjusted current account balances. Overall, the two methodological approaches should be taken as complementary and not as substitutes.

An important contribution to the latter strand of literature is that of Fabiani *et al.* (2016), which suggests a model that relies on trade elasticities for exports and imports. The authors focus on the Italian case but also apply the methodology to France, Germany and Spain. According to the results, the overall balancing of the Italian external accounts has largely been of a non-cyclical nature, with a positive contribution coming from the decline in the prices of energy commodities. For the other countries considered, they find that current account imbalances over the recent period are amplified when assessed in cyclically-adjusted terms. One important feature of Fabiani *et al.* (2016) is the explicit consideration of the composition effects associated with the different components of domestic demand, as suggested by Bussière *et al.* (2013).

[1] The effects of foreign and domestic output gaps on real exchange rate deviations are used in other models, such as Wu (2008) and Kara & Sarikaya (2013).

As for Portugal, Afonso & Silva (2017) studied the decomposition of the current account between cyclical and structural components, using Germany as a benchmark to assess its determinants. More recently, Afonso & Jalles (2018) distinguished between cyclical and non-cyclical current account determinants using a set of financial and non-financial variables, determined time-varying elasticities for exports and imports on a country basis.

In this chapter we apply the methodology suggested by Fabiani *et al.* (2016) to the Portuguese economy in the period 1996-2017. We consider the cyclical adjustment of the current account, both for exports and imports. However, we do not discuss elements associated with energy prices nor with the income account. Nevertheless, we go beyond Fabiani *et al.* (2016) by calculating the adjusted exports and imports relatively to the main Portuguese trade partners, making use of estimated bilateral trade elasticities.

The rest of the article is organized as follows. In the next section, Section 1.2, we briefly describe the methodology used for the cyclical adjustment of exports and imports, as suggested by Fabiani *et al.* (2016). Section 1.3 identifies the data sources. The following section, Section 1.4 presents the results obtained in aggregate terms, details relatively to the main trade partners and discusses their robustness by using different output gaps and trade elasticities. The last section, Section 1.5 offers some concluding remarks.

## 1.2 Methodology

### 1.2.1 Aggregate adjustment

This section closely draws on Fabiani *et al.* (2016) to explain the main features of the model that generates the expressions used for the elasticity of exports and imports to foreign and domestic output gaps, respectively. We start from the basic definition of the current account balance (CAB):

$$CAB = Exports - Imports + BPI + BSI \tag{1.1}$$

where $BPI$ and $BSI$ stand for "Balance of Primary Income" and "Balance of Secondary Income", respectively. Nevertheless, our adjustment focuses exclusively on the goods and services account. In terms of notation, the home and foreign economies are presented as $H$ and $F$, respectively. Moreover, current and potential GDP in the home country, in real terms, are identified as $Y$ and $Y^*$, respectively. In the same way $X^*$ and $M^*$ stand for potential exports and imports in the home economy, in real terms. In addition, nominal variables are denoted as the product of the real counterpart and the corresponding price index.

As in Fabiani *et al.* (2016), home imports and exports are taken to be *isoelastic*, which means that an exogenously given constant long-run elasticity is assumed. Therefore, if the foreign (home) GDP increases by one percent, exports (imports) increase by $\Delta X(\Delta M)$ percent. Starting with the export side, potential exports in real terms are obtained as:

$$\begin{aligned} X^* &= X + \Delta X = \\ &= X\left(1 + \frac{\Delta X}{X}\right) = X\left(1 + \theta_x \times \frac{\Delta Y^F}{Y^F}\right) = X\left(1 + \theta_x \times \frac{-y^F}{1+y^F}\right) \end{aligned} \tag{1.2}$$

where $\Delta X$ and $\Delta Y^F$ are the differences between observed and prevailing levels of real exports and real foreign output at the potential (i.e., distances to the potential and not changes between consecutive periods), respectively, and $\theta_x$ represents the long-run elasticity of exports to foreign real GDP. In addition, the definition of the foreign output gap $y^F = (Y^F - Y^{*F})/Y^{*F}$ establishes the last term in equation (1.2):

$$\frac{\Delta Y^F}{Y^F} = \frac{-y^F}{1+y^F} \tag{1.3}$$

Next, assuming that prices ($P_X$ and $P_Y$) are unchanged, the cyclically adjusted nominal exports ($x^{adj}$) is obtained by multiplying the unadjusted export share on GDP ($x$, computed in nominal terms) by the ratio of potential to actual real exports:

$$x^{adj} = \frac{P_X X^*}{P_Y Y} = \frac{P_X X}{P_Y Y} \times \frac{X^*}{X} = x\frac{X^*}{X} \tag{1.4}$$

Finally, combining equations (1.2) and (1.4), we write cyclically adjusted exports as:

$$x^{adj} = x\left(1 - \theta_x \frac{y^F}{1+y^F}\right) \tag{1.5}$$

The key exogenous variable is the foreign output gap $y^F$ and the intuition is straightforward: the cyclical adjustment of exports depends negatively on the foreign output gap. If Portuguese trade partners' output is higher than their potential, they will import more and consequently domestic exports benefit from the cycle. The crucial export elasticity is based on the cross-country panel regression in Bussière *et al.* (2013).[2] In the Appendix 1.5.1 we present the methodology and results for the elasticities of home exports to foreign GDP ($\theta_x = 2.6$).

If home imports are assumed to be isoelastic to home GDP, an expression similar to that used for exports could be applied to determine cyclically-adjusted imports. However, as stated by Fabiani *et al.* (2016), this would be a very strong simplification for the import side. Imports are activated by demand, rather than GDP, thus it may be misleading not to distinguish between components of demand in order to allow for their different import intensities.

Bussière *et al.* (2013) suggests a new measure that reflects the import intensity of the different components of domestic expenditure and the import content of exports. This import intensity-adjusted measure of demand is labelled as $IAD$, and it is constructed for each country as:

$$IAD_t = C_t^{\omega_{C,t}} G_t^{\omega_{G,t}} I_t^{\omega_{I,t}} X_t^{\omega_{X,t}} \tag{1.6}$$

where $C$ stands for private consumption, $G$ for government consumption, $I$ for investment, and $X$ for exports. The weights, $\omega_{k,t}$, with $k = C, G, I, X$ are the total

[2]In the panel regression we considered the following OECD countries: Australia; Belgium; Canada; Finland; France; Germany; Italy; Japan; Korea; Netherlands; New Zealand; Norway; Spain; Sweden; United Kingdom; United States. These were also the countries considered by Bussière *et al.* (2013), except for Denmark, for which the information was not fully available. The foreign output gap is the weighted average of individual output gaps with weights proportional to the share of these countries in Portuguese exports.

import contents of these final demand components. These weights are time-varying and normalized in each period such that their sum equals one.

Bussière *et al.* (2013) model imports as being activated by a geometric weighted average of the various demand components, with weights reflecting their relative import contents. The authors present rolling-window estimates confirming that the assumption of a stationary, time-invariant long-run elasticity of imports is reasonable only in the case of the IAD variable, whereas the long-run elasticity of imports to GDP shows an increasing trend. In this chapter, the IAD approach is implemented in a reduced-form approach, as in Fabiani *et al.* (2016). While the original version separately considers four components of demand (private consumption, public consumption, investment, exports), we just isolate the component that typically shows the highest import intensity: exports. This approach has also been used by Christodoulopoulou & Tkacevs (2016).

As in the case of exports, real imports are assumed to be isoelastic relatively to the reduced form $IAD$ variable, which is a convex combination of exports and domestic demand (in log terms). Therefore, the growth rate of imports is given by:

$$\frac{\Delta M}{M} = \theta_M^{IAD} \frac{\Delta IAD}{IAD} = \theta_M^{IAD} \left[ \omega_x \frac{\Delta X}{X} + (1 - \omega_x) \frac{\Delta DD}{DD} \right] \tag{1.7}$$

where $\theta_M^{IAD}$ is the constant long-run elasticity relatively to imports, which is calibrated using the regressions suggested in Bussière *et al.* (2013), $\omega_x$ is the weight of exports in building the $IAD$ variable, and $DD$ stands for domestic demand (the aggregation of private and public consumption and investment). As in Bussière *et al.* (2013) we compute the import intensity of each $IAD$ component with global input-output tables, using a linear interpolation to construct quarterly series and normalizing so that they sum to unity.

Taking $\Delta$ as the difference between potential and current levels of the variables, potential imports are defined as:

$$M^* = M + \Delta M = M + \theta_M^{IAD} \omega_x \left( \frac{M}{X} \right) \Delta X + \theta_M^{IAD} (1 - \omega_x) \left( \frac{M}{DD} \right) \Delta DD \tag{1.8}$$

where $\theta_M^{IAD} = (\Delta IAD / IAD)/(\Delta Y / Y)$.

Similarly to what was done for export elasticities, the methodology and panel regression results for the elasticity of $IAD$ are presented in Appendix 1.5.2 ($\theta_M^{IAD} = 1.48$). Next, equation 1.8 can be simplified to:

$$M^* = M + \eta_X(X^* - X) + \eta_D(DD^* - DD) \tag{1.9}$$

where $\eta_X = \theta_M^{IAD}\omega_x\frac{M}{X}$ and $\eta_D = \theta_M^{IAD}(1-\omega_x)\frac{M}{DD}$.

Considering the national accounts identity $Y^* = DD^* + X^* - M^*$ and including equation (1.9) we obtain:

$$Y^* = DD^* + X^* - [M + \eta_X(X^* - X) + \eta_D(DD^* - DD)] \tag{1.10}$$

then, solving with respect to $DD$ it is possible to write equation (1.9) as:

$$M^* = M + \frac{\eta_D(Y^* - Y)}{1-\eta_D} + \frac{(X^* - X)(\eta_X - \eta_D)}{1-\eta_D} \tag{1.11}$$

Equation (1.11) expresses the level of imports that would prevail if domestic and foreign output were jointly taken at their potential level, thus simultaneously determining (home) exports and domestic demand. These are the two components of aggregate demand that activate imports, each with a specific intensity. Moreover, the relative share of potential domestic demand and potential exports determine potential imports and are coherent with potential output.

As in the case of exports, the ratio between potential and actual imports in real terms is sufficient to pin down cyclically-adjusted nominal imports (nominal potential imports as a percentage of nominal unadjusted GDP):

$$m^{adj} = \frac{p_M M^*}{p_Y Y} = \frac{p_M M}{p_Y Y}\frac{M^*}{M} = m\frac{M^*}{M} \tag{1.12}$$

where $m$ denotes the unadjusted import share on GDP (computed in nominal terms). Finally, the adjusted current account, which is the ultimate object of interest, is given by:

$$ca^{adj} = x^{adj} - m^{adj} + bpi + bsi, \tag{1.13}$$

where $bpi$ and $bsi$ denote the unadjusted balance of primary income and secondary income, as percentage of GDP.

### 1.2.2 Bilateral adjustment

In this chapter, we go beyond the methodology previously presented and take a bilateral perspective. Conceptually, this is not different from what was described above, though it involves explicitly considering the output gap of the different trading partners and the structure of imports originating from them. Therefore, there is a larger number of (bilateral) import elasticities to be estimated.

On the export side, the cyclically adjusted exports of country $i$ (home) to country $j$ are obtained as:

$$x_{ij}^{adj} = x_{ij}\left(1 - \theta_x \frac{y_j}{1 + y_j}\right) \tag{1.14}$$

where $x_{ij}$ represents the unadjusted bilateral exports of country $i$ to country $j$ on home GDP. As before, we assume that the long-run elasticity of exports is the same for all countries: $\theta_x = 2.6$. The main difference is that the adjustment of bilateral exports relies on the foreign output gap which, in this case, is considered to be the individual output gap of country $j$ and not a weighted average of those of the main trade partners.

The cyclical adjustment of imports of country $i$ from country $j$ is given by:

$$m_{ij}^{adj} = m_{ij}\frac{M_{ij}^*}{M_{ij}} \tag{1.15}$$

where $m_{ij}$ represents the unadjusted bilateral imports of country $i$ from country $j$ on GDP of country $i$ and $M_{ij}^*$ measures the bilateral potential imports, which are defined as:

$$M_{ij}^* = M_{ij} + \frac{\eta_{ij}^D(Y^* - Y)}{1 - \eta_{ij}^D} + \frac{(X_{ij}^* - X_{ij})(\eta_{ij}^X - \eta_{ij}^D)}{1 - \eta_{ij}^D} \tag{1.16}$$

In addition, bilateral elasticities are given by:

$$\eta_{ij}^X = \theta_{Mij}^{IAD}\omega_x\frac{M_i}{X_i} \tag{1.17}$$

and

$$\eta_{ij}^D = \theta_{Mij}^{IAD}(1 - \omega_x)\frac{M_i}{DD_i} \tag{1.18}$$

where $\theta_{Mij}^{IAD}$ represents the bilateral elasticity of the $IAD$ variable.

## 1.3 Data

The implementation of the methodologies described in the previous section required a large amount of statistical information and some hypotheses. Firstly, the source of comparable cross-country data was the OECD Economic Outlook (November 2018). In particular, we used quarterly data from Q4 1995 until Q4 2017 for the volumes of GDP and its components: government consumption, private consumption, gross total fixed capital formation, imports and exports of goods and services. Moreover, we collected the corresponding deflators of GDP and total imports of goods and services.

Secondly, the information on the domestic and foreign output gaps, which are key elements in the methodology, was collected from the IMF World Economic Outlook (April 2018). It is widely acknowledged that estimates of output gaps depend on the method used for computation (statistical or structural methods) and are sensitive to revisions of data.[3] For this reason in Subsection 1.4.3 we evaluate the results obtained with different output gaps for the Portuguese economy. Nevertheless, in order to ensure the consistency of results we take a common statistical source for domestic and foreign output gaps: the IMF World Economic Outlook.

Thirdly, the estimation of the long-run elasticity of the $IAD$ requires information contained in global about input-output matrices. For this purpose, we used the $2016^{th}$ edition of the OECD Inter-Country Input-Output database (ICIO), which includes information for a total of 71 countries and 34 industries (according to a classification based on ISIC Rev3) on an annual basis from 1995 until 2011.

Finally, bilateral trade flows are not available in existing databases. Therefore, to break down the aggregate of total real imports in the OECD database, we assume that the share of each country on nominal and real Portuguese total imports is equal. The shares of the different partners in nominal trade flows are taken from Portuguese National Statistics (INE).

[3]For a discussion on output gap methodologies with an emphasis on Portugal see Banco de Portugal, BdP (2017).

## 1.4 Results

In this section, we present the results for the cyclically-adjusted current account balance of the Portuguese economy between 1995 and 2017. Firstly, we present the results for trade elasticities estimations. Secondly, we separately examine the adjustment for exports and imports. Thirdly, we compute the cyclical adjustment of exports relatively to the main Portuguese trade partners. Moreover, we present the cyclically adjusted current account balance for different series of the Portuguese output gap. Finally, we test the impact on the cyclical adjustment that results from using different elasticities. These two exercises make it possible to evaluate the robustness of the main results, while highlighting the uncertainty underlying this methodological approach.

We estimated trade elasticities both for exports and imports according to the methodology previously described. The Appendix 1.5.1 presents the results of the elasticity of home exports to foreign GDP (Table 1.1). As in Bussière *et al.* (2013), the exports elasticity is obtained through a panel regression and is assumed to be the same for all countries. We considered only the coefficients statistically significant at a 10 percent level and obtain $\theta_x = 2.6$.[4] The elasticity of imports to the $IAD$ is also described in Appendix 1.5.2 and, using the statistically significant parameters, it is equal to $\theta_M^{IAD} = 1.48$.

### 1.4.1 Cyclically-adjusted exports and imports

Panel A of Figure 1.2 presents the series for the observed and cyclically-adjusted Portuguese exports as a percentage of GDP, basing on equation (1.5). The element that stands out is the sharp increase in the share of exports as a percentage of GDP since the turn of the century. This corresponds to the adjustment of the Portuguese productive structure to the new pattern of comparative advantages that followed the enlargement of the EU to Central and Eastern European countries and the rise

[4] In the robustness section we assess the impact of considering exactly the same export elasticity as in Bussière *et al.* (2013).

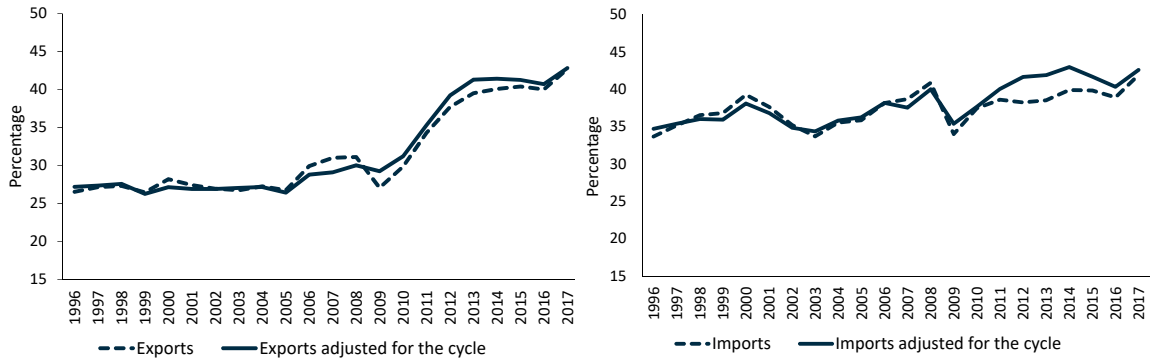
of Asian competition in the mid-nineties. Those were negative shocks to Portuguese exports and the recovery that followed started well before the economic and financial crisis of 2008 and the subsequent sovereign debt crisis in the euro area.

The cyclical developments in foreign clients did not strongly affect the path of domestic exports. In the years before the 2008 crisis, the positive foreign output gaps drove Portuguese exports above their structural level. Conversely, the problems that emerged in the aftermath of the sovereign debt crisis led the ratio of exports on GDP to increase less than potential. More recently, the dynamics of exports moderated, and they have remained close to the structural level as a percentage of GDP. Overall, the gap between observed and structural export to GDP ratios has been relatively small, never exceeding 2.2 percentage points (p.p.) in absolute terms (Appendix 1.5.3).

In panel B of Figure 1.2 we show the results for the adjustment of Portuguese imports to the domestic cycle, taking into account the structure of domestic demand, as presented in equation (1.12). The results show that from 1996 to 2008 the changes in imports of goods and services as a percentage of GDP were largely of a structural nature. Nevertheless, after this period the observed import ratio stood systematically below the structural level, meaning that the contraction of domestic demand that was associated to a negative output gap brought down imports significantly. In this period, the strongest cyclical adjustment of imports represented 3.4 p.p. of GDP in 2012 and 2013, while the smallest adjustment stood close to zero in 2006 (Appendix 1.5.3).

When the cyclical adjustment of exports and imports is combined, we obtain the proxy of the structural current account balance as a percentage of GDP for the Portuguese economy (Figure 1.3). In panel A we present the balance and in panel B the contributions of exports and imports to the difference between the adjusted and observed values. According to our results, the observed external balance stood about 0.5 p.p. of GDP lower than structural in the period 1998-2001, mostly due to the impact of the cycle on imports. From 2003 onwards the adjustment reversed (except in 2009 and 2010), amounting to 1.5 p.p. of GDP in the average of the

Figure 1.2: Cyclically-adjusted exports and imports (percentage of GDP), national accounts statistics

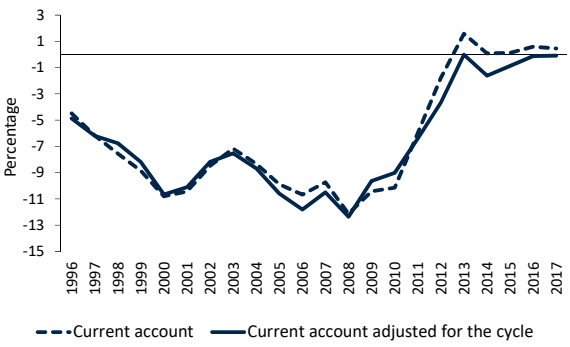



((a)) Exports ((b)) Imports

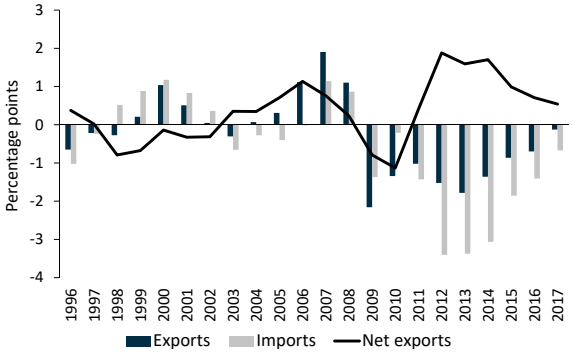
period 2012-2015 period, due to the effect of imports, which was not compensated by the fact that exports also stood below their structural level. Finally, in the most recent years the gap between adjusted and non-adjusted current account balances progressively diminished to 0.5 p.p. in 2017.

Overall, the adjustment of the Portuguese current account balance to the economic cycle is not very large. Nevertheless, a clear message is that most of the correction observed in the Portuguese current account balance in the latest years has a structural nature. Although the structural balance remains negative in the period studied, 2017 stands as the year with the second lowest deficit in the sample (-0.1 per cent of GDP).

Figure 1.3: Cyclically-adjusted current account balance (percentage of GDP), national accounts statistics




((a)) Observed and cyclically-adjusted current account balances




((b)) Contributions to cyclical adjustments

### 1.4.2 Detail for the main trade partners

The developments in the Portuguese current account balance are affected by cyclical developments in the main trade partners, notably in terms of demand for Portuguese exports. Moreover, Portuguese imports adjusted for demand differ for each trade partner. Therefore, by using the estimated bilateral elasticities, changes in the domestic output gap have a different impact on imports from each trade partner. In this subsection we take Spain, Germany and France and assess the cyclical adjustment on bilateral exports and imports.[5]

These three countries represent a large share of Portuguese international trade in the period considered. Spain, Germany and France are the three top export destinations and import origins, representing together 60 and 70 per cent of these aggregates in 2017, respectively.

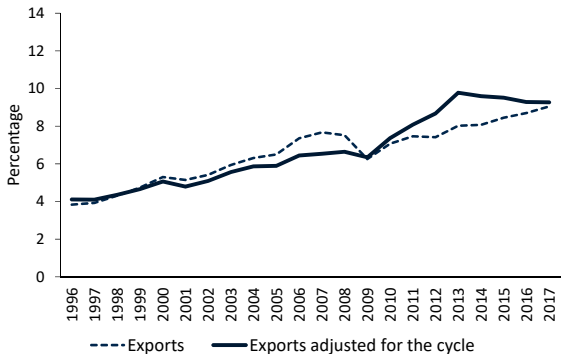
Figure 1.4 presents the results for the three countries and shows some differences. Spain (panels A and B), which has been reinforcing its role as the main trade partner, is the country where the distance between the observed and structural exports a percentage of GDP is higher. The structural exports stood above the observed ratio

[5]Bilateral $IAD$ coefficients estimated for Spain, Germany and France vis-à-vis Portugal are: $\theta^{IAD}_{M_{ESP}} = 0.94$; $\theta^{IAD}_{M_{DEU}} = 1.57$; $\theta^{IAD}_{M_{FRA}} = 0.84$.

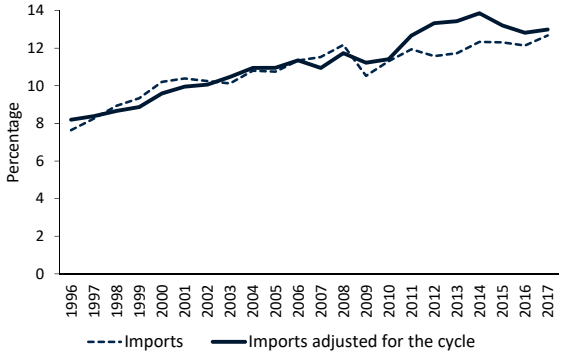
in the years before the sovereign debt crisis but turned significantly below trend afterwards due to the downturn in the Spanish economy, while correcting its own macroeconomic imbalances. Nevertheless, this gap has diminished in 2017. As for Portuguese structural imports from Spain, they stood slightly above the observed ratio up to the sovereign debt crisis, but the severe downturn of the Portuguese economy reversed this situation. Overall, the adjustment in exports and imports partly offset each other, which should be seen as a normal situation among strongly integrated economies, whose business cycles are synchronized.

