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Three Essays on the interconnection between the external sector and domestic macroeconomic performance

Alfonso Camba Crespo

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A Anna,

a mis padres, hermana

y a mi familia

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Muchas gracias a todos vosotros.

Index

List of Tables

List of Graphs and Figures

Acronyms

CEPII	Centre d'Études Prospectives et d'Informations Internationales
CPI	Consumer price index
F.O.C.	First order condition
FDI	Foreign direct investment
FGLS	Feasible generalized least squares
GDP	Gross domestic product
GNI	Gross national income
GVC	Global value chains
IMF	International Monetary Fund
LCU	Local currency units
OECD	Organisation for Economic Co-operation and Development
OEPC	Open economy Phillips curve
OLS	Ordinary least squares
PVAR	Panel vector autoregression
REER	Real effective exchange rate
S.d.	Standard deviation
US	United States
US$	United States dollar
VAR	Vector autoregression
WEO	World Economic Outlook
ZLB	Zero lower bound

Resumen

Resumen

La presente tesis analiza la interacción entre el sector exterior y el desempeño macroeconómico a nivel doméstico. Este estudio se basa tanto en análisis teóricos como empíricos, utilizando una amplia muestra de países para entender con mayor precisión los vínculos macroeconómicos subyacentes. La interrelación entre las variables externas y domésticas tiene un interés creciente como consecuencia de la drástica aceleración de la integración económica internacional en las últimas décadas, y de los flujos comerciales, financieros y migratorios que la componen. La interconexión de las economías influye decisivamente en las condiciones macroeconómicas y sobre la efectividad de las políticas internas. Por lo tanto, lograr una buena comprensión de tales interacciones es fundamental para diseñar políticas eficaces en la labor de promover un desempeño económico robusto y estable.

Dada la complejidad de la materia, el estudio de estas interacciones se puede realizar desde distintas perspectivas. En la presente tesis, el análisis se divide en tres capítulos principales, cada uno enfocado en cuestiones específicas. En concreto, el primer capítulo estudia los determinantes de los cambios estructurales de la cuenta corriente y los periodos de estabilidad ocurridos entre esos cambios. El segundo capítulo examina la interacción entre los desequilibrios en cuenta corriente, los tipos de cambio y los ‘output gaps’ domésticos e internacionales. Finalmente, el tercer capítulo analiza cómo la integración internacional puede haber modificado la curva de Phillips, en particular a través del impacto de la competencia extranjera. A continuación, se resume brevemente cada uno de estos tres capítulos.

En el primer capítulo, se identifican las rupturas estructurales de la cuenta corriente y se estudian sus características y determinantes. También se analizan los periodos de estabilidad de la cuenta corriente, un concepto que se introduce como novedad y que se refiere a los periodos entre rupturas. La identificación de las rupturas se realiza mediante el test de raíz unitaria de Lee y Strazicich (2003), aplicando una perspectiva global que incluye una muestra amplia de 181 economías entre 1980 y 2018. Se hallan 212 rupturas tanto positivas como negativas en niveles y tendencias. De ese resultado, se obtienen 341 periodos de estabilidad de la cuenta corriente, la mitad de los cuales duran 10 años o menos y resultan más volátiles y breves cuanto más se desvía la cuenta corriente del equilibrio. Las estimaciones indican que promover el crecimiento y acumular reservas de divisas resultan particularmente útiles para prevenir rupturas, mientras que un menor ingreso per cápita aumenta el riesgo de que éstas se produzcan. Por último, los resultados respaldan la utilidad de aplicar medidas de política activa para inducir rupturas en el caso de que la existencia de desequilibrios estructurales de la cuenta corriente así lo aconsejen. En particular, rupturas adecuadamente diseñadas en caso de desequilibrios insostenibles pueden dar lugar a períodos con saldos de cuenta corriente más estables.

El segundo capítulo analiza la relación entre los desequilibrios internos, externos y globales examinando cómo interactúan la cuenta corriente, los desajustes del tipo de cambio real y los ‘output gaps’ doméstico y exterior. En primer lugar, se parte de teorías clásicas sobre la balanza de pagos para adaptarlas con un enfoque original que permite reforzar la base teórica de la relación entre estas variables, y facilitar las estimaciones. A continuación, se emplean técnicas de panel para determinar si hay dependencia de sección cruzada y también se estima un VAR de panel para estudiar esta relación en 18 economías avanzadas entre 1986-2017. Los resultados muestran que las cuentas corrientes y los ‘output gaps’ registran una relación inversa con vínculos de causalidad bilaterales, concluyendo que las variaciones del ‘output gap’ doméstico tienen un impacto particularmente relevante en la cuenta corriente y, además, que las políticas que aumentan el saldo por cuenta corriente podrían impulsar tanto el crecimiento coyuntural como el estructural. Igualmente, se observa que los cambios en los desequilibrios del tipo de cambio efectivo real provocan una reacción contraria de la cuenta corriente y del ‘output gap’ doméstico. Los resultados también apuntan a que un mayor crecimiento resulta en una apreciación del tipo de cambio real, en favor de la hipótesis Balassa-Samuelson.

Por último, en el tercer capítulo se desarrolla y microfundamenta teóricamente una curva de Phillips en economía abierta en la que la competencia exterior influye sobre la inflación interna. Esta influencia se transmite a través de dos canales: a) el desfase entre las tasas de crecimiento actual y potencial de las importaciones, y b) el desalineamiento del tipo de cambio real. Tras el planteamiento teórico, se estima esta curva de Phillips en economía abierta aplicando dos tipos de técnicas econométricas: regresiones de panel y un PVAR acompañado de un análisis de respuestas al impulso. Las estimaciones parten de una