Relatively to Germany, which has broadly stabilized its importance as a Portuguese trade partner, the adjustments in exports are very small (panel C). This is partly explained by the fact that this country was not significantly affected by the sovereign debt crisis in the euro area. As for imports, the adjustment is important and results from the high bilateral elasticity estimated for the import content of domestic demand components (panel D). As for France (panels E and F), whose share in Portuguese exports has increased very significantly in the latest years, structural exports and, mostly, imports stood above what was observed.

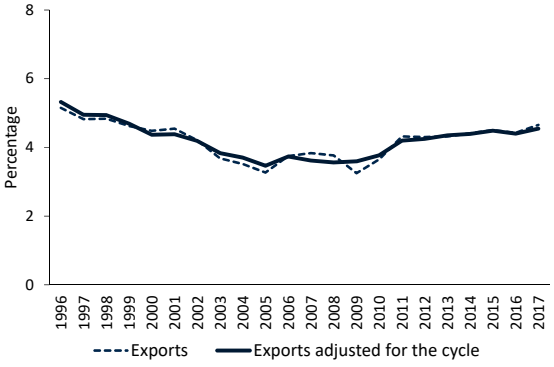
Figure 1.4: Cyclically-adjusted exports/imports vis-à-vis Spain, Germany and France (percentage of GDP)



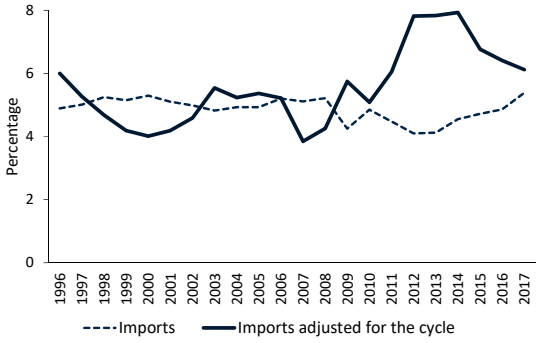

((a)) Spain - exports



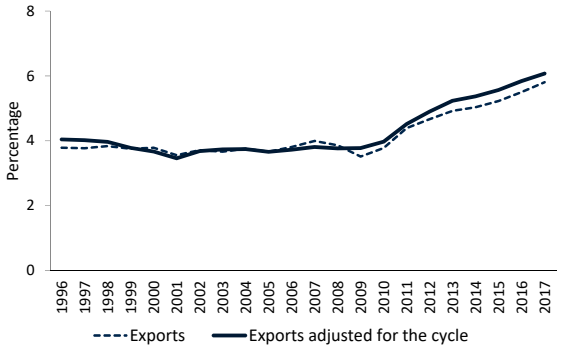

((b)) Spain - imports



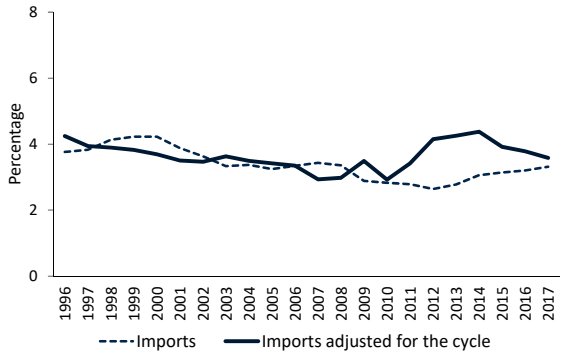

((c)) Germany - exports




((d)) Germany - imports




((e)) France - exports




((f)) France - imports

### 1.4.3 Robustness

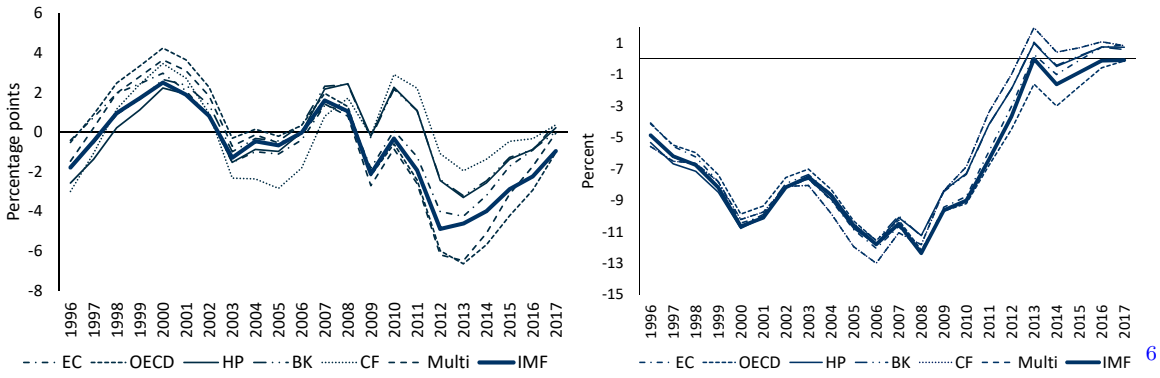
There is uncertainty regarding some parameters in the methodology, which may affect the results obtained for the Portuguese cyclically-adjusted current account balance as a percentage of GDP. To assess the robustness of results, we recomputed the adjusted current account balances with different series for the Portuguese output gap and for a range of import elasticity estimates.

Panel A of Figure 1.5 plots several series for the Portuguese output gap from 1996 to 2017. Beyond our baseline output gap (of the IMF) we show estimates by the OECD, European Commission, and calculations by Banco de Portugal with different statistical filters. The range of output gap estimations is considerable, reaching more than 4 p.p. of GDP in some periods. The panel B of Figure 1.5 plots the cyclically adjusted balances with the different output gap series. This exercise only affects the adjusted imports, and it is visible that the main features of the results are not altered. Foreign output gaps are part of the calculations for cyclically-adjusted exports but the consideration of different estimates for all these variables is beyond the scope of this article.

In addition, we computed the cyclically adjusted imports and the subsequent current account balance using the highest and lowest import elasticities that would emerge from adopting the methodology for the set of countries considered to compute the Portuguese external demand, particularly the ones for Spain ($\theta_{IAD}^{ESP} = 2.68$) and Norway ($\theta_{IAD}^{NOR} = 0.51$), respectively (Figure 1.6). The difference relatively to the benchmark situation is strong if we use the Spanish elasticity as the structural adjustment only takes place in the recent years. In any case the structural correction of the Portuguese current account balance is visible. It should be noted that these alternative elasticities affect the parameters $\eta_X$ and $\eta_D$ in equation (1.11) and have a non-linear impact on adjusted imports.

Another robustness exercise consists of computing the cyclically-adjusted current account balance with the export elasticity used by Fabiani *et al.* (2016), that is $\theta_x = 1.9$ instead of our $\theta_x = 2.6$. We observe that this change does not affect the structural current account balance in any significant way, thus we do not plot it.

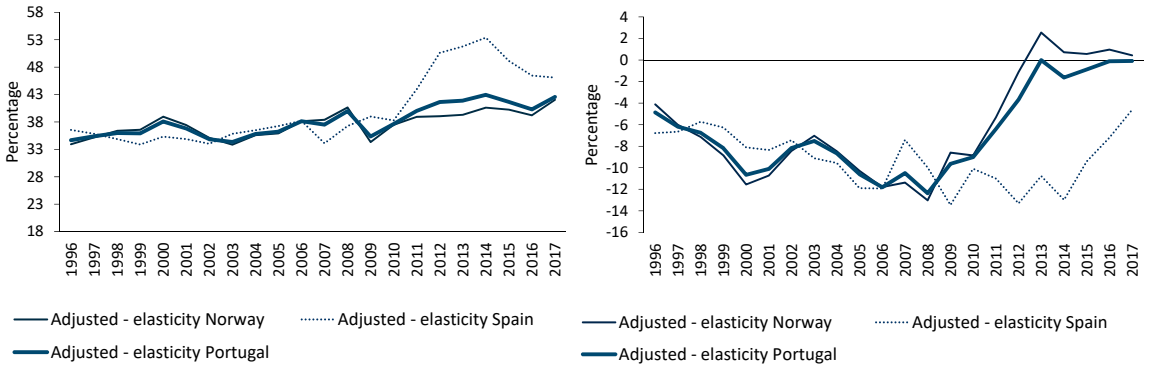
Figure 1.5: Robustness of results - Output gap




((a)) Output gaps

((b)) Adjusted current account

Figure 1.6: Robustness of results - Elasticity of imported adjusted demand




((a)) Adjusted imports

((b)) Adjusted current account

Finally, we replicated the overall exercise excluding exports and imports of energy products and the results remain qualitatively unchanged.

## 1.5 Final Remarks

The current account balance is a key macroeconomic indicator. Although in the nineties and early years of the new century its importance was somewhat downplayed for the case of countries taking part in a monetary union, the global economic and financial crisis of 2008 and the euro area sovereign debt crisis that followed have shown that countries cannot run prolonged current account deficits and strongly deteriorate the net external position.

As in the case of other macroeconomic variables, exports and imports are affected by cyclical developments. Therefore, it is important to disentangle structural and cyclical developments. In this chapter, we adopt the methodology presented by Fabiani *et al.* (2016) and apply it to the Portuguese economy in the period 1995-2017. In addition, we extend the analysis to the bilateral dimension and identify specific adjustments for the Portuguese exports and imports with its main trade partners.

We conclude that the strong current account adjustment observed in the Portuguese economy after 2010 was mainly structural, though a positive effect from cyclical developments is also observed. Taking the average of the period 2012-2017, the cyclically adjusted current account balance lies 1.2 p.p. below the observed balance. In 2017, the structural current account balance stood at -0.1 percent of GDP. The results are robust for different series of the Portuguese output gap and import elasticities. As for the bilateral analysis, we conclude that the recession in the main Portuguese trade partner (Spain) deteriorated Portuguese exports. However, for Germany and France the adjustments to exports are small but relevant for imports.

The Portuguese current account balance has strongly improved after the euro area sovereign debt crisis and the subsequent Portuguese economic and financial assistance program. Although the methodology only adjusts the current account balance for domestic and foreign output gaps, thus leaving other all other fluctuations unaffected, the structural nature of the Portuguese adjustment is visible. Nevertheless, this trend should be reinforced, and a continuing screening of current account developments is necessary. Only through near balance or positive current account balances will the Portuguese external indebtedness decrease, reducing exposure to future external economic and financial risks.

# Appendix

### 1.5.1 Elasticity of home exports to foreign GDP

The long-run elasticity of home exports to foreign GDP is assumed to be equal to the long-run elasticity of imports to GDP in the cross-country panel regression. It requires running the following panel regression:

$$\Delta lnM_{k,t} = \delta_k + \sum_{l=0}^{L} \beta_{GDP,l} \Delta lnGDP_{k,t-l} + \sum_{l=0}^{L} \beta_{P,l} \Delta lnP_{M,k,t-l} + \sum_{l=l}^{L} \beta_{M,l} \Delta lnM_{k,t-l} + \epsilon_{k,t} \quad (1.19)$$

where $k$ is a country, $\Delta$ denotes first differences, $\delta_k$ is the country fixed effects and $\epsilon_{k,t}$ is the error term. Applying the steady-state condition for a maximum of one lag we obtain:

$$\Delta lnM_{k,T} = \frac{(\widehat{\beta}_{GDP,0} + \widehat{\beta}_{GDP,1})}{(1 - \widehat{\beta}_{M,1})} \Delta lnGDP_{k,T} + \frac{(\widehat{\beta}_{P,0} + \widehat{\beta}_{P,1})}{(1 - \widehat{\beta}_{M,1})} \Delta lnP_{M,k,T} \quad (1.20)$$

Table 1.1 presents the results of the regression estimated for Portugal, which leads to $\theta_x = 2.6$. It should be noted that coefficients for lagged imports, prices and the constant are not statistically significant, at a 10 percent level.

A final note regards the extension of the methodology to the bilateral dimension. In all stages of the $IAD$ computation and in the regression that estimates elasticity of imports, the conceptual approach is similar. This implies taking sub-blocks of the global input-output matrix and bilateral export and import flows.

Table 1.1: Exports elasticity estimates for Portugal

| $M_{k,t}$ | Coef. | Std. Error | t | P-value |
|---|---|---|---|---|
| $M_{k,t-1}$ | -0.061 | 0.046 | -1.34 | 0.201 |
| $GDP_{k,t}$ | 1.606 | 0.294 | 5.46 | 0.00 |
| $GDP_{k,t-1}$ | 0.994 | 0.102 | 9.74 | 0.00 |
| $P_{M,k,t}$ | -0.190 | 0.078 | -2.44 | 0.027 |
| $P_{M,k,t-1}$ | 0.005 | 0.059 | 0.09 | 0.928 |
| $R^2$=0.36 | Number of obs. (17 countries)=1,071 | | | F(5,16)=102.32 |

### 1.5.2 Elasticity of imports to the Imported Adjusted Demand (IAD)

Bussière *et al.* (2013) show that the total import content of an expenditure component, assuming $S$ sectors and $v$ final demand components in the economy and that the output of each sector is used both as an intermediate and to satisfy final demand, can be defined as:

$$\omega_v = \frac{uM_v^{ind} + uM_v^{dir}}{uF_v^d + uF_v^m} = \frac{uA^m(1-A^d)^{-1}F_v^d + uF_v^m}{uF_v^d + uF_v^m} \tag{1.21}$$

where $u$ is a $1 \times S$ vector with all elements equal to one and the subscript $v$ selects the $v^th$ column of each matrix corresponding to the expenditure components of interest. $(1-A^d)^{-1}$ stands for the usual Leontief inverse, $A^d$ is an $S \times S$ matrix of domestic input coefficients, $A^m$ is the $S \times S$ matrix of imported input coefficients, $F^d$ is the matrix of final demands of domestic goods and services and the direct imports are given by the $S \times V$ matrix, $F^m = M^{dir}$. Therefore, $\omega_v$ allows us to capture the $IAD$ aggregate to be used in the regressions.

The estimation of the $IAD$ elasticity follows the theoretical underpinnings of some empirical trade literature, notably the CES demand system. Under CES preferences, the logarithm of import demand is determined by:

$$lnM_t = lnD_t + \beta_p lnP_{M,t} \tag{1.22}$$

where $D_t$ is aggregate demand (a CES aggregation of domestic and imported goods) and $P_{M,t}$ is the relative import price. This equation is estimated in first differences either for a panel of countries or for each country separately to obtain the elasticities of imports. However, standard measures of aggregate demand are replaced with $IAD$. Therefore:

$$\Delta lnM_{k,t} = \sum_{l=0}^{L} \beta_{IAD,l} \Delta lnIAD_{k,t-l} + \sum_{l=0}^{L} \beta_{P,l} \Delta lnP_{M,k,t-l} + \sum_{l=1}^{L} \beta_{M,l} \Delta lnM_{k,t-l} + \epsilon_{k,t} \tag{1.23}$$

where $k$ is a country, $\Delta$ denotes first differences and $\epsilon_{k,t}$ is the error term. Applying the steady-state condition for a maximum of one lag we obtain:

$$\Delta lnM_{k,T} = \frac{\widehat{\beta}_{IAD,0} + \widehat{\beta}_{IAD,1}}{(1 - \widehat{\beta}_{M,1})} \Delta lnIAD_{k,T} + \frac{\widehat{\beta}_{P,0} + \widehat{\beta}_{P,1}}{(1 - \widehat{\beta}_{M,1})} \Delta lnP_{M,k,T} \tag{1.24}$$

Table 1.2 presents the results of the regression estimated for Portugal, which leads to $\theta_M^{IAD} = 1.48$. It should be noted that coefficients for prices are not statistically significant at a level of 10 percent.

Table 1.2: Import elasticity estimates for Portugal

| $M_{k,t}$ | Coef. | Std. Error | t | P-value |
|---|---|---|---|---|
| $M_{k,t-1}$ | -0.343 | 0.123 | -2.79 | 0.007 |
| $IAD_{k,t}$ | 1.381 | 0.122 | 11.32 | 0.00 |
| $IAD_{k,t-1}$ | 0.61 | 0.209 | 2.92 | 0.00 |
| $P_{M,k,t}$ | 0.003 | 0.108 | 0.26 | 0.798 |
| $P_{M,k,t-1}$ | 0.123 | 0.107 | 1.15 | 0.254 |
| $R^2$=71.1 | Number of periods=63 | | F(5,57)=31.52 | |

### 1.5.3 Observed and cyclically adjusted exports and imports

Table 1.3: Yearly observed and cyclically adjusted exports and imports as a percentage of GDP

| | Exports | | | Imports | | | Current account | | |
|---|---|---|---|---|---|---|---|---|---|
| | Observed | Adjusted | Difference | Observed | Adjusted | Difference | Observed | Adjusted | Difference |
| 1996 | 26.5 | 27.2 | -0.6 | 33.7 | 34.7 | -1.0 | -4.5 | -4.9 | 0.4 |
| 1997 | 27.1 | 27.4 | -0.2 | 35.1 | 35.4 | -0.2 | -6.2 | -6.2 | 0.0 |
| 1998 | 27.3 | 27.6 | -0.3 | 36.5 | 36.0 | 0.5 | -7.5 | -6.8 | -0.8 |
| 1999 | 26.5 | 26.3 | 0.2 | 36.8 | 35.9 | 0.9 | -8.9 | -8.2 | -0.7 |
| 2000 | 28.2 | 27.2 | 1.0 | 39.3 | 38.1 | 1.2 | -10.8 | -10.7 | -0.1 |
| 2001 | 27.4 | 26.9 | 0.5 | 37.6 | 36.8 | 0.8 | -10.4 | -10.1 | -0.3 |
| 2002 | 26.9 | 26.9 | 0.0 | 35.2 | 34.8 | 0.4 | -8.5 | -8.2 | -0.3 |
| 2003 | 26.8 | 27.1 | -0.3 | 33.7 | 34.3 | -0.7 | -7.2 | -7.5 | 0.4 |
| 2004 | 27.3 | 27.2 | 0.1 | 35.5 | 35.8 | -0.3 | -8.3 | -8.7 | 0.3 |
| 2005 | 26.7 | 26.4 | 0.3 | 35.8 | 36.2 | -0.4 | -9.9 | -10.6 | 0.7 |
| 2006 | 29.9 | 28.8 | 1.1 | 38.1 | 38.2 | 0.0 | -10.7 | -11.8 | 1.1 |
| 2007 | 31.0 | 29.1 | 1.9 | 38.7 | 37.5 | 1.1 | -9.7 | -10.5 | 0.8 |
| 2008 | 31.1 | 30.0 | 1.1 | 40.8 | 40.0 | 0.9 | -12.1 | -12.4 | 0.2 |
| 2009 | 27.1 | 29.2 | -2.2 | 34.0 | 35.4 | -1.4 | -10.4 | -9.6 | -0.8 |
| 2010 | 29.9 | 31.2 | -1.3 | 37.4 | 37.6 | -0.2 | -10.1 | -9.0 | -1.1 |
| 2011 | 34.3 | 35.3 | -1.0 | 38.6 | 40.0 | -1.4 | -6.0 | -6.4 | 0.4 |
| 2012 | 37.7 | 39.2 | -1.5 | 38.2 | 41.6 | -3.4 | -1.8 | -3.7 | 1.9 |
| 2013 | 39.5 | 41.3 | -1.8 | 38.5 | 41.9 | -3.4 | 1.6 | 0.0 | 1.6 |
| 2014 | 40.1 | 41.4 | -1.4 | 39.9 | 43.0 | -3.1 | 0.1 | -1.6 | 1.7 |
| 2015 | 40.4 | 41.3 | -0.9 | 39.8 | 41.7 | -1.9 | 0.1 | -0.9 | 1.0 |
| 2016 | 40.0 | 40.7 | -0.7 | 38.9 | 40.3 | -1.4 | 0.6 | -0.1 | 0.7 |
| 2017 | 42.7 | 42.8 | -0.1 | 41.9 | 42.6 | -0.7 | 0.5 | -0.1 | 0.5 |

# Chapter 2

# Bilateral Cyclically Adjusted Trade Accounts - Before and During the Financial Crisis

## 2.1 Introduction

In a more globalized world, trade imbalances are important and may pose some risks. They are usually described by a situation where a country experiences high and persistent current account deficits or surpluses, with global repercussions. The presence of current account deficits (or surpluses) may be the result of movements of capital from countries with a low (or high) economic growth / income towards countries with a better (or worse) growth / income prospect. In some circumstances global imbalances play an important role when there are investment opportunities in foreign markets, and domestic investors tend to invest in a different economy. The inflows (or outflows) of resources both of a financial and non-financial nature, will have an impact on the current account balance. Another situation occurs to ensure the economic sustainability, as for example, countries where populations are ageing rapidly. This situation is raised in some advanced economies, to ensure the pension benefits when their workers retire. On the contrary, rapidly growing economies have usually larger investments and, thus, are characterized by external deficits. These

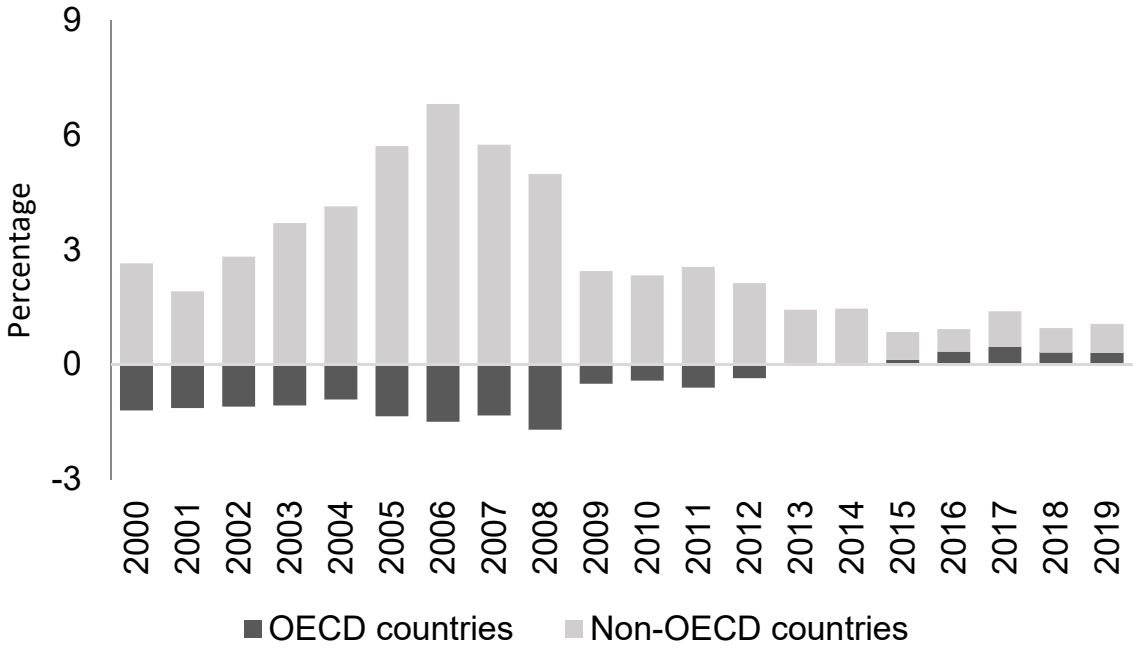
countries usually benefit from capital inflows - external funds in the form of foreign direct investment, for example, under which foreign companies own domestic firms to influence their activity, while providing also financial resources in the form of capital and debt. The deficits and/or surpluses of the current account translate into the financial side of the Balance of Payments, International Investment Position and External Debt. When a country is a net external borrower (negative balance of the current and capital account), his creditor (or debtor) position vis-à-vis the rest of the world will be reduced (or increase). On the contrary, when a country runs into surpluses of the current account (being a net external lender), it will increase its financial assets and/or reduce liabilities vis-à-vis foreign economies, thus increasing its net International Investment Position to the rest of the world.

Persistent trade imbalances may also pose some risks and can be the cause of macroeconomic and financial stress. Economies that accumulate external liabilities (assets) on a large scale may become vulnerable to sudden stops in capital flows and to currency depreciation (appreciation). These situations may lead to financial crises and instability as the financial sector may be unable to absorb these flows.

Global imbalances also affect bilateral trade imbalances, and consequently countries tend to look at their trade account on a bilateral basis, which sometimes leads to economic conflicts. One example may be the adoption of protectionist policies, such as tariffs or quotas. Escalating protectionism leads to trade wars, as the case of the United States - China. Figure 2.1 represents the global imbalances between 2000-2019 for OECD and Non-OECD countries[1]. According to this figure, in the early 2000s the current account from the OECD countries recorded deficits close to 1% of GDP, while Non-OECD countries recorded surplus around 4% of the GDP until 2004. The accumulation of trade imbalances during the early years of the 2000s exacerbated the impact of the 2008-2009 financial crisis. After 2004, the surpluses (deficits) of the OECD (Non-OECD) countries increased. Between 2006 and 2008, the OECD surplus of the current account was nearly 6% of GDP on average and the current account deficit of the Non-OECD countries represented -1.5% of GDP,

[1] reference year: 2015

Figure 2.1: Current account balances, as % of GDP 2000-2019



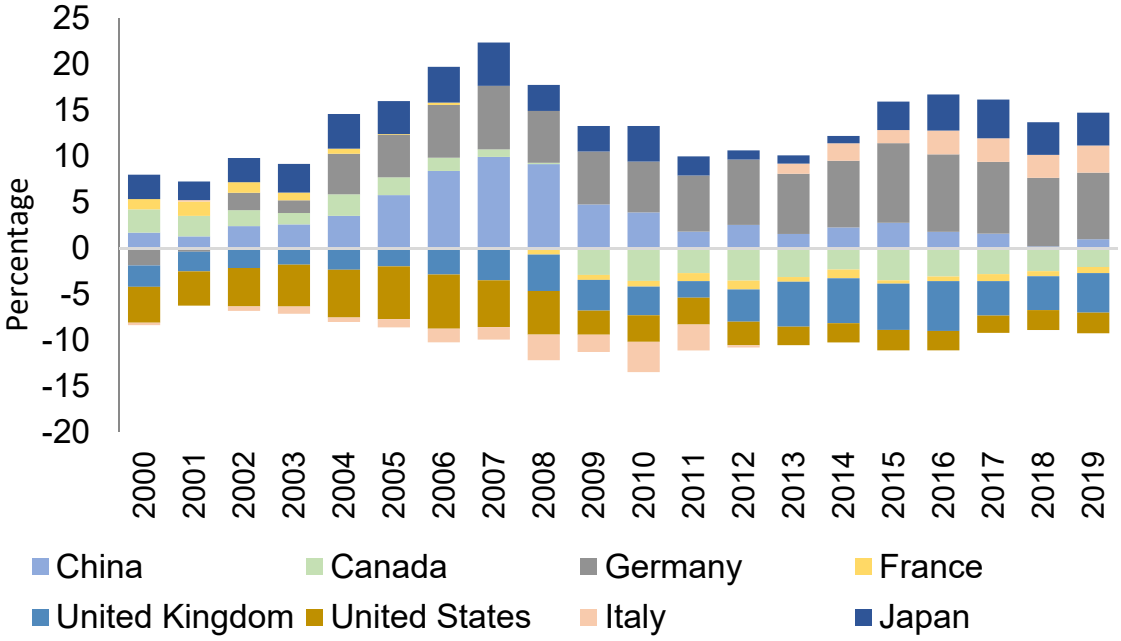

Source: OECD: Economic Outlook, November 2019 and author calculations.

on average.

The size of global imbalances is determined by structural and cyclical factors. The cyclical balance of the current account reflects the economic cycle, whereas the structural balance is related with a long-term approach, when the economy is operating at its potential level. Regarding the cyclical balance, some factors may influence the magnitude of this indicator, namely the domestic and foreign economic growth, oil prices and exchange rates, among others. The structural trade balance is influenced mainly by the ratio of export to import prices (terms of trade), the costs of production and domestic inflation (competitiveness), the global value chains, among other economic factors. In addition, factors like demographic aspects, financial market development and institution quality may also have an important impact on the structural component.

On a country level, figure 2.2 shows the G7+China countries current account as percentage of GDP (global imbalances) between 2000-2019.

Figure 2.2: Current account balances G7+China, as % of GDP 2000-2019




Source: OECD: Economic Outlook, November 2019.

As it can be observed, during the financial crises period there were sharp increases in the current account balances in Germany, in Japan and in China, where the country's significant savings and policies in support of the exporting sectors, were the key drivers of the global imbalances. During this period, the oil-exporting countries also benefited from the sharp rises in the oil prices between 2000 and 2007. Moreover, rising deficits in the United States (the country with the highest current account deficit in the world) and United Kingdom also increased global imbalances. The remaining countries (Canada, France, and Italy) represented in figure 2.2 reduced their imbalances during the financial crisis period.

It should be noted that after 2008 the aggregate (OECD and non-OECD countries) excessive deficits and surpluses were substantially corrected (as it can be seen in figure 2.1). On a country dimension, figure 2.2 shows that the United States managed to reduce its deficit and China reduced its current account surplus. The years next to the financial crisis marked the major imbalances' adjustments after 2000, while more recently, the individual current account imbalances have remained more stable, although still above the 2000s levels. Nevertheless, the global correc-

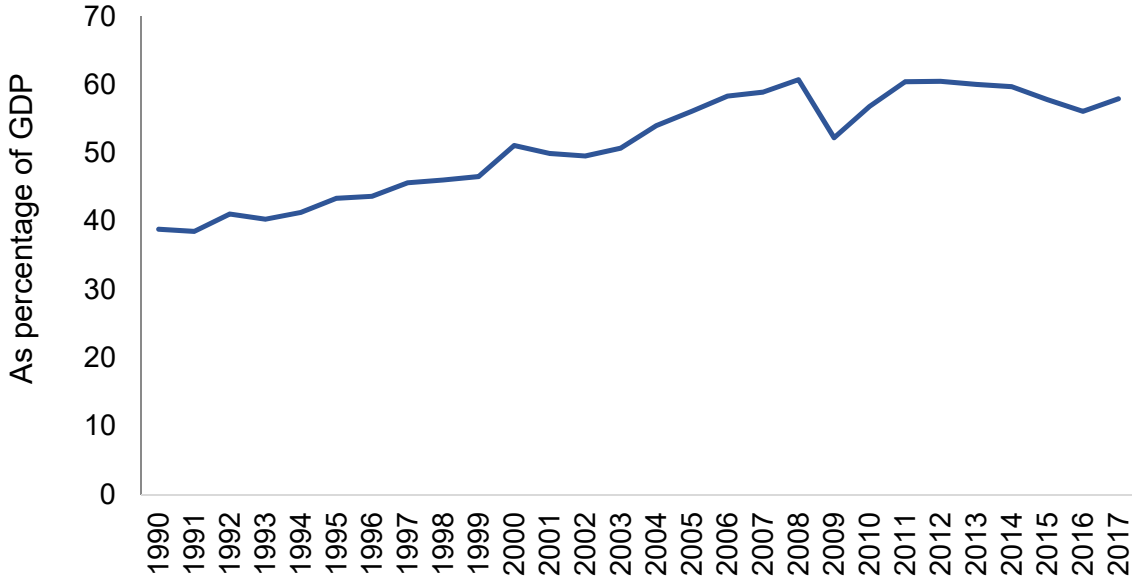
tion of the current account following the financial crisis can be masking important risks that remain significant or that may even have increased on a country basis. In the United States, the reduction of the tax rate and the increase in expenditure implied an increase in the current account deficit with a negative impact on the global imbalances. Secondly, the introduction of protectionist measures by the United States, like tariffs to imported goods from China and Europe may also increase global imbalances. Thirdly, the bilateral trade imbalances among different countries can be offset on a global perspective. Finally, the current account balance and its counterpart in the financial account may have declined in net terms in the recent period, but the gross flows (inflows and outflows) are significant, and their fluctuations could be a major source of instability.

Global imbalances can be measured by international trade flows, through the exports and imports of goods and services (trade account balance). This indicator which is commonly the most important component of the current account, can be a powerful indicator of investment, economic growth and sustainable development. In figure 2.3, international flows between 1990-2017 are represented by the trade openness indicator, as a percentage of the GDP. The indicator is defined by the sum of the exports and imports of goods and services for all the world economies, as a share of their correspondent gross domestic product.

According to the World Bank Group data, the world trade openness increased from 39 per cent of GDP approximately in 1990, to 57.9 per cent of GDP in 2017, representing an increase in trade flows relatively to GDP. Figure 2.3 also illustrates the existence of international trade downturns during the economic recessions.

As stated by Obstfeld & Rogoff (2009), before the 2008 global financial crisis period, world economies were marked by economic prosperity, economic growth, and expanding trade and credit. This economic prosperity was visible also on developing countries which performed better than what could have been predicted. When trade opportunities are seized, they induce investment and technology transfer that strengthen trade's ability to create jobs and incomes, deepen economic diversification and advance structural transformation. In emerging economies, current account

Figure 2.3: Trade openness, World 1990-2017




Source: World Bank Group: World development indicators.

surpluses increased, whereas many developing and developed countries ran current account deficits.

After 2008, the financial crisis led to the reduction of capital flows, the reduction of domestic demand, credit and import contraction. The reduction of trade was observed in economies in this period as a result of a reduction of the purchasing power, leading to a decrease in the imports. Exports also decreased, although not as much as imports. As a result, the current account deficits shrank (figures 2.1 and 2.2). In addition, international flows also decreased as can be seen in figure 2.3 (between 2008 and 2009 the world trade openness as a percentage of GDP, decreased about 8 percentage points from 60.7 per cent of GDP to 52.2 per cent of GDP). Moreover, Monge-Naranjo (2013) stated that the great recession was a rich-country phenomenon, which affected in different magnitudes the world economies. The authors refer that the international trade has become more important in the United States, thus growth perspectives depend more on the growth performance of its major trade partners.

According to the BIS (2011), persistently large imbalances are unsustainable. Therefore, it is important to understand how the global imbalances can be corrected,

as the magnitude of the latest financial crisis was not the same for all the economies. Among other causes, there were pointed cyclical factors - the level of the economic recession, which was not the same in all economies, and the authors also highlight the dependency level to some specific trading partner countries. In the context of the most recent financial crisis one relevant question is to understand if the financial crisis recession had a negative or positive impact on the trade account balances (net exports of goods and services), at a global level. In addition, it is also important to assess if the financial crisis impact on the correction of global imbalances is also observable on a bilateral trade account dimension (bilateral exports and imports of each country vis-à-vis the main trade partners).

This article tries to answer the above questions by assessing the cyclical adjustment of the trade account on a bilateral country-analysis. Using available information, for a sample of twenty-five countries[2], the cyclical adjustment methodology is applied to the trade account balances. Two different periods are considered - before the most recent global financial crisis (between 1996 and 2006) and during the financial crisis (between 2007-2011). The results suggest that during the financial crisis the cyclical adjustment was higher for most of the twenty-five countries than the cyclical adjustment verified for the previous years. At a country level, the United States and Japan were the key drivers to the cyclical adjustment before and during the financial crisis within the set of G7+China economies. In addition, it should be highlighted also the role of Spain as an important country to influence the patterns of the cyclical adjustment of the trade account balances.

The rest of the article is organized as follows. Section 2.2 identifies the different economic approaches that exist on the cyclical adjustment methodology. Section 2.3 briefly describes the methodology to estimate the bilateral cyclical adjustment of the trade account. Section 2.4 identifies the data sources and Section 2.5 presents the results obtained through the bilateral data approach. Lastly, section Section 2.6 offers some concluding remarks.

[2]Australia, Austria, Belgium, Canada, Switzerland, China, Germany, Spain, Finland, United Kingdom, Hungary, Ireland, Iceland, Italy, Japan, South-Korea, Luxembourg, Mexico, Netherlands, Norway, New Zealand, Portugal, Sweden, United States.

## 2.2 Related literature

Bilateral trade imbalances have been widely discussed in the academic literature. Two important contributions were made by Feenstra *et al.* (1998) and Davis & Weinstein (2002). Feenstra *et al.* (1998) focused on the United States trade deficit vis-à-vis China, whereas Davis & Weinstein (2002) analysed the bilateral imbalances for a large set of countries. Their work relies on the gravity model of trade in goods to assess bilateral imbalances and contrast with the observed imbalances. On a more quantitative approach, models of international trade were also used as in Eaton & Kortum (2002), to analyse the relations between countries' sector-level productivities, bilateral trade costs and real incomes. As discussed previously, bilateral imbalances are related with the global imbalances. In this context, some authors explore the impact of changes in aggregate trade imbalances on countries' incomes as Eaton *et al.* (2007) and Dekle *et al.* (2008). In addition, Obstfeld & Rogoff (2000) analysed the impact of trade costs on aggregate imbalances.

At a country level, a large debate on the global imbalances have been also increasing in the economic literature. Cusolito & Nedeljkovic (2013) state that a current account balance is considered to be sustainable when the economy can satisfy its long-run intertemporal budget constraint without modifying radically their policies or, as in Milesi-Ferretti & Razin (1996) a large change in private agents' behaviour. Ghosh & Ramakrishnan (2017) addressed the current account deficits depending on the type of countries. According to the authors, advanced and very poor economies usually run into external deficits, whereas developing and emerging market economies often exhibit surpluses. Moreover, in some cases (usually very poor countries) the external deficits are usually financed by official/external grants and loans.

As mentioned by Sahin & Mucuk (2014), a current account deficit potentially promotes investment, economic growth and development. Although, there is no empirical evidence that developing countries with positive net external inflows grow faster than industrial countries with current account surpluses. Some factors may contribute to an external deficit - less developed domestic financial systems that

cannot allocate foreign capital efficiently, demography, quality of institutions, terms of trade, among others. Nevertheless, private capital often flows from developing to advanced economies. More recently, Cuñat & Zymek (2019) work embedded Davis & Weinstein (2002) analysis to identify the importance of aggregate trade imbalances determinants, to explain also bilateral trade imbalances.

The analysis of macroeconomic imbalances in the context of the financial crisis has also been discussed in the literature. Lane & Ferretti (2011) analysed the current account imbalances before the financial crisis period in a sixty-five countries' sample of industrialized and developing economies. According to the authors, these imbalances were associated to both domestic and external market financing, or changes in commodity prices (as, for example, oil prices). In addition, other factors related with the foreign exchange markets (real exchange rate, for example) were also important to the (de)stabilization of currencies.

Notwithstanding, the current account deficits and surpluses can be desirable from an individual country perspective and from a global perspective. IMF (2019) states that a country's ability to incur in current account deficits or surpluses at different times may in some circumstances absorb country-specific shocks and facilitate an efficient allocation of capital. According to this report, countries may need to save through current account surpluses; others may need to borrow externally via external deficits for investment purposes and not necessarily because they are reaching debt expansionary policies. In this regard, Coutinho *et al.* (2018) identify foreign investment as one important factor for the existence of unbalances of the current accounts. This situation may occur for example, when external markets are more attractive than the domestic market and stimulates external resources (inflows) to finance the investment, thus running into external deficits. More recently, Afonso *et al.* (2019) assess the sustainability of the current account, through the level of trade balance that stabilizes the financial external stocks of an economy - the net International Investment Position and the net External Debt. The authors use data for the European Union countries and conclude that there is sustainability of the current account balance in a few surplus countries, whereas their results show that

the sustainability of the Net International Investment Position and External Debt can also exist in some European Union countries with an external debit position.

The analysis of the key drivers for sustainability conditions does not distinguish whether its impact is cyclical or structural. The understanding of the cyclical and structural factors requires a separate analysis and is important for anticipating the evolution of the balance in the medium term, and the impact of policy actions. The distinction between structural and cyclical current account balances has been growing in the literature in the last years.

The literature presents two main methods of adjusting the current account balance for the impact of the cycle. The first method bases on the estimation of regressions where the current account balance is correlated with a set of demographic, macroeconomic, financial and institutional variables. The structural current account is obtained by applying the estimated coefficients to the (medium-term) trend values of the explanatory variables. This approach typically considers a panel of countries over a long period of time.

The second method of computing structural current account balances focuses on the goods and services account and uses trade elasticities. A strong advantage of this approach is the possibility of adjusting separately the export and import components of the current account. Haltmaier (2014) quantifies the cyclical part of the current account balance for several countries by estimating a long-run (or trend) elasticity from a co-integration relationship between trade and income, as well as a short-run (or cyclical) elasticity.[3] The caveats of this approach lie on the uncertainty and revisions associated to output gaps and trade elasticities. Overall, the two methodological approaches should be taken as complementary and not as substitutes.

At an aggregate country level, Afonso & Silva (2017) focused on a nineteen European Union countries' sample to assess the determinants of the current account cyclical and non-cyclical components. The authors concluded that the trade bal-

[3]The effects of foreign and domestic output gaps on real exchange rate deviations are used in other models, such as Wu (2008) and Kara & Sarikaya (2013).

ance have a positive impact both on the cyclical and on the non-cyclical items of the current account, while the cyclical component of the current account balance was negatively influenced by the 2008-2009 financial crisis due to the evolution of employment and compensation of employees.

Although these methods aim to distinguish between the cyclical and non-cyclical component of the international trade, the cyclical adjustment is applied at a country level both to the total amount of exports and imports. Therefore, it is not possible to disaggregate the adjustment by trade partner and consequently country-bilateral considerations on the contributions of each trade partner to the cyclical adjustment are not measurable.

In this paper we estimate the bilateral cyclical adjustment of the trade account to decompose the aggregated cyclical adjustment by trade partner. Consequently, it enables to identify the most important contributors to the external deficit/surplus of each economy. The bilateral cyclical adjustment is performed by using mainly bilateral information on domestic exports and imports and bilateral estimations for the trade elasticities.

The empirical literature on the estimation of bilateral trade elasticities as stated by Imbs & Mejean (2010), goes back to at least Orcutt (1950), or Houthakker & Magee (1969). Houthakker & Magee (1969) for example, included also controls for domestic or world GDP, to estimate the income elasticity of imports (or exports, respectively).

Earlier estimates were sophisticated in Marquez *et al.* (1998), Marquez (2002) or Gagnon (2003). They included differences between short and long-run elasticities. It attempted also to alleviate endogeneity and range from the estimation or simultaneous equations, co-integration analysis to the instrumentation of relative price changes.

More recent contributions as Bussière *et al.* (2013) invoked the change in the composition of aggregate demand to explain the cyclical factors behind the slowdown in global trade, while others focus on the weakness in intra-euro area trade [4].

[4]the EU trade represents one-third of total world trade.

Martinez-Martin (2016) shows that between 2012 and 2015, the import volumes of emerging economies has decreased. At a regional level, the author refers the work of Slopkek (2015), that demonstrates the linkages between the shift in relative growth from advanced economies towards emerging market economies and the decline in the elasticity of global imports.

External bilateral-trade interactions are also illustrated with the recourse of the network analysis, to map global and bilateral trading activity. Serrano *et al.* (2007) uses the network analysis to identify the most relevant country-connections. Analogously, Benedictis & Tajoli (2009) apply the network analysis to represent the interconnections of the World Trade Network, its composition over time, and the impact on the global trade from the adoption of new policies. Moreover, Fracasso & Schiavo (2008) use the network theory to characterize the structure of the web of bilateral external trade, thus allowing to assess the web of bilateral trade imbalances.

Our approach follows Bussière *et al.* (2013) to estimate the trade elasticity based on an import intensity-adjusted measure of aggregate demand ($IAD$ variable). Bussière *et al.* (2013) approach complements the results from Levchenko *et al.* (2010) and Bems *et al.* (2010). These authors combine the synthetic global Input-Output table with a Leontief production function to study the combination of changes in the composition of demand and country-specific demand shocks in the global trade contraction.

Furthermore, this article estimates the trade elasticity not at an aggregate perspective of one country vis-à-vis the rest of the world as in Bussière *et al.* (2013), but at a bilateral country-perspective, using a bilateral Imported Adjusted Demand, $IAD$ elasticity relatively to the imports. It identifies the impact driven by a change in the imported adjusted demand components on its bilateral imports vis-à-vis each of its trading partners. We focus on the exports and imports of goods and services (trade account balance), which is commonly the most relevant category of the current account.

## 2.3 Cyclical adjustment of the trade account

This section describes the methodology used to estimate the bilateral cyclical adjustment of the trade account to perform the adjustment at a bilateral level, i.e., the cyclically adjusted trade account of one country vis-à-vis its trade partners.

### 2.3.1 Bilateral trade assumption

On aggregate terms, the current account balance (CAB) is identified by the following:

$$CAB = Exports - Imports + BPI + BSI \tag{2.1}$$

where $BPI$ and $BSI$ stand for "Balance of Primary Income" and "Balance of Secondary Income", respectively.

As it was previously mentioned, we will focus on the cyclical adjustment of the exports and imports of goods and services. Moreover, this methodology will define exports of goods and services as the 'mirror' of imports of goods and services.

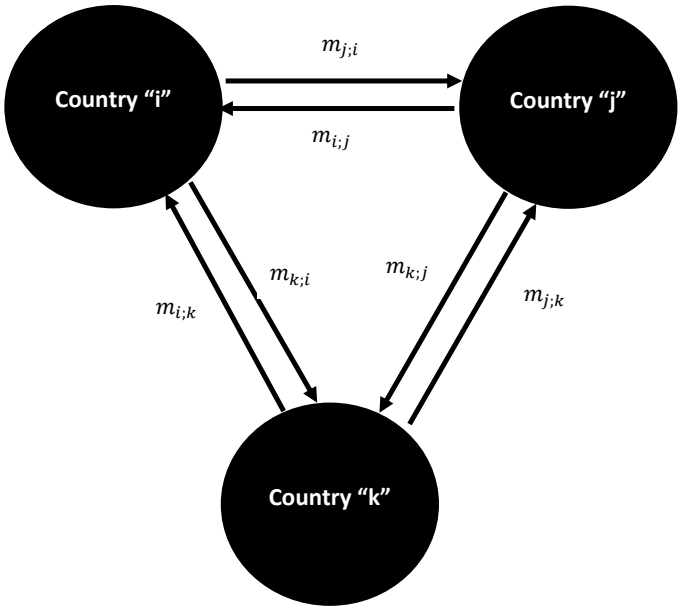
In our bilateral country approach, only imports of goods and services are considered. The exports of the domestic economy are obtained through the imports of its trading partners. Figure 2.4 illustrates this export/import assumption, by considering a three-country case ($i$, $j$ and $k$), where $m_{i;j}$ represents the imports to country "$i$" from country "$j$". In this three-country economy, the international trade is represented only in terms of imports.

Moreover, it is assumed that the goods and services exported from country "$j$" to country "$i$" correspond to the imports of goods and services to country "$i$" from country "$j$":

$$m_{i;j} = x_{j;i} \tag{2.2}$$

In our model, current and potential GDP in the home country, in real terms, are identified as $Y$ and $Y^*$, respectively. Moreover, $M^*_{ij}$ stands for potential bilateral

Figure 2.4: Bilateral imports representation of the international trade




imports to country "$i$" from country "$j$", in real terms. Nominal variables are denoted as the product of the real counterpart and the corresponding price index. Home imports are taken to be *isoelastic*, which means that an exogenously given constant long-run elasticity is assumed. Therefore, if the home GDP increases by one percent, imports increase by $\theta_M$ percent. Therefore, the impact on the imports is given by:

$$M_{ij}^{*} = M_{ij} + \Delta M_{ij} = M_{ij}(1 + \frac{\Delta M_{ij}}{M_{ij}}) = M_{ij}(1 + \theta_{M_{ij}} \frac{\Delta Y}{Y}) \tag{2.3}$$

### 2.3.2 Bilateral trade elasticities

Equation 2.3 shows that imports are activated by GDP. However, as Fabiani *et al.* (2016) state, imports are usually activated by demand, rather than GDP, and it may be misleading not to distinguish between components of demand to allow for different import intensities.

As suggested in Bussière *et al.* (2013), the import intensity-adjusted demand, labelled as $IAD$, is a good measure that reflects the import intensity of the different

components of domestic expenditure and the import content of exports. The $IAD$ variable can be described as:

$$IAD_t = C_t^{\omega_{C,t}} G_t^{\omega_{G,t}} I_t^{\omega_{I,t}} X_t^{\omega_{X,t}} \tag{2.4}$$

where $C$ stands for private consumption, $G$ for government consumption, $I$ for investment, and $X$ for exports. The weights, $\omega_{k,t}$, with $k = C, G, I, X$ are the total import contents of these final demand components. These weights are time-varying and normalized in each period such that their sum equals one.

In Bussière *et al.* (2013) model, imports are activated by a geometric weighted average of the various demand components, with weights reflecting their relative import contents. The authors present rolling-window estimates confirming that the assumption of a stationary, time-invariant long-run elasticity of imports is reasonable only in the case of the $IAD$ variable, whereas the long-run elasticity of imports to GDP shows an increasing trend. We follow the $IAD$ approach in a reduced-form approach, as in Fabiani *et al.* (2016). While the original version separately considers four components of demand (private consumption, public consumption, investment, exports), we isolate the component that typically shows the highest import intensity: exports. This approach has also been used by Christodoulopoulou & Tkacevs (2016).

We compute the import intensity of each $IAD$ component based on the Inter-Country-Input-Output tables and used a linear interpolation to construct quarterly series and normalizing so that they sum to unity.

The real imports are assumed to be isoelastic relatively to the reduced form $IAD$ variable, which stands for a convex combination of exports and domestic demand (in log-terms). Therefore, the growth rate of aggregate imports is given by:

$$\frac{\Delta M}{M} = \theta_M^{IAD} \frac{\Delta IAD}{IAD} = \theta_M^{IAD} \left[ \omega_x \frac{\Delta X}{X} + (1 - \omega_x) \frac{\Delta DD}{DD} \right] \tag{2.5}$$

where $\theta_M^{IAD}$ is the constant long-run $IAD$ elasticity relatively to the aggregate imports (calibrated using the regressions suggested in Bussière *et al.* (2013)), $\omega_x$ is the weight of exports in building the $IAD$ variable, and $DD$ stands for domestic

demand.

The total import content is determined as in Bussière *et al.* (2013), as the sum of the direct ($\omega_k^{dir}$) and indirect import content ($\omega_k^{indir}$) for each expenditure component ($k$), where the direct import content reflects the share of imported final goods and services and the indirect import content refers to the share of intermediate imported inputs per unit of final demand.

Taking $\Delta$ as the difference between potential and current levels of the variables, potential imports are defined as:

$$M^* = M + \Delta M = M + \theta_M^{IAD}\omega_x \left(\frac{M}{X}\right)\Delta X + \theta_M^{IAD}(1-\omega_x)\left(\frac{M}{DD}\right)\Delta DD \quad (2.6)$$

where $\theta_M^{IAD} = (\Delta M/M)/(\Delta IAD/IAD)$.

Equation 2.6 can be simplified to:

$$M^* = M + \eta_X(X^* - X) + \eta_D(DD^* - DD) \quad (2.7)$$

where $\eta_X = \theta_M^{IAD}\omega_x\frac{M}{X}$ and $\eta_D = \theta_M^{IAD}(1-\omega_x)\frac{M}{DD}$.

As it was previously mentioned, once the aggregate methodology is defined, the bilateral country approach is applied. Thus, the long-run bilateral $IAD$ elasticity relatively to the imports is represented by $IAD_{ij}$. It represents the long-run impact on the imports to country $i$ from country $j$ as a consequence of changes in the import intensity-adjusted demand of country $i$ from country $j$. Applying the bilateral $IAD$ concept, equation 2.7 is expressed for country $j$ by:

$$M_j^* = M_j + \eta_{X_j}(X_j^* - X_j) + \eta_D(DD^* - DD) \quad (2.8)$$

where $\eta_{X_j} = \theta_{M_{ij}}^{IAD}\omega_x\frac{M_{ij}}{X_{ij}}$ and $\eta_D = \theta_{M_{ij}}^{IAD}(1-\omega_x)\frac{M_{ij}}{DD}$. Using the bilateral identity, $\eta_{X_j}$ can be represented by: $\eta_{X_j} = \theta_{M_{ij}}^{IAD}\omega_x\frac{M_{ij}}{M_{ji}}$.

The estimations use the same methodology presented in Appendix 1.5.2 but calculated at a bilateral level, i.e., using bilateral data of each country vis-à-vis its trading partners. The estimates are firstly illustrated using a heatmap analysis. Figure (2.5) shows the results in a $25X25$ matrix.

In this representation, each cell corresponds to the long-run bilateral $IAD$ elasticity relatively to the imports of one country represented in the vertical axis, from its trade partner (the country from where it imports), represented on the horizontal axis. Each cell represents the value of $\theta_{M_{ij}}^{IAD}$, where $i$ corresponds to the vertical axis country and $j$ represents the horizontal axis country.

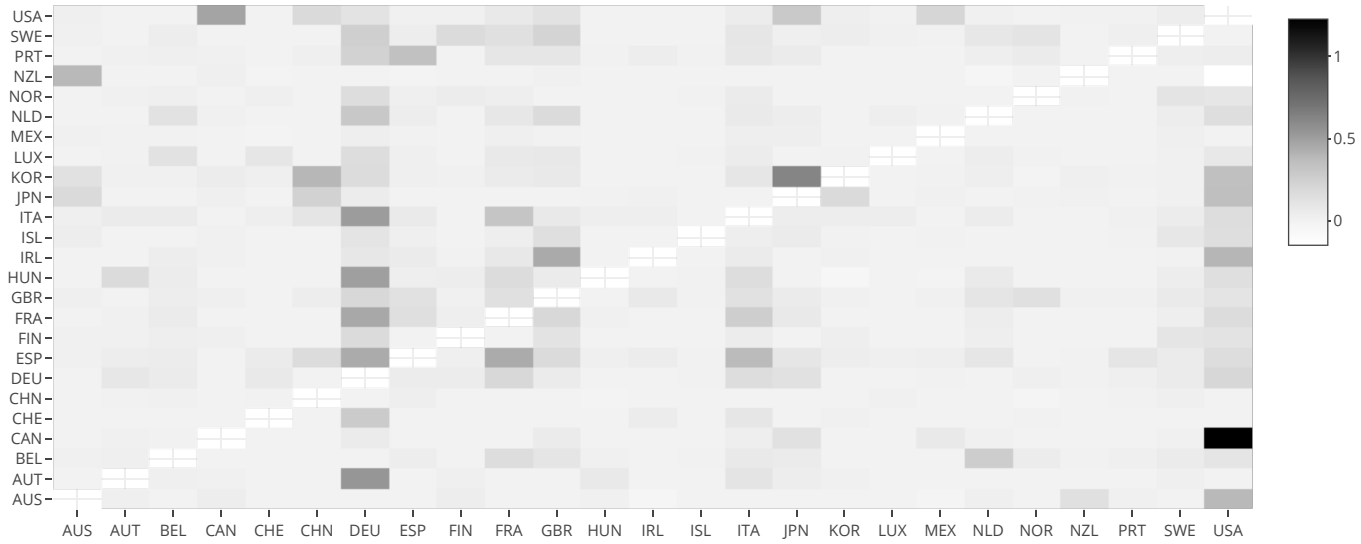
The heatmap was obtained using the *shiny* R package. The colour of each cell is ranked between the lowest value (represented with a white colour) and the highest trade elasticity (represented by a black colour).

The interpretation of the heatmap is straightforward: high levels of $IAD$ long-run elasticities (darker colours) represent the situations where the vertical axis country imports react significantly to a change of the imported intensity-adjusted demand vis-à-vis its partner country, represented in the horizontal axis country. On the contrary, lighter cells represent the situations where a change in the imported intensity-adjusted demand components of one country ($i$, vertical axis) vis-à-vis its trade partner ($j$, horizontal axis) has a smaller effect on the bilateral imports of the vertical axis country.

According to the heatmap representation figure 2.5, some results can be inferred. At an aggregate level and on the country-origin imports' perspective, countries that import from Germany, France, United Kingdom, Italy and United States (represented with the darkest columns) are more responsive to changes in the imported components. In addition, it can be seen that at a bilateral level, Canada imports from the United States increase significantly with a change of its imported demand components. On a country bilateral perspective, additional examples are visible in figure 2.5: South-Korea is responsive to Japan, Spain to France, Portugal to Spain and New Zealand is responsive to Australia, among other bilateral country cases.

On the contrary, there are situations where imports react less significantly to the

Figure 2.5: Heatmap - long-run bilateral $IAD$ elasticity relatively to the imports



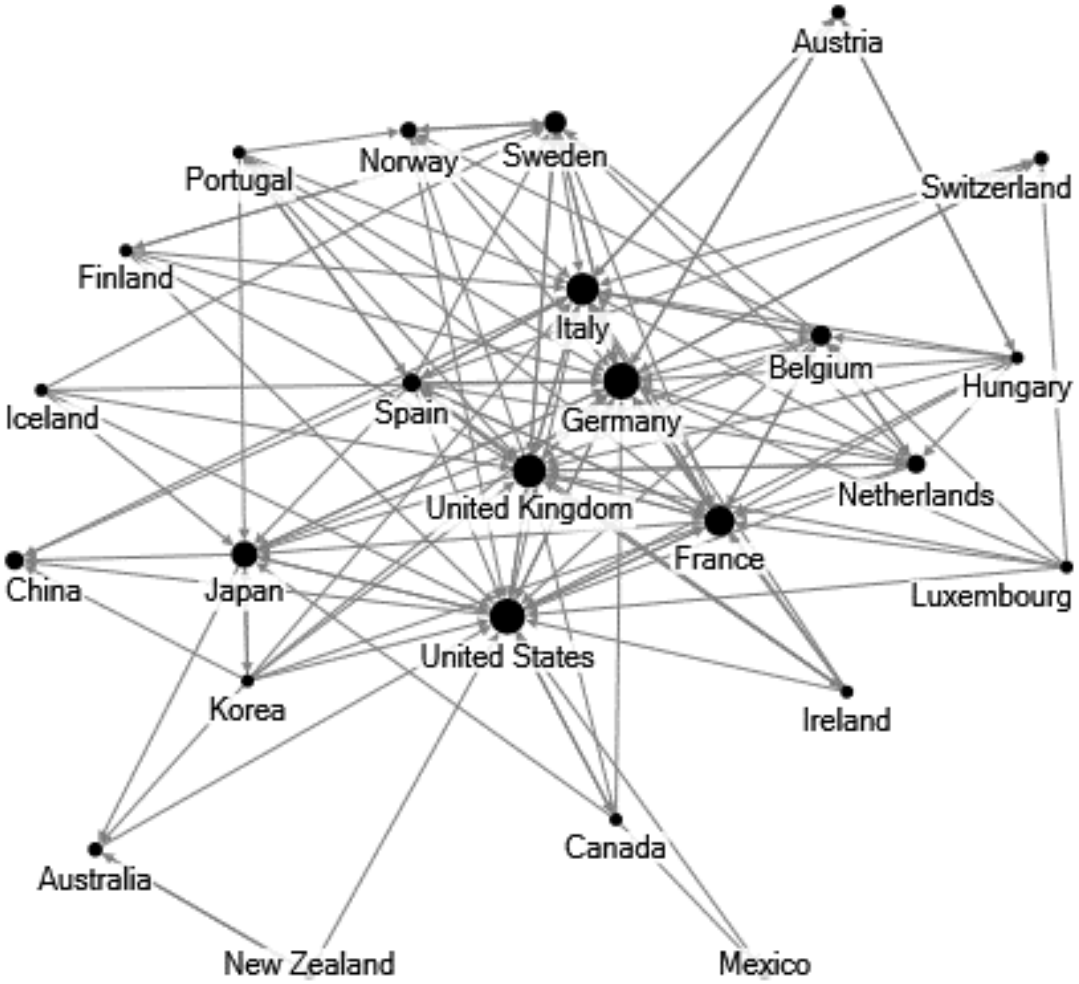

imported intensity-adjusted demand. At a bilateral level New Zealand imports from United States are represented by a lighter colour meaning that they do not react significantly to changes of the imported intensity-adjusted demand.

Another way to represent the bilateral trade elasticity is illustrated in figure 2.6, using the network analysis. This representation enables to illustrate the connections between countries in a clear and structured way identifying the centrality, i.e., the core countries in terms of trade linkages and closeness (the countries which are close to each other).

The matrix with the bilateral $IAD$ elasticities was used to construct a directed and unweighted network. The nodes correspond to each of the individual countries ($N = 25$). The existence of an edge between two countries relies on threshold criterion that aims to reflect the importance of country $j$ (seller) to import intensity-adjusted demand elasticity of country $i$ (buyer). The threshold was set at $\theta^{IAD}_{M_{ij}} = 0.05$. Hence, the edge is directed from a country $i$ to a country $j$, if country $i$ import intensity adjusted demand elasticity from country $j$ is larger than the threshold. The choice of this threshold ensures that the resulting network easy to interpret and visualise, while capturing the relevant interrelations between nodes.

The size of each node is proportional to its total indegree (the imports amount).

Figure 2.6: long-run $IAD$ elasticity - network analysis




The network graphs are based on the Harel-Koren fast multi-scale algorithm and are drawn with the use of NodeXL (see Hansen D. & Smith (2010)), an open-source template for Excel for analysis complex networks (http://nodexl.codeplex.com/).

The results show that Germany, United Kingdom, United States, France and Italy are the centre of the network, the imports from these countries have the highest import intensity-Adjusted Demand. It means that most of the countries considered in this network are more reactive to the imported adjusted demand from these countries.

### 2.3.3 Bilateral adjustment

According to this proposed methodology, the cyclical adjustment is not calculated at an aggregate level and separately to exports and imports (as in the Chapter 1). It will consider the bilateral imports to a domestic country from its trade partners, using the assumption that bilateral imports of the domestic economy correspond to the exports from the foreign economies to the domestic country. Therefore, bilateral adjustment is performed using the bilateral $IAD$ elasticities as described in the previous subsection, according to the equations: 2.4 to 2.8.

The national account's identity was introduced: $Y^* = DD^* + X^* - M^*$ in equations 2.7 and 2.8. Then, solving with respect to $DD$ it is possible to write equation 2.8 as:

$$M^*_{ij} = M_{ij} + \frac{\eta^D_{ij}(Y^*_i - Y_i)}{1 - \eta^D_{ij}} + \frac{(X^*_{ij} - X_{ij})(\eta^X_{ij} - \eta^D_{ij})}{1 - \eta^D_{ij}} \tag{2.9}$$

where $X_i = \sum_{j=1}^{24} X_{ij} = \sum_{j=1}^{24} M_{ji}$

Thus, exports from country $j$ to country $i$ can be expressed as imports to country $i$ from country $j$, we get: $X^*_{ji} = M^*_{ij}$:

$$M^*_{ij} = M_{ij} + \frac{\eta^D_{ij}(Y^*_i - Y_i)}{1 - \eta^D_{ij}} + \frac{(M^*_{ji} - M_{ji})(\eta^X_{ij} - \eta^D_{ij})}{1 - \eta^D_{ij}} \tag{2.10}$$

Equation 2.10 expresses the level of potential bilateral imports that would prevail if domestic output was taken at its potential level (i.e., the level that would prevail if domestic output was at its potential, determining simultaneously (home) exports and domestic demand). This equation estimates the bilateral potential imports of one country ($i$) vis-à-vis its trading partner ($j$).

The ratio between potential and actual imports in real terms is sufficient to pin down cyclically-adjusted nominal imports (nominal potential imports as a percentage of nominal unadjusted GDP):

$$m_{ij}^{adj} = m_{ij} \frac{M_{ij}^*}{M_{ij}} \tag{2.11}$$

where $m_{ij}$ denotes the unadjusted import share on GDP (computed in nominal terms). Finally, the adjusted current account, which is the ultimate object of interest, is given by:

$$ca_{ij}^{adj} = m_{ji}^{adj} - m_{ij}^{adj} + bp_i + bs_i, \tag{2.12}$$

where *bpi* and *bsi* denote the unadjusted balance of primary income and secondary income, as percentage of GDP.

The methodology which is developed allows to model potential exports and imports in a symmetric way, involving only the domestic output gap. In addition, the net trade balance of one country depends not only the impact of the output gap changes on the cyclical adjustment, but also the impact of the adjusted import content of each country vis-à-vis its trading partners, which enables to decompose the cyclical adjustment by trade partner.

Thus, to estimate the cyclical adjustment according to this bilateral endogenous model a recursive solution was applied, using a simultaneous-equation model to encompass all partner countries' as well as domestic economy:

$$\begin{cases} M_{ij}^* = M_{ij} + \frac{\eta_{ij}^D (Y_i^* - Y_i)}{1 - \eta_{ij}^D} + \frac{(M_{ji}^* - M_{ji})(\eta_{ij}^X - \eta_{ij}^D)}{1 - \eta_{ij}^D} \\ M_{ji}^* = M_{ji} + \frac{\eta_{ji}^D (Y_j^* - Y_j)}{1 - \eta_{ji}^D} + \frac{(M_{ij}^* - M_{ij})(\eta_{ji}^X - \eta_{ji}^D)}{1 - \eta_{ji}^D} \\ ... \end{cases} \tag{2.13}$$

This system was calibrated for $25X25 = iXj$ number of equations (different lines) and the solution of this system of 625 equations give the amount of the potential bilateral imports of country $i$ from country $j$.

## 2.4 Data sources

The implementation of the methodology described in the previous section requires a large amount of statistical information and some hypothesis. Firstly, the

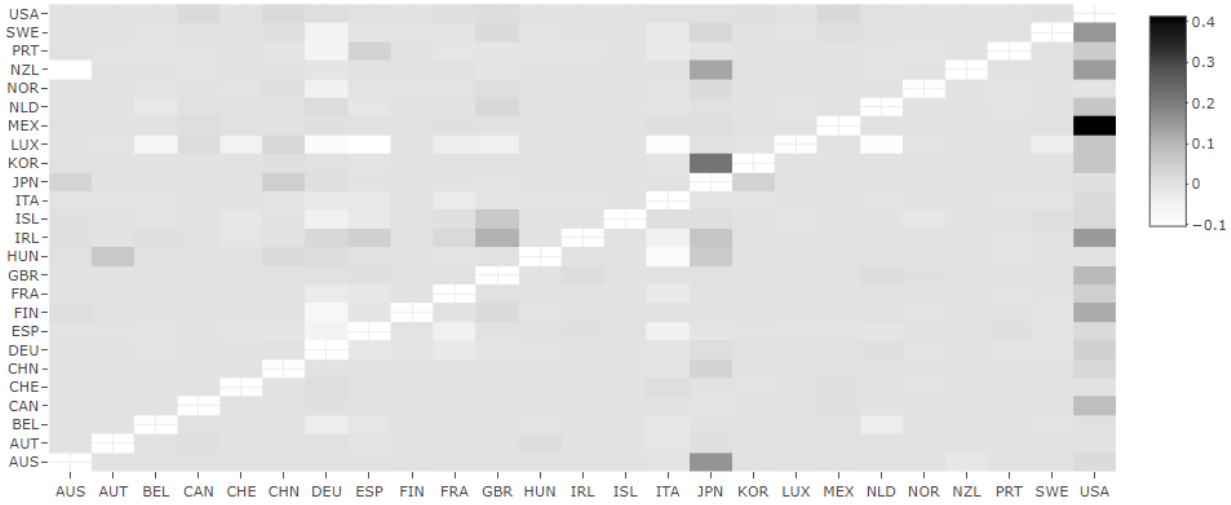
information on the domestic output gaps, is collected from the IMF World Economic Outlook (April 2019). It is widely acknowledged that output gaps depend on the method used for computation (statistical or structural methods) and are sensitive to revisions of data.

Secondly, the source of aggregate and comparable cross-country data to estimate the bilateral long-run $IAD$ elasticity was the OECD Economic Outlook (November 2018). We used quarterly data from Q4 1995 until Q4 2011 for the volumes of GDP and its components: government consumption, private consumption, gross total fixed capital formation, imports and exports of goods and services. Moreover, we collected the corresponding deflators of GDP and total imports of goods and services. In addition, the long-run elasticity of the $IAD$ requires also information contained in global about input-output matrices. For this purpose, we used the $2016^{th}$ edition of the OECD Inter-Country Input-Output database (ICIO), which includes information for a total of 71 countries and 34 industries, according to a classification based on ISIC Rev3, on an annual basis from 1995 until 2011.

As in Bussière *et al.* (2013), both the domestic and imported matrices were used to construct the import contents of four expenditure components: private consumption, government consumption, investment (proxied by gross fixed capital), and exports. In addition, the information was aggregated across sectors and took the import contents at a country level. The ICIO tables enables to compute the indirect imports, i.e., the amount of imports "induced" by the expenditure on domestically provided goods and services. This includes the imports of intermediate inputs from foreign suppliers, as well as imports already incorporated in capital and intermediate inputs acquired from domestic suppliers. Direct imports are also considered for each component. To determine the domestic output induced by each expenditure component, the domestic input coefficients obtained under the ICIO tables was used, through the Leontief inverse matrix.

Finally, bilateral imports were estimated by applying the weights of imports of goods and services by counterpart country from the OECD ICIO tables to the individual country data from OECD available until 2011. The bilateral exports were

Figure 2.7: Bilateral trade cyclical adjustment differences during and before the financial crisis period, as percentage of GDP - Heatmap (grey scale colour)




obtained through the bilateral imports information according to the assumption illustrated previously (figure 2.4).

## 2.5 Results

### 2.5.1 Bilateral cyclical adjustment of the trade account

The methodology described in the previous section was applied to the individual unadjusted bilateral trade account. The results obtained for each country in the sample are represented in the $25X25$ heatmap (figure 2.7). The heatmap represents the difference (in absolute terms) between the average of the bilateral trade account balance cyclically adjusted during the financial crisis (2007-2011) and before (1996-2006). The vertical axis (twenty-five countries) represents the domestic economies which import from each of the twenty-five countries represented in the horizontal axis.

The heatmaps was obtained through the *shiny* R package. It uses grey colours ("R" package colours - 'Greys') to represent the differences in the cyclical adjustment during and before the financial crisis period in the bilateral trade account.

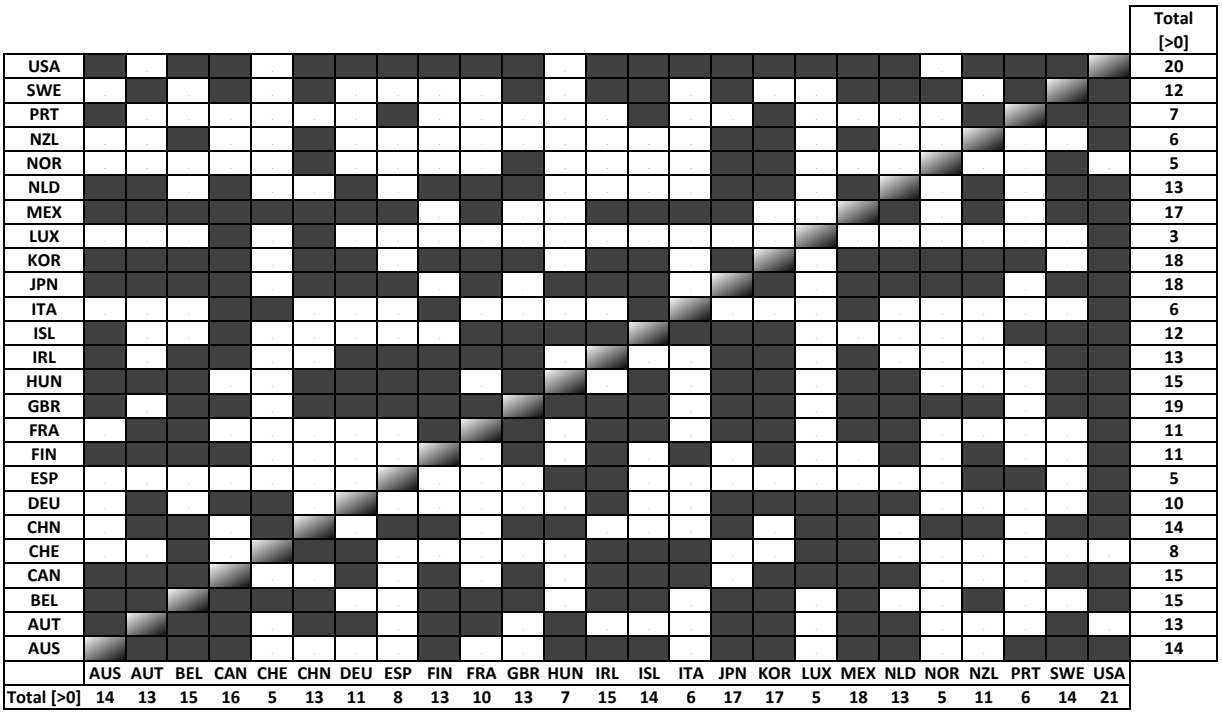
The colour of each cell is ranked between the lowest value (represented with a lighter colour) and the highest positive value (represented by a darker colour). This heatmap aims to represent mainly the magnitude of the bilateral cyclical adjustment difference during and before the financial crisis.

The results show that in general the differences of the cyclical adjustment of the trade account as percentage of GDP during and before the financial crisis period are small (there are not many situations with black/white cells). It means that at a global level (for the selected twenty-five-country sample), if all countries were at their potential output level during and before the financial crisis period, the cyclical adjustment of the trade account as the percentage of GDP would not differ significantly from the actual amounts.

Nevertheless, at a bilateral country level the results suggest that there are some specific situations which are important to be highlighted. The two darker columns 'USA' and 'JPN' mean that the United States and Japan contributed for its trading partners to a higher cyclical adjustment during the financial crisis period when compared with the previous years. On the contrary, Germany and Italy exhibit lighter columns meaning that these two countries contributed to a lower cyclical adjustment of their trade partners during the financial crisis than before. In addition, on a bilateral basis, the cyclical adjustment difference of New Zealand vis-à-vis Australia is negative (represented by a white colour) which means that Australia contributed for a lower cyclical adjustment during the financial crisis than before this period. On the contrary, the cyclical adjustment of Mexico vis-à-vis United States is positive (represented by a darker colour) meaning that United States contributed to a higher cyclical adjustment of the trade account during the financial crisis than before this period.

This analysis is complemented by figure 2.8 that represents the cases where the cyclical adjustment (in absolute values) was higher during the financial crisis than before (positive differences - black colour), or the opposite situations (white colour). The column 'Total' represents the number of trade partner countries that contributed to a higher bilateral cyclical adjustment during the financial crisis than

Figure 2.8: Bilateral trade cyclical adjustment differences during and before the financial crisis, absolute values - Heatmap

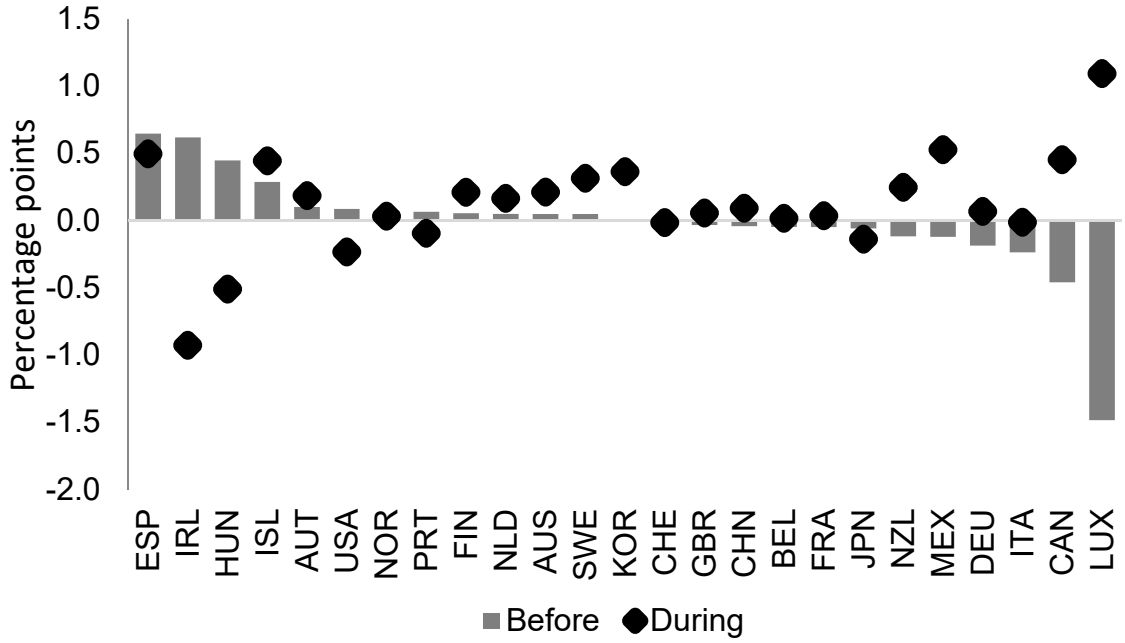



before this period, for each row country. Complementary, the row 'Total' represents the number of (row) countries that each column country impacted for a higher cyclical adjustment during the financial crisis than before this period.

The results show that there are different impacts either positive or negative to the overall cyclical adjustment, depending on the trade partner country. In particular, the United States contributed to a higher cyclical adjustment during the financial crisis period for 21 countries (row 'Total') out of the remaining 24 sample countries, whereas Luxembourg, Switzerland and Norway contributed to a higher cyclical adjustment of less countries during the financial crisis period (5 countries out of 24).

In addition, it can be mentioned that 20 trade countries out of the remaining 24 counties contributed to a higher cyclical adjustment of the United States cyclical adjustment during the financial crisis period (column 'Total') and only 3 in the case of Luxembourg.

Figure 2.9: Cyclical adjustment of the trade account on a country basis, as percentage of GDP during and before the financial crisis




On an individual country level figure 2.9 shows for each country of the sample, the individual cyclical adjustment during and before the financial crisis period. It represents the average of the cyclical adjustment trade account as percentage of GDP during the financial crisis (annual average 2007-2011) and after the financial crisis (1996-2006). The results were aggregated for each of the twenty-five country sample.

Figure 2.9 shows that the magnitude and the sign of the cyclical adjustment differ in these two periods. Globally, the cyclical adjustments are higher during the financial crisis period than before. On an country basis, 17 [5] out of the 25 sample countries exhibit higher adjustments during the crisis than before this period.

Regarding the G7+CHN countries, the figure illustrates that for Canada, China, Germany, France, United Kingdom and United States, the average of the cyclically adjusted trade accounts during and before the financial crisis, was asymmetric. On the contrary, Italy and Japan remained with negative cyclical adjustments as before

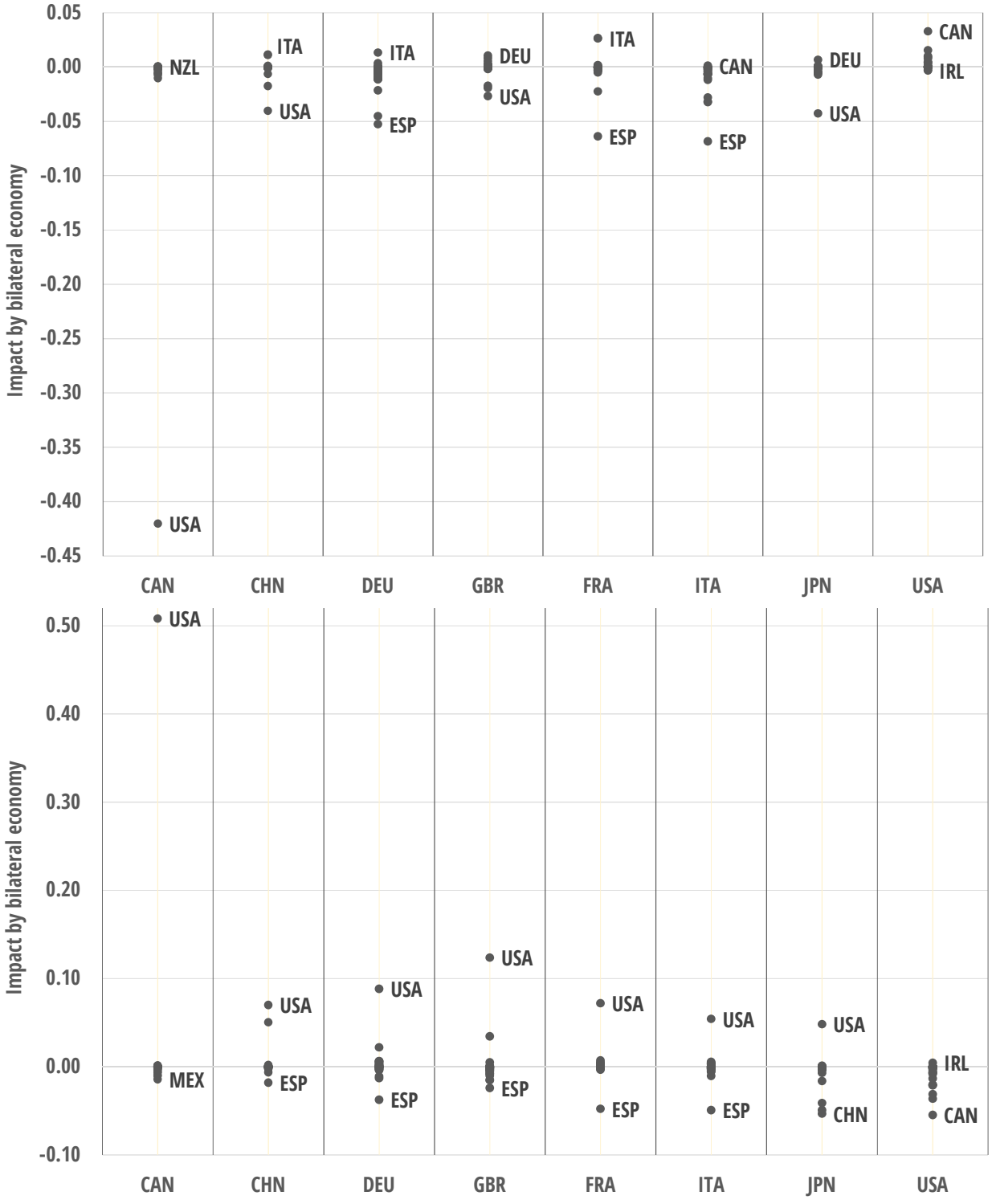
[5]AUS, MEX, IRL, KOR, GBR, JPN, NZL, USA, SWE, CAN, NLD, HUN, FIN, CHN, ISL, AUT and CHE.

the financial crisis. This analysis is complemented with figure 2.10 that shows by contribution, the impact of the cyclical adjustment before and during the financial crisis period for the G7+China countries.

At a country level, it can be seen that before the crisis United States contributed to a negative cyclical adjustment impact for Canada, China, United Kingdom and Japan, whereas Spain had a negative impact vis-à-vis Germany, France and Italy (Ireland vis-à-vis United States). On the contrary, Italy, Germany, Canada and New Zealand were the responsible for the positive cyclical adjustments.

During the financial crisis period it is interesting to see that United States had the most positive impact on the cyclical adjustment in the G7 countries+China, whereas Spain, China, Canada and Mexico (had a negative impact on the cyclical adjustment).

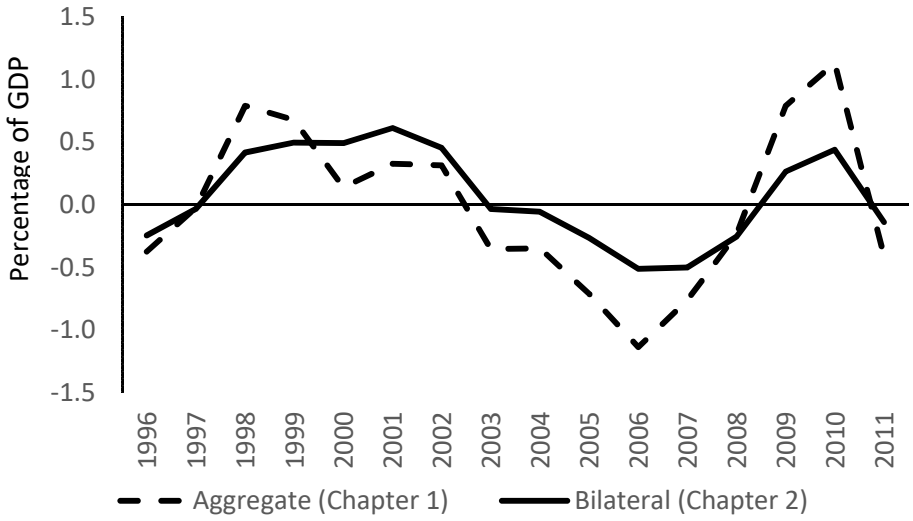
Figure 2.10: Cyclical trade account adjustment, as percentage of GDP by counterpart country before (top) and during (bottom) the financial crisis period



### 2.5.2 Bilateral vs Aggregate cyclical adjustment

As mentioned previously, the methodology presented in this Chapter complements, on a bilateral perspective, the aggregate cyclical adjustment estimated in the Chapter 1. The results obtained through the two methodologies are consistent, thus they depend on the relevance of the sample for the aggregate trade. Figure 2.11 plots the comparison between the two methodologies for Portugal (aggregate and bilateral estimations of the cyclical adjustment).

Figure 2.11: Bilateral vs Aggregate cyclical adjustment, as percentage of GDP




Nevertheless, the methodologies do not reproduce the exact results. These differences are mainly explained by the methodology and the relevance of the sample to the aggregate trade. In respect to the methodology, in this chapter, exports are determined as a 'mirror' value of the imports. Therefore, long-run elasticity of exports is not used in this estimation, but rather the $IAD$ values. Regarding to the relevance of the sample to the overall imports, if total imports are almost covered by the contribution of the sample partners, then the two estimations are close and produce similar results. Analogously, if the sample did not correspond to a representative percentage of the total imports, then the results obtained through these two methodologies would diverge.

According to our results, (figure 2.11) the two methodologies are consistent for

Portugal. The model exhibited in the Chapter 1, provides the aggregate cyclical adjustment, whereas Chapter 2 provides the bilateral cyclical adjustment of Portugal vis-à-vis its twenty-five sample partners.

## 2.6 Concluding remarks

The financial crisis showed that effectively managing the risks posed by both types of imbalance is crucial for sustainable global growth and financial stability. The trade account balance is a key macroeconomic indicator to evaluate global imbalances and specifically the impacts of the most recent financial crisis. Although in the nineties and early years of the new century its importance was somewhat downplayed for the case of countries taking part in a monetary union, the global economic and financial crisis of 2008 and the euro area sovereign debt crisis that followed have shown that countries cannot run prolonged current account deficits and strongly deteriorate the net external position. As in the case of other macroeconomic variables, exports and imports are strongly affected by cyclical developments. Therefore, it is important to disentangle structural and cyclical developments. This article performs the cyclical adjustment of exports and imports on a bilateral dimension, to evaluate the global impact of the financial crisis in the trade account balances.

Moreover, although global imbalances diminished after the 2008-2009 financial crisis, there are bilateral asymmetries across countries, which can offset the global results. In this chapter, we concluded that for most of the countries of this sample, the cyclical adjustment of the trade account during the financial crisis was higher than in the previous years, on average. At a bilateral level it is important to highlight that the adjustment is not homogeneous and therefore, bilateral analysis is crucial to assess global imbalances. The United States and Japan were the countries that contributed mostly to this result.

Focusing on the cyclical adjustment during and before the financial crisis period for the G7+China countries, we concluded that the United States was the main

driver of the cyclical adjustment, but Spain also played an important role.

Before the financial crisis the United States represented the country with the most negative adjustment for Canada, China, United Kingdom and Japan, whereas Spain contributed mostly for European Countries (Germany, France and Italy). On the opposite direction, Italy, Germany, Canada and New Zealand contributed positively to the cyclical adjustment of the current account. During the financial crisis, the United States was the country that contributed most positively to all the remain G6+China countries, whereas Spain contributed negatively to the cyclical adjustment of China, Germany, United Kingdom, France and Italy. Mexico, Canada and China were also the most responsible negative contributors for Canada, Japan and United States respectively.

The caveats of this approach lie on the data asymmetries that may exist when countries report their bilateral imports/exports vis-à-vis its trade partners. Notwithstanding, the results suggest that policy makers should be very conscious about the international trade policy. In particular, the international trade linkages between the United States and all the other countries are crucial for the reduction of global imbalances. With the financial crisis global imbalances reduced, although it is important also to assess bilateral imbalances. In this respect, it is important that all the countries promote free movement of goods and services avoiding any kind of trade barriers. Moreover, countries should allow for adjustments in exchange rates. In the short-run it will benefit international trade across countries and, in the long-run, enhance better standards of economic growth specialized on comparative advantages and mutual gains from trade.

# Chapter 3

# Cross-Border Banking Linkages and the Cascading Effects of Crisis

## 3.1 Introduction

Deeper financial integration has been one of the main traits of globalization. Access to the international capital markets expands investment opportunities, making it possible to diversify portfolios while allowing for higher rates of return. From the perspective of the recipient country, foreign investment promotes potential growth and welfare gains as a result of international risk sharing (Obstfeld & Rogoff (1995)). Moreover, it promotes financial development and provides resources needed to finance domestic investment.

During the last decades, many countries encouraged capital flows by deregulating domestic financial markets and improving their overall economic regulation. Many developing economies in East Asia, Latin America and Eastern Europe have removed restrictions on international financial transactions. Borio & White (2003) and Borio & Disyatat (2011) refer that the financial system became more elastic because regulations on the financial system have been relaxed. According to the BIS (2001), the development of financial liberalization and globalisation undertaken since the 1970s

[0]This chapter was written in co-authorship with João Amador.

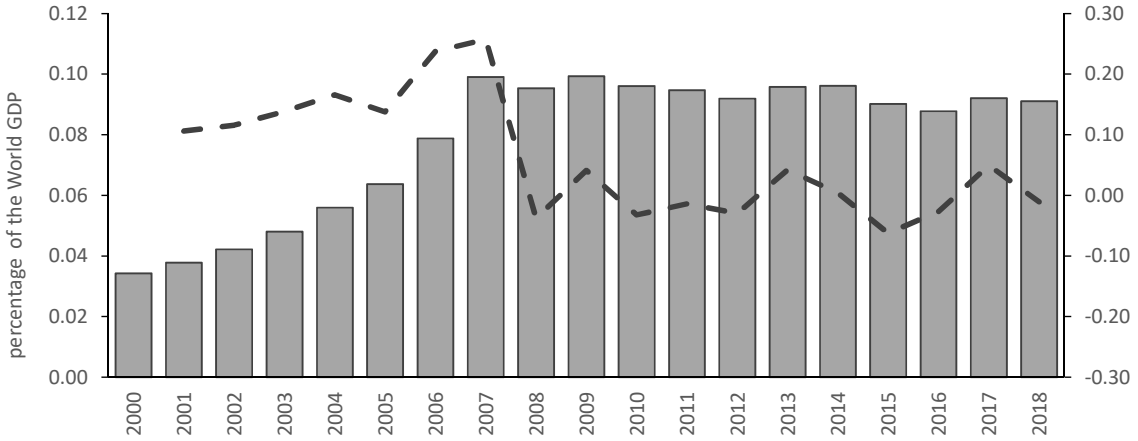
has been instrumental in generating "excess financial elasticity" in the global system. Nevertheless, financial volatility has been enhanced by technological progress, notably in terms of lower transaction costs that arise from digitalization. After the latest financial crisis, the 'shadow banking' has emerged and non-bank financial institutions outside the regular banking system have increased their importance in facilitating credit to the economies. Similar to the traditional baking system, these non-bank credit intermediaries assume the risk of credit, liquidity, currency and maturity but usually these activities occur in a less regulated market, increasing also the volatility and exposure of the financial sector.

Stability is a desired feature in the economies in general and in financial markets in particular. Schinasi (2011) argues that a financial system is stable when it enhances the performance of the economy, notably through the efficient allocation of resources, being able to dissipate financial imbalances. The risk of financial volatility and abrupt reversals has an immediate impact on the credibility and is made worse by contagion effects of a systemic nature. The risks of contagion are more sensitive in the traditional banking sector due to the need to preserve the confidence of depositors. The risk of confidence does not apply to the non-banking institutions, that cannot accept deposits from its clients.

The size of banks' cross-border portfolios increased significantly over the last decades. Their market value is influenced also by valuation effects, both in terms of price and exchange rate changes. Figure 3.1[1] plots banking cross-border claims, from a bank residence perspective, between 2000 and 2018 as a percentage of world GDP. The graph shows a sharp increase in cross-border claims up to 2007 and a sharp decrease with the global financial crisis of 2008. Since then, claims as a percentage of world GDP levelled off around 10% of the world GDP.

[1]Iso-code 2 will be considered to identify countries: AU - Australia; AT - Austria; BE - Belgium; CA - Canada; CH - Switzerland; CN - China; DE - Germany; DK - Denmark; ES - Spain; FI - Finland; FR - France; IE - Ireland; IN - India; IT - Italy; JP - Japan; KO - South Korea; LU - Luxembourg; MY - Malaysia; NL - Netherlands; PT - Portugal; SE - Sweden; SG - Singapore; UK - United Kingdom; US - United States

Figure 3.1: Banking cross-border claims as % of GDP (LHS) and annual growth rates (RHS) in 2000-2018



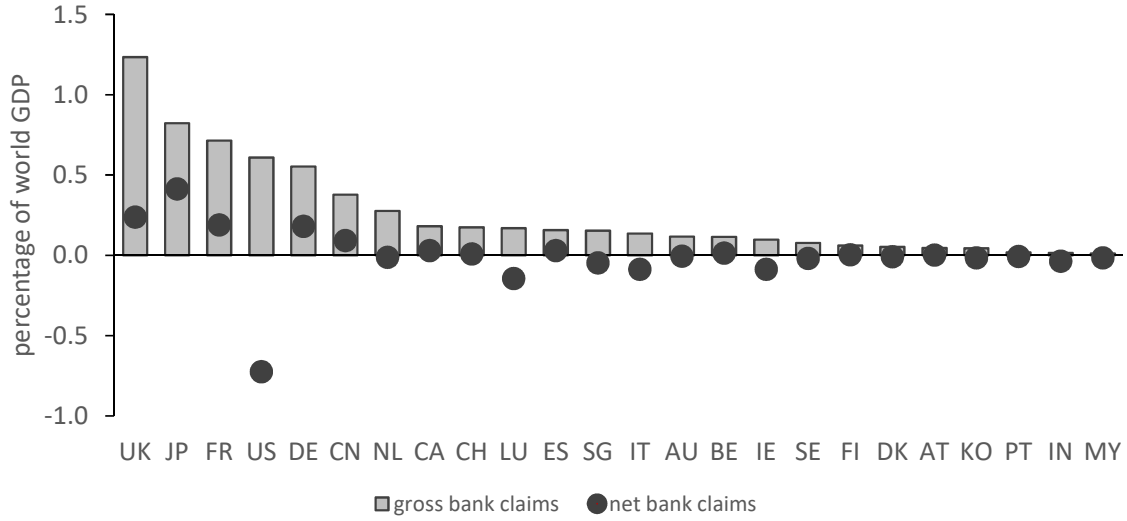

Source: International Monetary Fund and Bank for International Settlements.

Note: Cross-border claims are obtained from Locational Banking Statistics (LBS). LBS comprise stocks of financial claims and liabilities of internationally active banks, i.e. excluding only resident domestic banks without positions vis-à-vis non-residents of the reporting country. It covers all on-balance sheet positions and some off-balance sheet positions in trustee business.

Figure 3.2 takes cross-border gross and net claims as a percentage of world GDP in 2018 for a set of 24 countries, basing on the existing information by counterpart country. According to these numbers, United Kingdom holds the highest cross-border gross claims as a percentage of world GDP, followed by Japan, France, United States and China, respectively. Conversely, Portugal, India and Malaysia are the countries in the sample with the lowest cross-border claims as a percentage of world GDP. Figure 3.2 shows that Japan is the country with the highest positive net claims holdings as a percentage of world GDP, while for United States the net position is negative, reaching 0.8 percent world GDP.

Despite the large scale of cross-border claims facilitated by higher liberalization of capital movements and technological progress, there is limited diversification of portfolios. The data reveals that external assets are highly concentrated in a few countries. The top six countries (United Kingdom, Japan, United States, France, China and Germany) represented on average approximately 55% of total cross-border claims in the period 2000-2018.

Figure 3.2: Cross-border gross and net bank claims as % of world GDP (2018), by holding country




Source: International Monetary Fund and LBS - Bank for International Settlements

The strong financial integration and the concentration of banks' cross-border holdings in a few foreign countries accelerate the propagation of shocks, which can ultimately lead to global financial crisis with strong impacts on employment and GDP developments. Nevertheless, the origins of potential shocks and the specific linkages associated with banks' cross-border claims determine differences in the time profile and overall effects of the crisis.

The purpose of this paper is to simulate the impact of shocks in banks' cross-border holdings in selected countries and assess the impact on others along time. The underlying set up is one of partial equilibrium, with no impact of crisis in GDP levels or any other macro variables and shocks are triggered by net positions turning lower than pre-defined thresholds. Although this is a very stylized exercise, it adds the value to the literature by considering cross-country cascading effects. Most of the analysis and results focus on the G7 countries plus China.

The results show that United Kingdom - where banking systems located most of their assets in 2018 - is the most affected country in the event of shocks in each of the G7+China group. In addition, the United States imposes the most relevant damages on international banking assets. In our stylized exercise, an initial shock on

the United States banking system will cause a decrease of almost 60 percent of total cross-border claims after 5 periods. Finally, when comparing the impacts of United States banking shocks on others China emerges as the country mostly affected.

The paper is organized as follows. Section 3.2 briefly reviews the literature on cross-border banking linkages and its connection with financial stability. In addition, it refers the literature on cascading effects in networks. Section 3.3 describes the data used in the stylized simulation exercises. Section 3.4 describes the iterative algorithm constructed to estimate bank interconnections and assesses the resilience of the global system. Results are presented in section Section 3.5. Finally, Section 3.6 concludes.

## 3.2 Related literature

The literature on the propagation of financial crisis and systemic risk encompasses different strands. Regarding the size of international capital flows related to banks Hills & Hoggarth (2013) look at the cross-border credit assets and conclude that it contributed to the vulnerabilities before the great financial crisis and exacerbated the bust after the recession. Complementary, Hoggarth *et al.* (2010) discuss how the 2008-2009 financial crisis propagated through the international banking system and conclude that several constituencies strongly deleveraged their external positions due to funding and capital pressures. More recently, Bremus & Fratzscher (2015) argued that cross-border bank lending has decreased and that regulatory policies should adapt to the new reality.

In a close strand of research, Vinãls *et al.* (2013) analyse on the optimal banks size and their functional / organizational complexity. They conclude that larger and more complexed banks, create more systemic risk and, thus, financial systems should define a more global and coordinated policy. Complementary, Laeven *et al.* (2014) analysed the relationship between four different aspects - measures of bank size, market-based activities, organizational complexity, and measures of risk. According to the authors, large banks create more systemic risk than smaller ones.

In a different vein Degryse *et al.* (2009) examine cross-border contagion risk over the period 1999-2006. The authors argue that a shock affecting assets and liabilities in one country may undermine the financial stability of the entire financial system. Their simulations show that the magnitude and the speed of the shocks' propagation has increased in recent years and, consequently, the vulnerabilities and exposure of banking systems to financial risk is higher. Moreover, the contagion is more widespread in geographical proximities. On the cross-country financial claims linkages and the resilience of national banking systems to systemic shocks, Buch *et al.* (2010) identify the optimal international asset portfolios for banks. The authors find that the differences between the optimal portfolios and the actual international asset positions are explained mainly by regulations, institutional and organizational arrangements, cultural conditions among other factors.

The literature based on networks to explore the linkages between the banking systems has also expanded. Kali & Reyes (2010) analysed the interconnections of the stock market returns under an interdependent complex network to explain the dynamics of the latest financial crisis and the correspondent financial contagion effects. Joseph *et al.* (2013) analysed the network of portfolio investment, both on equity and debt securities (long-term) financial instruments, to measure the interdependence of financial markets and robustness of the global financial system. Caccioli *et al.* (2018) summarize the recent developments in the modelling of financial systemic risk, focusing on interbank networks, notably models of default due to bilateral exposures or to overlapping portfolios.

Since the 2008-2009 financial crisis, systemic risk has been analysed in multiple domains such as: economics and finance, statistical physics, ecology among other domains (May *et al.* (2008)). One interesting perspective is the utilization of extinction analysis to determine the robustness of a network (Foti *et al.* (2013)). Acemoglu *et al.* (2015) analyse the systemic risk and stability in financial networks. The authors suggest if the magnitude of negative shocks affecting financial institutions are sufficiently small, a more connected and denser financial network reflects financial stability through a diversified pattern of interbank liabilities.

## 3.3 Data sources

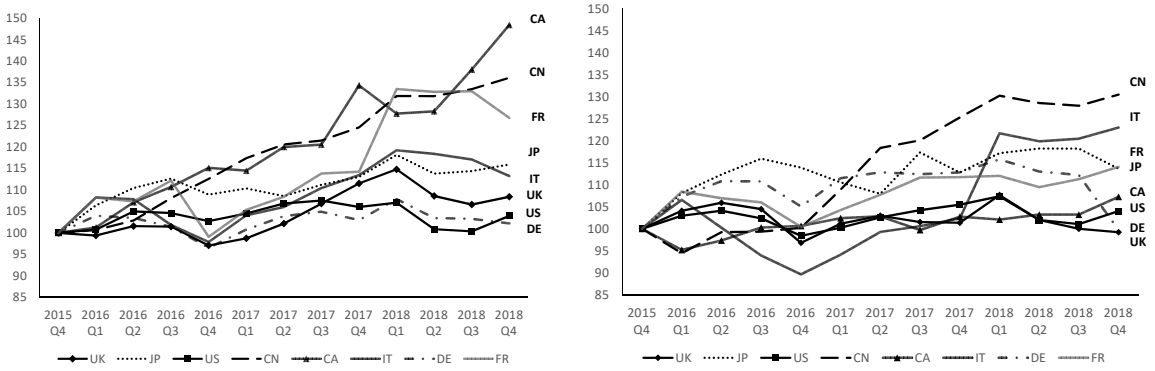
The paper uses data on bilateral balance sheet assets and liabilities of resident banks for a set of twenty-four countries in the period 2000-2018. The bilateral nature of the data makes it very rich, and this feature is crucial to study the cross-border cascading impact of crisis. The source of the data is the Locational Banking Statistics (LBS), compiled by the Bank for International Settlements. We focus on cross-border assets (that we take as liabilities of the counterpart countries) because this information is broader than the one reported for liabilities. The sample represents more than 80 percent of the total claims and liabilities reported in the LBS for the whole time period. However, most results will focus on the group of the G7 countries plus China. This group represents close to 60 percent of total banking cross-border assets and liabilities reported.

Although the BIS database contains two subsets of information, by residence and nationality, we use the locational banking statistics by residence, which combines the breakdown by residence of the reporting bank with a full country breakdown of counterparties. The objective is to assess shocks originating in specific locations. In other words, a shock that affects a specific country will impact on all resident banks independently of their nationality, which implicitly bases on the assumption that assets and liabilities are linked to the situation of the country where it is operating. The information of LBS by residence provides the end-of-period stocks of the bank's assets and liabilities, which is defined also by the bank's international investment position.

The database comprises outstanding amounts for all instruments (loans and deposits, debt securities and other assets and liabilities) and counterparty institutional sectors (Banks, General Government, Households and NPISHs, Non-bank financial institutions and Non-financial corporations). Again, we assume that a shock that occurs in a specific location will affect all instruments in the balance sheet.

The dynamics of cross-border assets and liabilities for the G7 and China are depicted in the two panels of figure 3.3.

Figure 3.3: G7 and China country cross-border assets and liabilities as percentage of total in 2018




((a)) Cross-border assets

((b)) Cross-border liabilities

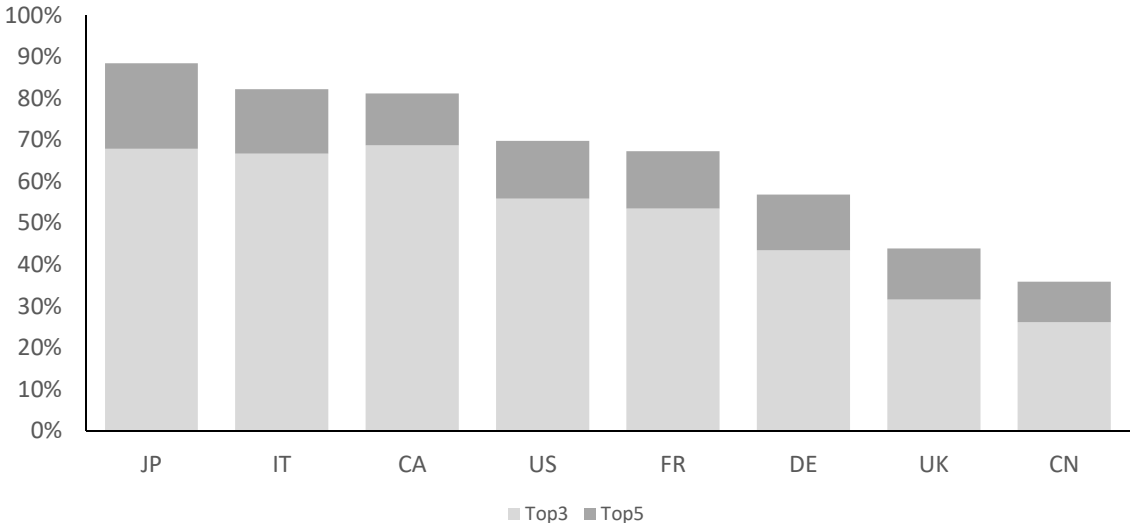
Source: LBS - Bank for International Settlements

Between 2015 and 2018 Chinese banks increased its foreign assets by almost 50 percent in accumulated terms. French banks increased foreign assets by 35 percent. On the liabilities side, China is also the country with the largest accumulated increase (30 percent).

The concentration of the reported banking cross-border claims vis-à-vis the recipient countries is high and varies across countries. Figure 3.4 represents the share of the top 3 and top 5 recipients for each of the G7 countries and China in 2018. The top 5 recipient countries of cross-border claims represent almost 90 percent of the total foreign assets of the Japanese banking sector. A similar calculation for China reports a share of less than 50 percent. Table 3.2, in Appendix also shows the comparison between the concentration of the top 5 recipient countries by G7 plus China investors between 2015 and 2018.

Finally, nominal Gross Domestic Product (GDP) and net international investment positions for 2018 are also used in our stylized simulation exercise to set vulnerability thresholds. The source of these variables is the IMF World Economic Outlook.

Figure 3.4: Top 3 and top 5 countries as a percentage cross-border claims, 2018




Source: LBS - Bank for International Settlements

## 3.4 Methodology

The main objective of this article is to analyse the propagation of shocks across banking systems and thereby assess the resilience of individual jurisdictions and the overall system to such shocks. For this purpose, we construct a sequential algorithm that operates over two main steps.

The first step corresponds to the initial shock that is set deterministically. In this step a specific banking system restructures and, consequently, banking cross-border claims and liabilities vis-à-vis the rest of the world are reduced by a given proportion (a pre-defined rule). In the second step a sequence of adjustments is triggered and operates in the following periods. At each point in time the net position of each banking system is computed and if it reduces in such a way that drags the International Investment Position of the country to below a given threshold, there is a restructuring as established in the pre-defined rule. This change in banking cross-border claims and liabilities versus the remaining banking systems, whose net position is reassessed in the following period, potentially gives rise to cascading defaults.

Matrix $A$ represents the $N \times N$ matrix of banks' cross-border claims and liabilities

of the $N$ reporting countries. Claims versus counterparts are presented in rows and liabilities are identified in columns. Therefore:

$$A^t = \begin{bmatrix} a^t_{1,1} = 0 & a^t_{1,2} & ... & a^t_{1,N} \\ a^t_{2,1} & a^t_{2,2} = 0 & ... & a^t_{2,N} \\ ... & ... & ... & ... \\ a^t_{N,1} & a^t_{N,2} & ... & a^t_{N,N} = 0 \end{bmatrix}$$

where $a^t_{i,j}$ represents the cross-border claims of country $i$ vis-à-vis country $j$, or equivalently, the liabilities of country $j$ vis-à-vis country $i$ in moment $t$. Combining cross-border claims and liabilities, the net claims of country $i$ in moment $t$ are defined as:

$$N^t_i = \sum_{\substack{j=1, \\ i \neq j}}^{N} a^t_{i,j} - \sum_{\substack{i=1, \\ j \neq i}}^{N} a^t_{j,i} \tag{3.1}$$

The starting point of the exercise ($t = 0$) corresponds to LBS data for 2018. If a shock occurs in period $t$ in a country $k$ we assume a decrease of all its banking cross-border claims and liabilities vis-à-vis the other $N - 1$ partner-countries by a similar proportion $\phi$. Therefore, elements in line and column $k$ of matrix $A^{t+1}$ are affected and become:

$$A^{t+1} = \begin{bmatrix} a^t_{1,1} = 0 & ... & \phi a^t_{1,k} & ... & a^t_{1,N} \\ ... & ... & ... & & ... \\ \phi a^t_{k,1} & ... & a^t_{k,k} = 0 & ... & \phi a^t_{k,N} \\ ... & ... & ... & & ... \\ a^t_{N,1} & ... & \phi a^t_{N,k} & ... & a^t_{N,N} = 0 \end{bmatrix}$$

As previously mentioned, restructures lead to a sequence of adjustments in foreign banking systems, which may conduct to additional restructures down the line. Such reductions in claims and liabilities of a country $k$ occur when two conditions are present: i) there is a net reduction of net cross-border claims of country $k$; ii) the net International Investment Position of country $k$ as a percentage of GDP, which

is affected downwards by the restructuring that took place, stands below a given parameter $\gamma$ measured as a percentage of GDP.

We carried out illustrative simulations using the 24 countries in the sample and started each one of them with a separate shock in the group of the G7 countries plus China. After the initial shock, the simulation estimates the impacts in the next 5 periods. The benchmark values for the parameters are $\phi = 50\%$ (haircut percentage of cross-border claims and liabilities, both in the initial shock and in subsequent restructures) and $\gamma = -12.2\%$ (corresponds to the 3rd percentile of the distribution of the international investment positions as a percentage of the GDP in the sample of 24 countries).

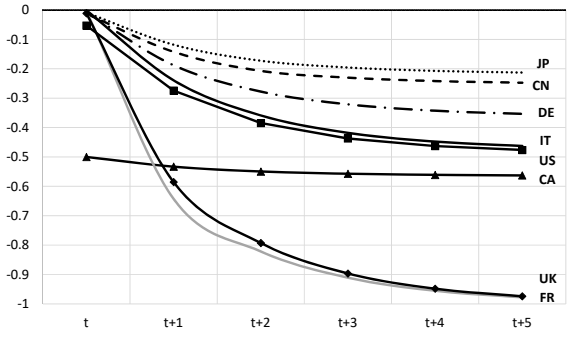
## 3.5 Results

In this section use analyse the effects of shocks in each of the G7 countries plus China and the emerging cascading effects. Next, we take a network perspective and discuss the relative importance of each country after the occurrence of these shocks.

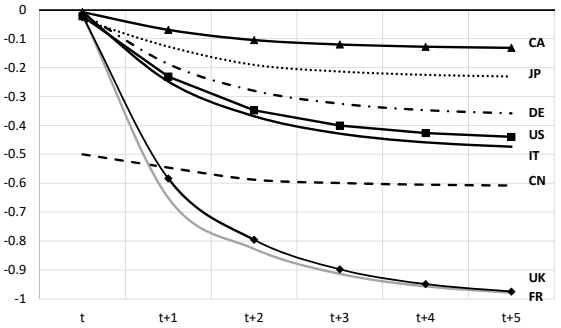
### 3.5.1 Cascading effects from crisis

The eight panels of figure 3.5 present the cross-border claim losses as a percentage of total claims in each of the G7 countries and China motivated by a shock in each country separately. In the initial period the country affected by shock reduces its total cross-border assets by 50 per cent, as assumed in the exercise ($\phi = 0.5$). Only in $t + 1$ other countries start recording losses.

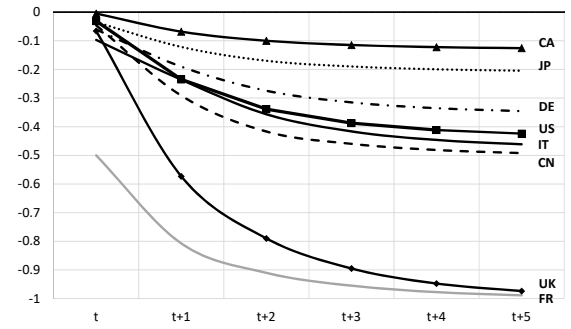
Figure 3.5: Losses in cross-border claims as a percentage of total claims



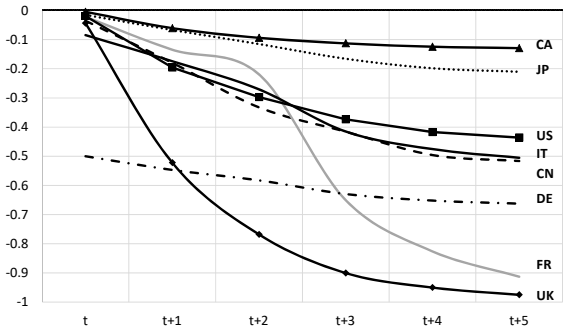

((a)) Shock in Canada



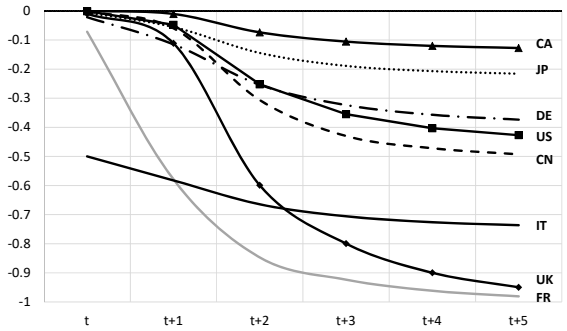

((b)) Shock in China



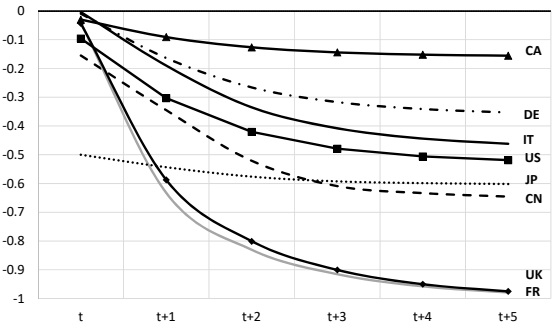

((c)) Shock in France



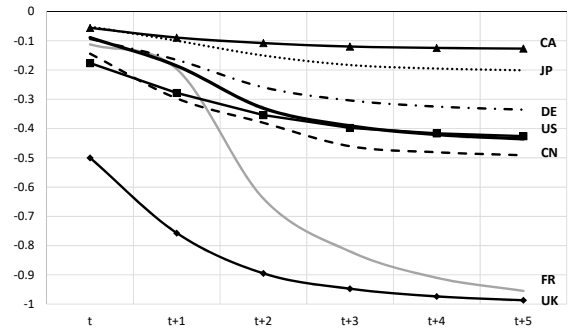

((d)) Shock in Germany



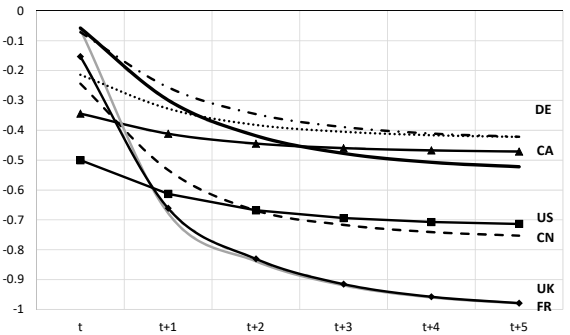

((e)) Shock in Italy




((f)) Shock in Japan




((g)) Shock in UK

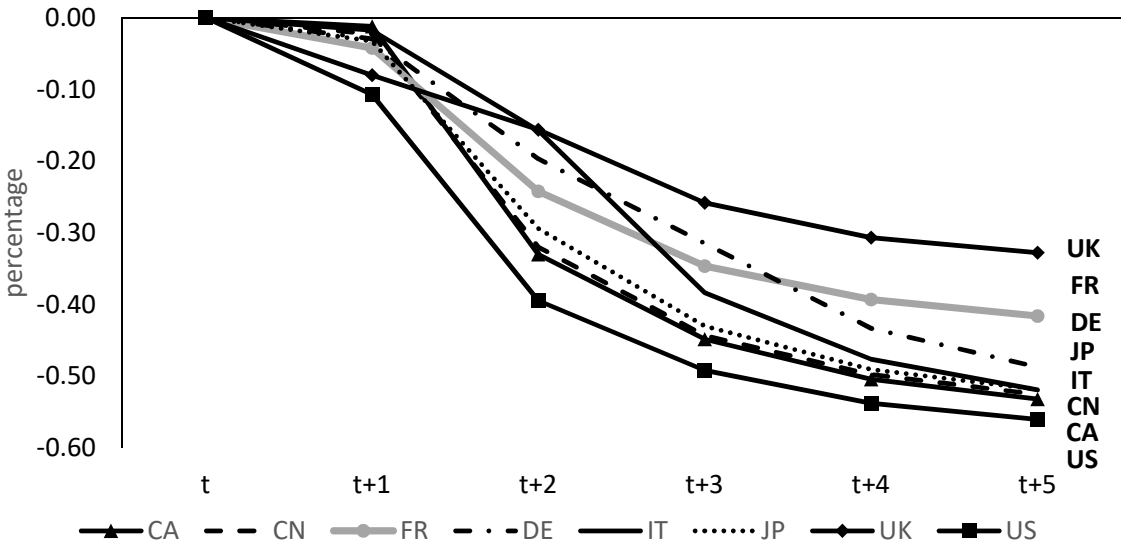



((h)) Shock in US

The exercise shows that the two countries most affected by foreign restructurings are France and the United Kingdom. For all cases, after 5 periods, these two countries loose almost all cross-border claims. Another relevant result is that, besides United Kingdom and France, China is severely affected in the event of a shock starting in the United States banking system, loosing almost 80 per cent of its total cross-border assets. This effect is more severe than the one emerging from a shock starting in China itself. On the contrary, Canada stands as a relatively resilient country in the face of cross-border banking shocks, with losses between 10 and 20 per cent after 5 years. The impact on its cross-border claims is only stronger if the shock is triggered in the US (reaching 40 per cent after 5 years).

Figure 3.6 presents the aggregate losses in the sample during the 5 years following a shock in each of the G7 countries and China. It shows that the shock originated in the United States has the highest impact on the total cross-border claims (close to 60 per cent after 5 periods). Canada, China and Japan also have a relevant impact on total losses (close to 50 per cent after 5 periods). The United Kingdom is the country with the lowest total impact, amounting to losses of 30 per cent of total international cross-border claims after 5 years.

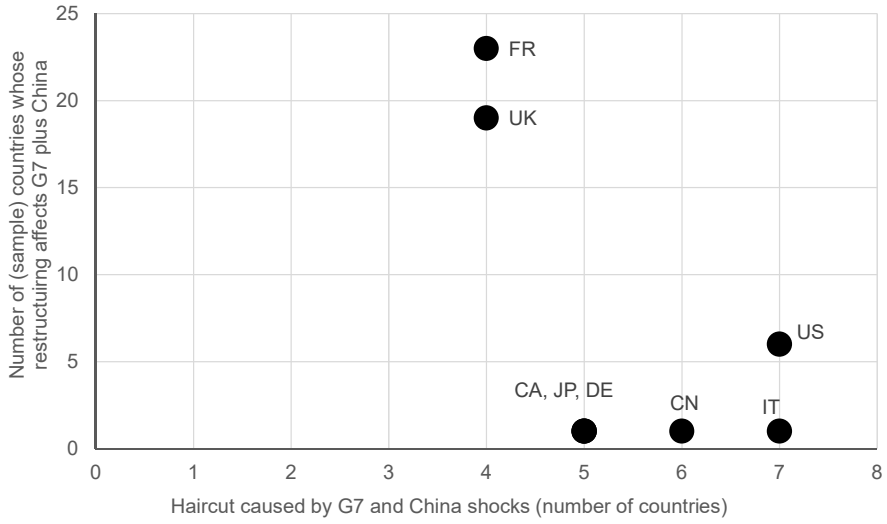
Figure 3.6: Aggregate losses for different shock origins, as a percentage of total claims - 2018



A complementary analysis consists in counting and identifying the number of restructuring events that take place in each country during the five years posterior to shocks in each G7 country and China. As mentioned, the cascading impact of shocks depends on the structure of cross-border claims and liabilities, as well as on the thresholds assumed for the restructuring to occur and its magnitude. Therefore, the number of events is mostly an indicator of how impactful initial shocks are in terms of coverage and not directly an indicator of total losses.

Figure 3.7 plots, for each of the G7 countries and China, the number of different countries (including the source of the shock country) affected by their restructurings (in the horizontal axis) and the number of the 24 sample countries whose restructurings affects them (in the vertical axis). France and the United Kingdom are countries that are affected by most countries while restructurings in Italy and the United States affect a largest scope of foreign countries.

Figure 3.7: Number of countries affected by restructurig events after 5 years




However, restructurings can be repeated in the same country. In addition, the results for the G7+CHN shocks for the 5 periods (horizontal axis of figure 3.7) are presented in the matrix of table 3.1. The columns identify the countries originating the initial shock and in rows the number of times each correspondent country is affected after 5 periods. Results show that the most affected countries are France, United Kingdom, Spain and, to a lesser extent, Australia. This can be verified in

the last (sum) column. Strikingly, except Australia, these countries are affected almost every period after the shock. On the other extreme, as already reported, some countries are not affected, no matter the origin of the shock. This is the case of the United States, China, Canada and Italy. In addition, the countries whose restructuring causes more follow-up restructuring episodes abroad are China and the United States, as visible in the bottom (sum) line.

Table 3.1: Restructuring events after 5 periods

| | Source of shock | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Impact | IT | US | CN | CA | JP | DE | UK | FR | Other | Total |
| Australia | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 33 | 48 |
| Canada | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - |
| China | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | 0 | - |
| France | 5 | 5 | 5 | 5 | 5 | 3 | 4 | 4 | 68 | 104 |
| Germany | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | - |
| Ireland | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 6 |
| India | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 |
| Italy | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | - |
| Japan | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | - |
| Portugal | 1 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 19 | 25 |
| Spain | 5 | 5 | 5 | 5 | 4 | 2 | 2 | 4 | 61 | 93 |
| UK | 4 | 5 | 5 | 5 | 5 | 5 | 4 | 5 | 53 | 91 |
| US | 0 | - | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 6 |
| Sum | 18 | 19 | 20 | 17 | 16 | 12 | 12 | 15 | 246 | 375 |

The results are influenced by the parameters that are considered. Moreover, the reduction of the net cross-border claims depends not only on the original shock but also on the propagation of this shock to other countries and the haircut on the net cross-border claims. In addition, the net International Investment Position as

percentage of GDP cannot be ignored[2]. It affects the initial shock but will also influence the propagation to future shocks. Therefore, the establishment of different parameters will influence the overall results.

### 3.5.2 Robustness

It is important to verify how sensitive are results to changes in the parameters used to define the triggering of the restructuring and its size. To assess the robustness of results, we recomputed the aggregate losses considering different haircuts percentages, $\phi = 0.25$ and $\phi = 0.75$ and considering a different threshold for the net International Investment Position as percentage of GDP below which the restructuring is triggered, $\gamma = 0$, $\gamma = 0.155$.

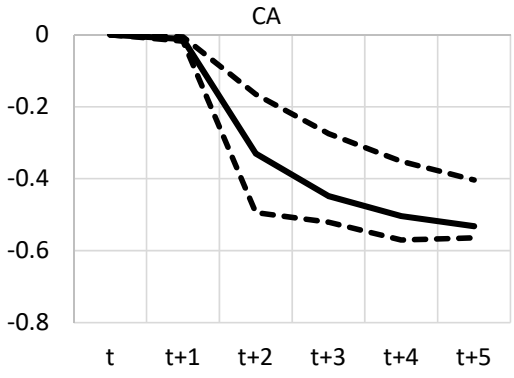
Figure 3.8 reports the results of the first robustness, plotting the profile of losses with dashed upper and lower bounds for restructurings of 25 and 75 per cent, respectively. The results suggest that the 25 percent restructuring generates milder losses than the baseline, while the 75 per cent scenario is closer to the benchmark of a 50 per cent loss. This asymmetry signals that beyond a certain level of losses, the survivors stabilize the situation. This is also visible by the flattening of the lower dashed line in $t + 4$ and $t + 5$.

Figure 3.9 plots the results of the second robustness test, which consists of computing aggregate losses considering as different lower bounds for the international investment threshold below which the restructuring event is triggered. Results show that when the threshold is zero the effect is much smaller than when it is set at -15.5 per cent of GDP (which consists of the first quartile of the distribution across countries in 2018). In this exercise the lower bound is very close to the benchmark. This phenomenon occurs for the same motive outlined above. It should be noted that the UK, which is the country with the highest banking cross-border (gross) claims in 2018, is not further affected when net International Investment Position

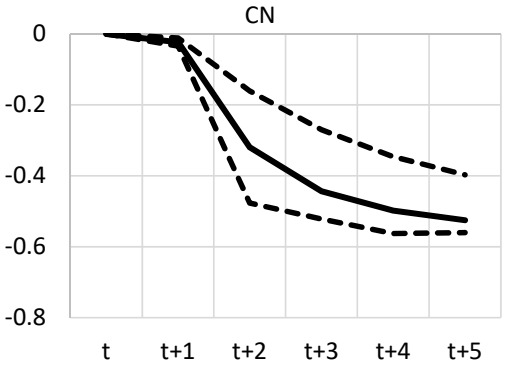
[2]in this sample only 8 countries exhibit a negative net International Investment Position as percentage of GDP - Australia, France, India, Ireland, Portugal, Spain United Kingdom and United States.

as percentage of GDP is set up below -15.5%.

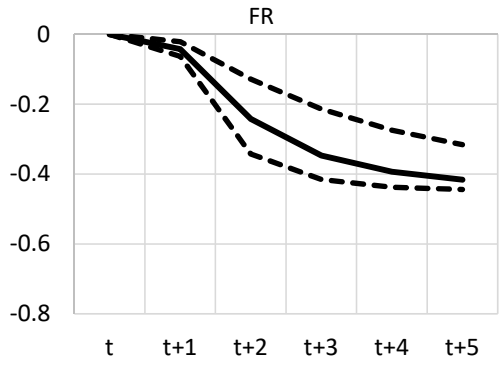
Figure 3.8: Upper bound of 25% and lower bond of 75% of cross-border claims and liabilities losses



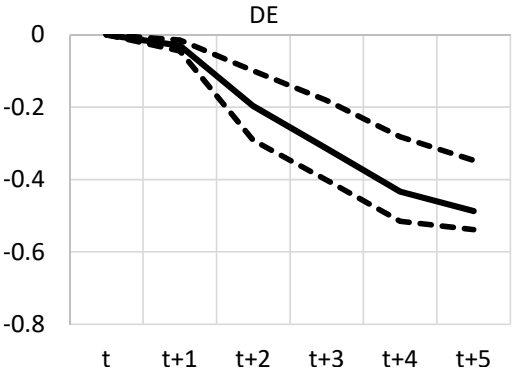

((a)) Shock in Canada



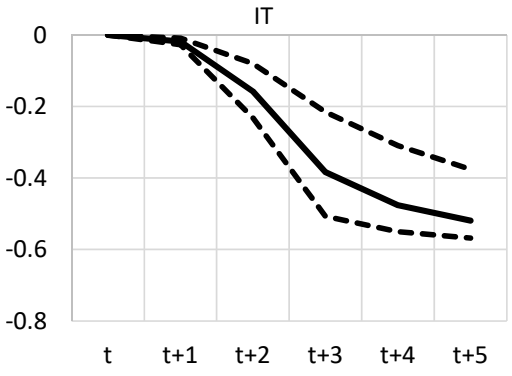

((b)) Shock in China



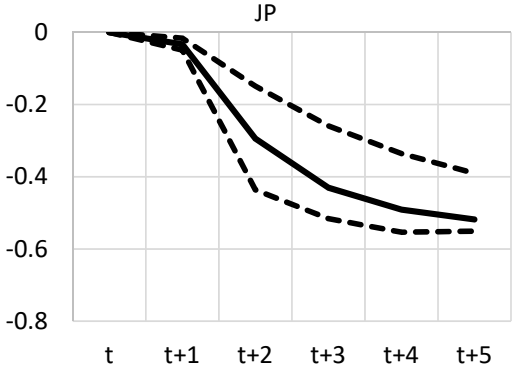

((c)) Shock in France



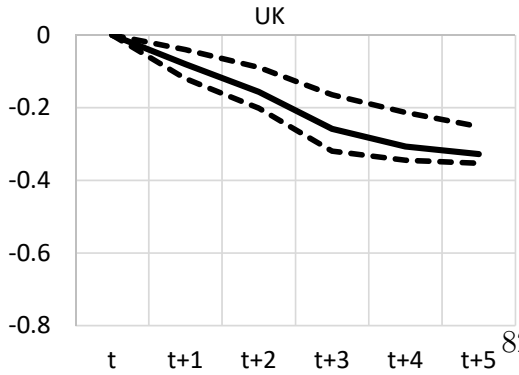

((d)) Shock in Germany



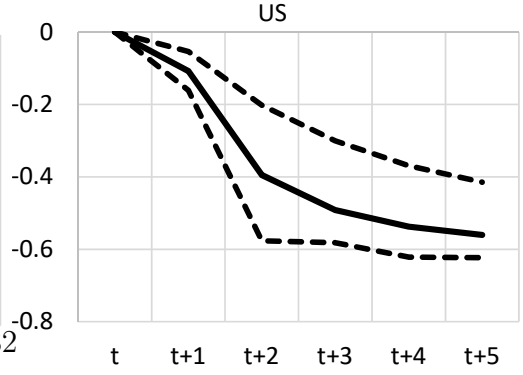

((e)) Shock in Italy




((f)) Shock in Japan

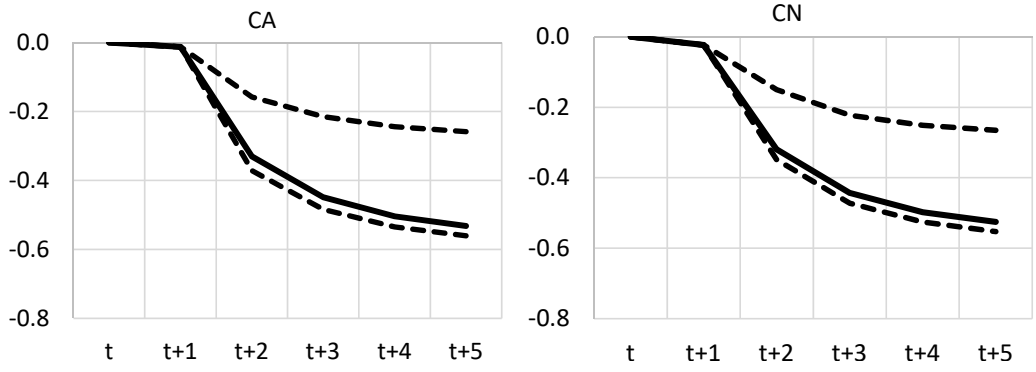



((g)) Shock in UK




((h)) Shock in US

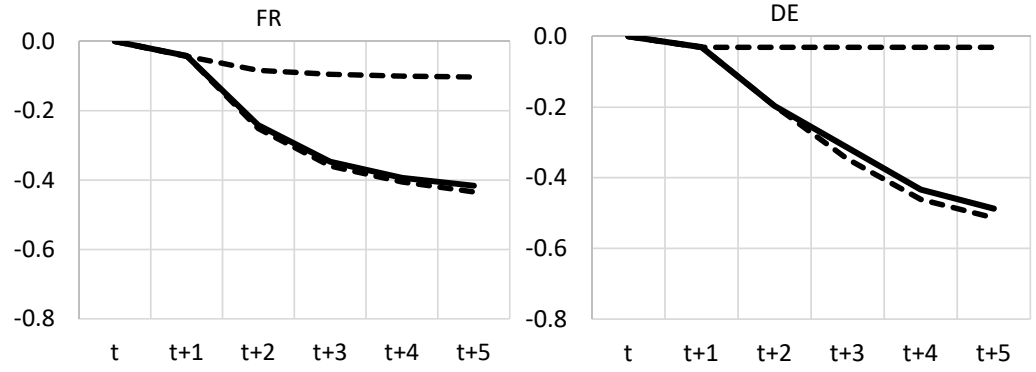
Figure 3.9: Upper bound of -15.5 and lower bound of zero per cent of net International Investment Position as percentage of GDP




((a)) Shock in Canada

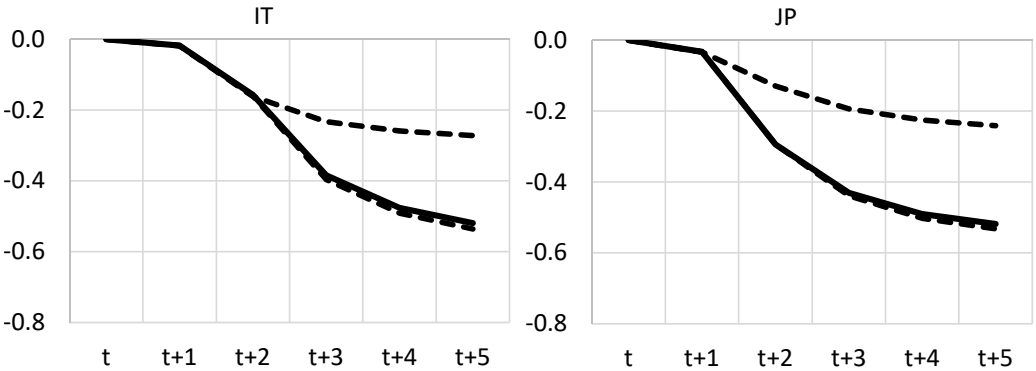



((b)) Shock in China



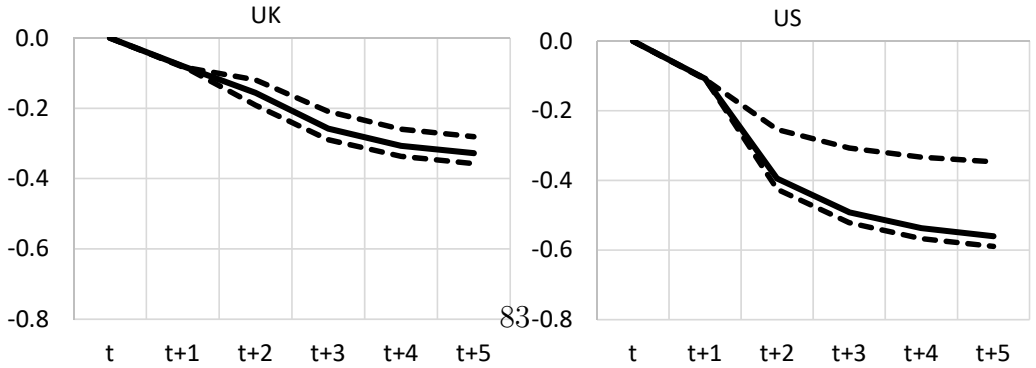

((c)) Shock in France

((d)) Shock in Germany




((e)) Shock in Italy

((f)) Shock in Japan




((g)) Shock in UK

((h)) Shock in US

### 3.5.3 Network changes

The analysis of cross-border effects of restructuring events depends on the direct and indirect links between banking systems. The cascading effect of shocks depends on the topology of the network formed by these linkages and the restructuring events modify the network itself. Therefore, network visualization methods are suited to complement the analysis carried out above.

The cross-country banking linkages can be represented by a directed and unweighted network. The links between countries represent the percentage of cross-border claims of a given country vis-à-vis each of the other 23 countries in the sample. The existence of an edge between two countries relies on a threshold criterion that aims to reflect the importance of country j (creditor) on the total bank's international asset portfolio (IAP) of country i (debtor). The threshold $\zeta$ is set at 5 per cent of total bank's international asset. This threshold ensures that the resulting network is easy to interpret and visualize, while capturing the relevant interrelations between nodes.

Hence, the edge is directed from a country $i$ to a country $j$, if country $i$ banks' international asset portfolio in country $j$ is larger than the threshold $\zeta$. More formally:

$$\vec{a}_{i,j} = \begin{cases} 1, & if \frac{IAP_{i,j}}{IAP_j} > \zeta \quad i \neq j, j = 1, 2, ..., 24 \\ \\ 0, & otherwise \end{cases} \tag{3.2}$$

where $a_{i,j}$ corresponds to each element of the $A$ matrix described above.

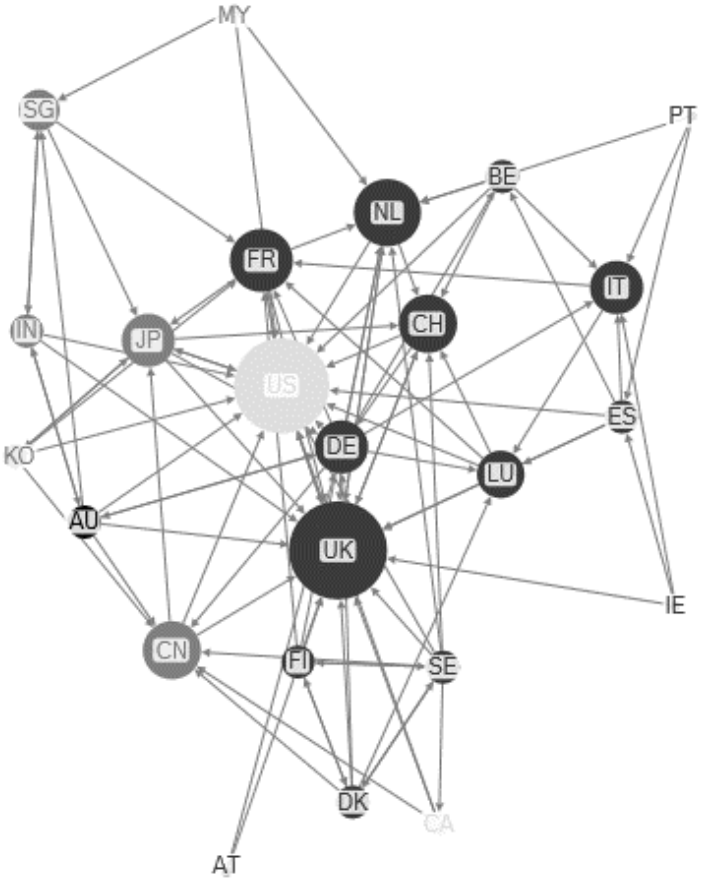
Since the network is directed, every node has two different degrees: indegree and outdegree. The indegree is the number of incoming edges, whereas the outdegree is the number of outgoing edges. In the context of our model, the number of indegrees represents the number of relevant cross-border claims (above $\zeta$) which are in one specific country (according to the defined criteria).

The network visualization results are illustrated by Figures 3.10, 3.11 and 3.12. The size of each node is proportional to its indegree and the colour of the node is

mapped to its continent.[3].

Figure 3.10 shows that at in 2018, the United Kingdom is the country where the majority of the sample countries locate more than 5% of their total cross-border claims (a financial hub), followed by the United States.

Figure 3.10: Initial network (2018)




Following an initial shock in China, 5 periods later the cross-border linkages between the sample countries is presented in figure 3.11. According to this representation and in connection with results presented in the previous sections, United Kingdom, France, Spain and Austria lose all their initial connections, meaning that they do not hold more than 5% of any of the sample countries cross-border claims. On the contrary, United States becomes the core country with an indegree of 23,

[3]The network graphs are based on the Harel-Koren fast multi-scale algorithm and are drawn with the use of NodeXL (an open-source template for Excel for analysis complex networks, http://nodexl.codeplex.com/)

Germany and Luxembourg also increase their centrality in the network, i.e., their relevance as destinations of the cross-border claims.

Figure 3.11: Network 5 periods later - China as source of the shock

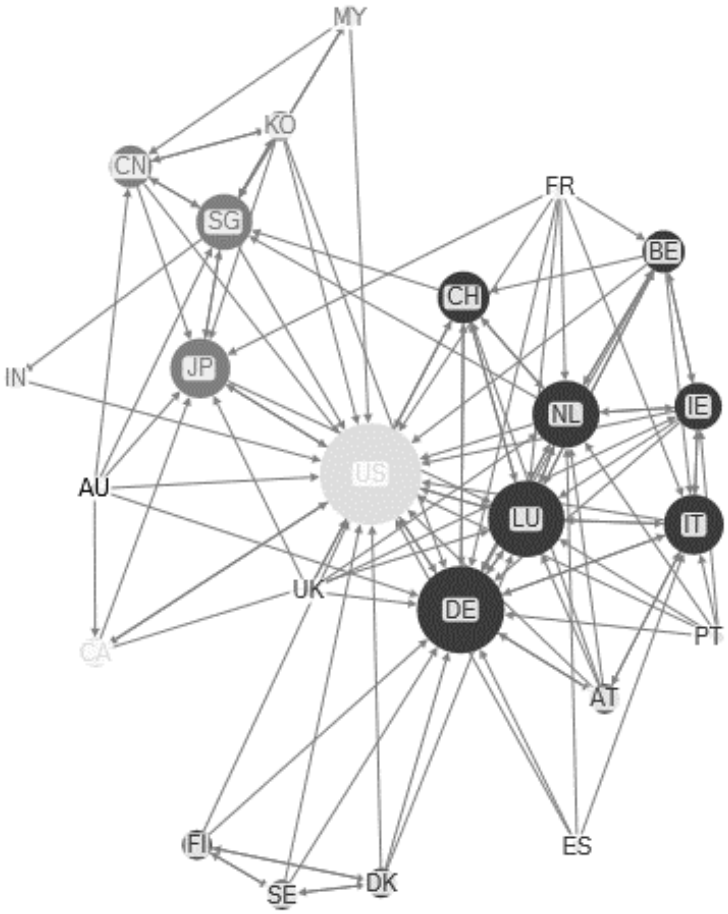
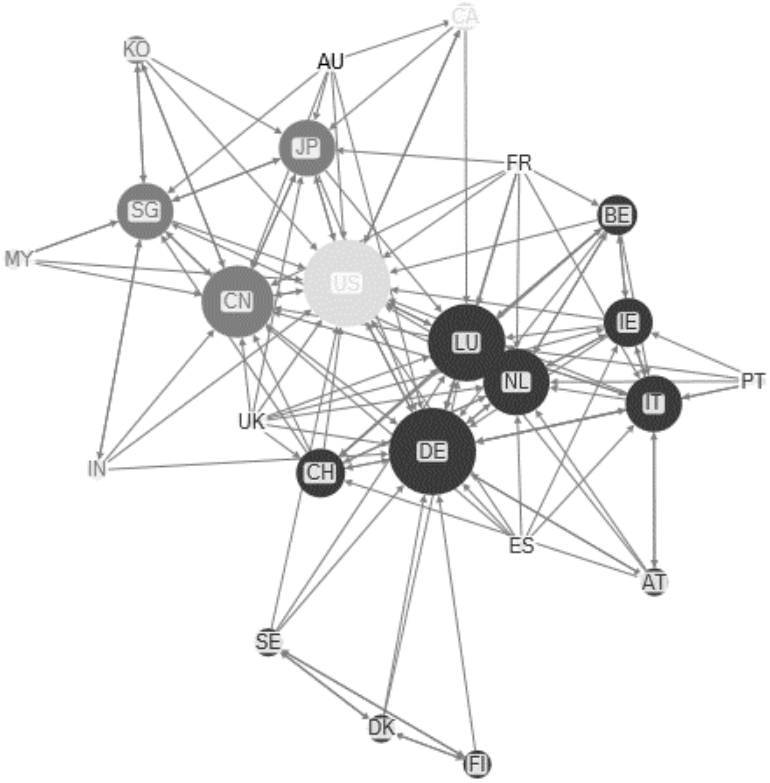



Figure 3.12 presents the network that results in period $t + 5$ after the initial shock in the US banking system. The results show that the new top cross-border claims countries are US, Germany with an indegree of 19, followed by Luxembourg and China, with 15 and 13 connections, respectively. This means that China might benefit from an initial shock in the US in terms of its centrality in the network of cross-border banking linkages. The changes in the number of degrees motivated by shocks in US and China are summarized in the Appendix, table 3.4.

Figure 3.12: Network 5 periods later - US as source of the shock



## 3.6 Conclusions

The financial system plays a key role in any economy taken individually and in the global economy. It is composed by the Central Bank, Deposit-taking corporations except the central bank and other financial corporations as Money market funds, Captive financial institutions, Insurance corporations, among others. The financial system is essential to allow for the flow of funds between all the economic agents (investors, lenders, and borrowers), thus ensuring an efficient allocation of the financial resources. In this article we assess the contagion effects that may be caused by cross-border banking shocks.

In 2018, United Kingdom was the country where the majority of the other 24 sample-countries considered in this exercise located their banking cross-border assets. The results from this highly stylized exercise suggest that shocks in the group of the G7 countries and China will affect mainly United Kingdom and France. In addition, results show that an initial shock in Italy, China and United States will affect the largest number of countries in the sample, i.e., these are the countries with the strongest contagion impact in terms of number of induced restructurings after 5 periods. At an aggregate level, US is the most potentially damaging country, as an initial shock in its banking system, will cause the highest reduction of cross-border claims: about 60% of total claims would be lost.

This exercise relies on two main assumptions - the percentage of the International Investment Position of GDP and the change in bank's net international assets, to determine if there exists a shock in the financial system. As it is shown, for the set of countries that were considered, France and United Kingdom comply mostly the criteria of a financial shock and, consequently, will be mostly affected by these shocks. In the presence of different criteria/thresholds the results could be different. It would also be possible to simulate random shocks according to a specific distribution function, where one country would affect all the other countries simultaneously. This would allow for a more flexible estimation of the propagation shocks and the results would not be so dependent on the parameters that were selected.

Although, the results show how important is to analyse not only the immediate impact of a banking shock, but also the subsequent impacts (shocks' propagation) that may exist in the domestic and foreign banking systems. The 'cascading effect' reflects the importance of one initial shock for the current but also future losses and shows how important is to monitor economic and financial reality, to enhance financial stability and promote global economic growth.

# Appendix

## 3.7 Concentration of cross-border banks assets and liabilities

Table 3.2: Concentration: Top5 recipient countries by G7+CN investors, 2015 and 2018

| | | 2015 | | 2018 | |
|---|---|---|---|---|---|
| Investor | | Recipient | Weight | Recipient | Weight |
| Canada | 1 | United States | 43 | United States | 41 |
| | 2 | UK | 13 | UK | 18 |
| | 3 | Cayman Islands | 10 | Japan | 10 |
| | 4 | Japan | 9 | China | 6 |
| | 5 | Germany | 5 | Germany | 6 |
| China | 1 | Japan | 11 | Japan | 9 |
| | 2 | Singapore | 10 | UK | 8 |
| | 3 | UK | 7 | Singapore | 8 |
| | 4 | Chinese Taipei | 7 | Chinese Taipei | 5 |
| | 5 | United States | 4 | Macao SAR | 5 |
| France | 1 | United Kingdom | 27 | United Kingdom | 30 |
| | 2 | Germany | 14 | Germany | 12 |
| | 3 | Japan | 11 | Japan | 11 |
| | 4 | Luxembourg | 7 | United States | 7 |
| | 5 | Netherlands | 6 | Luxembourg | 7 |
| Germany | 1 | United Kingdom | 27 | United Kingdom | 28 |
| | 2 | Luxembourg | 10 | France | 8 |
| | 3 | France | 10 | Luxembourg | 7 |
| | 4 | Japan | 8 | Netherlands | 7 |
| | 5 | Netherlands | 6 | Japan | 6 |

Table 3.3: Concentration: Top5 recipient countries by G7+CN investors, 2015 and 2018 (cont)

| | | 2015 | | 2018 | |
|---|---|---|---|---|---|
| Investor | | Recipient | Weight | Recipient | Weight |
| Italy | 1 | France | 30 | France | 46 |
| | 2 | UK | 17 | Germany | 11 |
| | 3 | Germany | 15 | UK | 10 |
| | 4 | Spain | 8 | Spain | 10 |
| | 5 | Ireland | 7 | Ireland | 6 |
| Japan | 1 | United States | 36 | United States | 28 |
| | 2 | United Kingdom | 23 | UJ | 26 |
| | 3 | China | 13 | France | 14 |
| | 4 | France | 13 | China | 13 |
| | 5 | Singapore | 7 | Singapore | 7 |
| UK | 1 | United States | 17 | France | 14 |
| | 2 | France | 11 | Germany | 9 |
| | 3 | Netherlands | 9 | Netherlands | 8 |
| | 4 | Germany | 9 | Japan | 8 |
| | 5 | Japan | 7 | China | 5 |
| US | 1 | UK | 23 | UK | 25 |
| | 2 | Japan | 22 | Japan | 23 |
| | 3 | Cayman Islands | 17 | Cayman Islands | 8 |
| | 4 | China | 5 | Canada | 8 |
| | 5 | Canada | 5 | France | 6 |

## 3.8 Network properties

Table 3.4: Indegree in 0, and 5 periods after an initial shock in CN and US

| Country | t=0 | China t+5 | US t+5 |
|---|---|---|---|
| AT | 0 | 2 | 2 |
| AU | 2 | 0 | 0 |
| BE | 2 | 4 | 4 |
| CA | 1 | 2 | 2 |
| CH | 6 | 6 | 6 |
| CN | 6 | 4 | 13 |
| DE | 5 | 17 | 19 |
| DK | 2 | 2 | 2 |
| ES | 2 | 0 | 0 |
| FI | 2 | 2 | 2 |
| FR | 7 | 0 | 0 |
| IE | 0 | 5 | 6 |
| IN | 2 | 1 | 1 |
| IT | 5 | 8 | 8 |
| JP | 5 | 8 | 8 |
| KO | 1 | 2 | 2 |
| LU | 4 | 13 | 15 |
| MY | 0 | 1 | 1 |
| NL | 8 | 10 | 11 |
| PT | 0 | 0 | 0 |
| SE | 2 | 2 | 2 |
| SG | 3 | 7 | 8 |
| UK | 17 | 0 | 0 |
| US | 16 | 23 | 19 |

# References


Acemoglu, Daron, Ozdaglar, Asuman, & Tahbaz-Salehi, Alireza. 2015. Systemic Risk and Stability in Financial Networks. *American Economic Review*.

Afonso, António, & Jalles, João Tovar. 2018. Decomposing and Analysing the Determinants of Current Accounts' Cyclicality: Evidence from the Euro Area. *Open Economies Review*.

Afonso, António, & Silva, Jorge. 2017. Current account balance cyclicality. *Applied Economics Letters*, **24**(13), 911–917.

Afonso, António, Huart, Florence, ao Tovar Jalles, Jo & Stanek, Piotr. 2019. Assessing the sustainability of external imbalances in the European Union. *The World Economy*, **42**(2), 320–348.

Alesina, Alberto, & Perotti, Roberto. 1995. The Political Economy of Budget Deficits. *IMF Staff Papers*, **42**(1).

Amador, João, & Silva, João Falcão. 2019. Cyclically-adjusted current account balances in Portugal. *Economic Bulletin and Financial Stability Report Articles and Banco de Portugal Economic Studies*.

BdP. 2017 (December). *Potential output: Challenges and uncertainties*. Special issues. Banco de Portugal.

Bems, Rudolfs, Johnson, Robert C, & Yi, Kei-Mu. 2010. Demand Spillovers and the Collapse of Trade in the Global Recession. *IMF Economic Review*, **58**(2), 295–326.

Benedictis, Luca De, & Tajoli, Lucia. 2009 (Mar.). *The World Trade Network*. Working Papers 51-2009. Macerata University, Department of Finance and Economic Sciences.

BIS. 2001. Marrying the Macro- and Micro-Prudential Dimensions of Financial Stability. *SSRN Electronic Journal*.

BIS. 2011. *81st Annual Report*. Annual publication 81. Bank for International Settlements.

Borio, C., & Disyatat, P. 2011. *Global imbalances and the financial crisis: Link or no link?* Working Papers 346. Bank for International Settlements.

Borio, C., & White, W. 2003. *Whither monetary and financial stability: the implications of evolving policy regimes*. Proceedings - Economic Policy Symposium - Jackson Hole.

Bremus, Franziska, & Fratzscher, Marcel. 2015. Drivers of structural change in cross-border banking since the global financial crisis. *Journal of International Money and Finance*, **52**(C), 32–59.

Brownlees, Christian, & Engle, Robert F. 2017 (Mar.). *SRISK: a conditional capital shortfall measure of systemic risk*. Tech. rept. European Systemic Risk Board.

Brunnermeier, Markus, De Gregorio, Jose, Eichengreen, Barry, El-Erian, Mohamed, Fraga, Arminio, Ito, Takatoshi, Lane, Philip R., Pisani-Ferry, Jean, Prasad, Eswar, Rajan, Raghuram, & Ramos, Ma. 2012 (Sept.). *Banks and cross-border capital flows: challenges and regulatory responses*. Tech. rept.

Buch, Claudia M., Driscoll, John C., & Ostergaard, Charlotte. 2010. Cross-Border Diversification in Bank Asset Portfolios. *International Finance*, **13**(1), 79–108.

Buiter, Willem. 1981. Time Preference and International Lending and Borrowing in an Overlapping-Generations Model. *Journal of Political Economy*, **89**(4), 769–97.

Bussière, Matthieu, Callegari, Giovanni, Ghironi, Fabio, Sestieri, Giulia, & Yamano, Norihiko. 2013. Estimating Trade Elasticities: Demand Composition and the

Trade Collapse of 2008-2009. *American Economic Journal: Macroeconomics*, **5**(3), 118–151.

Ca' Zorzi, Michele, Dieppe, Alistair, & Chudik, Alexander. 2009 (Jan.). *Current account benchmarks for Central and Eastern Europe: A desperate search?* ECB Working Papers 995. European Central Bank.

Caccioli, Fabio, Barucca, Paolo, & Kobayashi, Teruyoshi. 2018. Network models of financial systemic risk: a review. *Journal of Computational Social Science*, **1**(1), 81–114.

Cheung, C., D. Furceri, & Rusticelli, E. 2010. *Structural and Cyclical Factors behind Current-Account Balances*. Working paper 775. OECD Economics Department.

Chinn, Menzie D., & Prasad, Eswar S. 2003. Medium-term determinants of current accounts in industrial and developing countries: An empirical exploration. *Journal of International Economics*, **59**(1), 47–76.

Christodoulopoulou, Styliani, & Tkacevs, Olegs. 2016. Measuring the effectiveness of cost and price competitiveness in external rebalancing of euro area countries: What do alternative HCIs tell us? *Empirica*, **43**(3), 487–531.

Coutinho, Leonor, Turrini, Alessandro, & Zeugner, Stefan. 2018 (Sept.). *Methodologies for the Assessment of Current Account Benchmarks*. Tech. rept. 086. Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

Crockette, A. 2001. Marrying the Macro- and Micro-Prudential Dimensions of Financial Stability. *SSRN Electronic Journal*, 03.

Cuñat, Alejandro, & Zymek, Robert. 2019. *Bilateral Trade Imbalances*. CESifo Working Paper Series 7823. CESifo Group Munich.

Cusolito, Ana Paula, & Nedeljkovic, Milan. 2013. *Toolkit for the Analysis of Current Account Imbalances*. World Bank.

Davis, Donald R., & Weinstein, David E. 2002. The Mystery of the Excess Trade (Balances). *American Economic Review*, **92**(2).

Degryse, H.A., Elahi, M.A., & Penas, M.F. 2009. *Cross-Border Exposures and Financial Contagion*. Tech. rept. Tilburg University, Center for Economic Research.

Dekle, Robert, Eaton, Jonathan, & Kortum, Samuel. 2008. Global Rebalancing with Gravity: Measuring the Burden of Adjustment. *IMF Staff Papers*, **55**(3).

Eaton, Jonathan, & Kortum, Samuel. 2002. Technology, Geography, and Trade. *Econometrica*, **70**(5).

Eaton, Jonathan, Dekle, Robert, & Kortum, Samuel. 2007. Unbalanced Trade. *American Economic Review*, **97**(2).

Fabiani, Silvia, Federico, Stefano, & Felettigh, Alberto. 2016. *Adjusting the external adjustment: Cyclical factors and the Italian current account*. Questioni di Economia e Finanza (Occasional Papers) 346. Bank of Italy, Economic Research and International Relations Area.

Faruqee, Hamid, & Debelle, Guy. 1996. *What Determines the Current Account? A Cross-Sectional and Panel Approach*. IMF Working Papers 346. International Monetary Fund.

Feenstra, Robert C., Hai, Wen, Woo, Wing T., & Yao, Shunli. 1998. *The US-China Bilateral Trade Balance: Its Size and Determinants*. NBER Working Papers 6598. National Bureau of Economic Research, Inc.

Foti, Nicholas J., Pauls, Scott, & Rockmore, Daniel N. 2013. Stability of the World Trade Web over time – An extinction analysis. *Journal of Economic Dynamics and Control*.

Fracasso, Andrea, & Schiavo, Stefano. 2008. *Trade-imbalances networks and exchange rate adjustments: The paradox of a new Plaza*. Tech. rept.

Gagnon, Joseph E. 2003. *Productive capacity, product varieties, and the elasticities approach to the trade balance.* Tech. rept. 781. Board of Governors of the Federal Reserve System (U.S.).

Ghosh, Atish R., & Ramakrishnan, Uma. 2017. Current Account Deficits: Is There a Problem? *Finance  Development*, **43**(4), 48–49.

Goldstein, M., & Kahn, M. 1985. *Income and price eect in foreign trade.* J. Ronald and P. Kennen, Editors, Handbook of International Economics, North-Holland, Amsterdam, 1042–1099.

Gruber, Joseph W., & Kamin, Steven B. 2005. *Explaining the global pattern of current account imbalances.* International Finance Discussion Papers 846. Board of Governors of the Federal Reserve System.

Haltmaier, Jane. 2014. *Cyclically Adjusted Current Account Balances.* International Finance Discussion Papers 1126. Board of Governors of the Federal Reserve System.

Hansen D., Shneiderman B., & Smith, M.A. 2010. *Analyzing social media networks with NodeXL: Insights from a connected world.* Morgan Kaufmann.

Hills, Robert, & Hoggarth, Glenn. 2013. Cross-border bank credit and global financial stability. *Bank of England Quarterly Bulletin*, **53**(2), 126–136.

Hoggarth, Glenn, Mahadeva, Lavan, & Martin, Jeremy. 2010 (Sept.). *Financial Stability Paper No 8: Understanding International Bank Capital Flows during the Recent Financial Crisis.* Tech. rept.

Houthakker, Hendrik S, & Magee, Stephen P. 1969. Income and Price Elasticities in World Trade. *The Review of Economics and Statistics*, **51**(2), 111–125.

Imbs, Jean, & Mejean, Isabelle. 2010 (Dec.). *Trade Elasticities: A Final Report for the European Commission.* Tech. rept. 432. Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

IMF. 2019 (July). *External Positions and Policies*. Report Chapter 3. International Monetary Fund.

Joseph, Andreas, Joseph, Stephan, & Chen, Guanrong. 2013 (June). *Cross-border Portfolio Investment Networks and Indicators for Financial Crises*. Tech. rept.

Kali, Raja, & Reyes, Javier. 2010. Financial Contagion On The International Trade Network. *Economic Inquiry*, **48**(4), 1072–1101.

Kara, A. Hakan, & Sarikaya, Cagri. 2013. *Cyclically Adjusted Current Account Balance*. Research Notes 18. Research and Monetary Policy Department, Central Bank of the Republic of Turkey.

Laeven, Luc, Ratnovski, Lev, & Tong, Hui. 2014 (May). *Bank Size and Systemic Risk*. IMF Staff Discussion Notes. International Monetary Fund.

Lane, Philip R., & Ferretti, Gian Maria Milesi. 2011 (Aug.). *External Adjustment and the Global Crisis*. NBER Working Papers 17352. National Bureau of Economic Research, Inc.

Leasure, Leasure, D. Wenger S. Chelgren N. Neville H. Dauwalter D. Bjork R. Fesenmyer K. Dunham J. Peacock M. Luce C. Lute C. Isaak D. 2018. Hierarchical multi-population viability analysis. *Ecological Society of America*.

Levchenko, Andrei A., Lewis, Logan T., & Tesar, Linda L. 2010. *The Role of Financial Factors in the Trade Collapse: A Skeptic's View*. Tech. rept. 616. Research Seminar in International Economics, University of Michigan.

Marquez, J. 2002. *Estimating Trade Elasticities*. Springer London Editor.

Marquez, Jaime R., Johnson, Karen H., & Hooper, Peter. 1998. *Trade elasticities for G-7 countries*. Tech. rept. 609. Board of Governors of the Federal Reserve System (U.S.).

Martinez-Martin, Jaime. 2016 (July). *Breaking down world trade elasticities: a panel ECM approach*. Globalization Institute Working Papers 275. Federal Reserve Bank of Dallas.

May, Robert, Levin, Simon, & Sugihara, George. 2008. Complex Systems: Ecology for Bankers. *Nature*, 03.

Milesi-Ferretti, Gian M, & Blanchard, Olivier J. 2011 (Mar.). *(Why) Should Current Account Balances Be Reduced?* IMF Staff Discussion Notes 3. International Monetary Fund.

Milesi-Ferretti, Gian Maria, & Razin, Assaf. 1996 (Feb.). *Sustainability of Persistent Current Account Deficits.* Tech. rept. 5467. National Bureau of Economic Research, Inc.

Monge-Naranjo, Alexander. 2013. Major U.S. trading partners before and after the great recession. *Economic Synopses*, 27.

Obstfeld, Maurice, & Rogoff, Kenneth. 1995. The intertemporal approach to the current account. *Chap. 34, pages 1731–1799 of:* Grossman, G. M., & Rogoff, K. (eds), *Handbook of International Economics.* Handbook of International Economics, vol. 3. Elsevier.

Obstfeld, Maurice, & Rogoff, Kenneth. 2000. *The Six Major Puzzles in International Macroeconomics: Is There a Common Cause?* NBER Working Papers 7777. National Bureau of Economic Research, Inc.

Obstfeld, Maurice, & Rogoff, Kenneth. 2009 (Dec.). *Global Imbalances and the Financial Crisis: Products of Common Causes.* Tech. rept. 7606. C.E.P.R. Discussion Papers.

Ollivaud, Patrice, & Schwellnus, Cyrille. 2013 (June). *The Post-crisis Narrowing of International Imbalances: Cyclical or Durable?* OECD Economics Department Working Papers 1062. OECD Publishing.

Orcutt, G. 1950. Measurement of Price Elasticities in International Trade. *The Review of Economics and Statistics*, **32**(2), 117–132.

Phillips, Steven T, Catão, Luis, Ricci, Luca A, Bems, Rudolfs, Das, Mitali, Giovanni, Julian Di, Unsal, Filiz D, Castillo, Marola, Lee, Jungjin, Rodriguez, Jair, &

Vargas, Mauricio. 2013. *The External Balance Assessment (EBA) Methodology.* IMF Working Papers 272. International Monetary Fund.

Sachs, Jeffrey D. 1981. The Current Account and Macroeconomic Adjustment in the 1970s. *Brookings Papers on Economic Activity*, **12**(1), 201–282.

Sahin, Ibrahim Erem, & Mucuk, Mehmet. 2014 (July). *The Effect of Current Account Deficit on Economic Growth: The Case of Turkey.* Tech. rept. 0301828. International Institute of Social and Economic Sciences.

Salto, Matteo, & Turrini, Alessandro. 2010. *Comparing alternative methodologies for real exchange rate assessment.* European Economy - Economic Papers 427. European Commission.

Sastre, Teresa, & Viani, Francesca. 2014 (Jan.). *Countries' safety and competitiveness, and the estimation of current account misalignments.* Working Papers 1401. Banco de España.

Schinasi, Garry J. 2011. Defining Financial Stability and Establishing a Framework to Safeguard It. *In:* Alfaro, Rodrigo (ed), *Financial Stability, Monetary Policy, and Central Banking.* Central Bank of Chile.

Serranito, Francisco, & Gossé, Jean-Baptiste. 2014. Long run current determinants in OECD countries: Lessons for intra-European Imbalances. *Economic Modelling*, **38**(02), 451–462.

Serrano, M., Boguñá, Marián, & Vespignani, Alessandro. 2007. Patterns of dominant flows in the world trade web. *Journal of Economic Interaction and Coordination*, **2**(2), 111–124.

Slopkek, Ulf. 2015. Why has the income elasticity of global trade declined? *Deutsche Bundesbank, Economics Department, mimeo.*

Tamara, Tinti. 2016. *External sustainability analysis.* M.Phil. thesis, Nova School of Business and Economics, Portugal.

Vinãls, José, Pazarbasioglu, Ceyla, Surti, Jay, Narain, Aditya, Erbenova, Michaela, & Chow, Julian T. 2013 (May). *Creating a Safer Financial System; Will the Volcker, Vickers, and Liikanen Structural Measures Help?* Tech. rept. International Monetary Fund.

Wu, Yi. 2008. Growth, Expansion of Markets, and Income Elasticities in World Trade. *Review of International Economics*, **16**(4), 654–671.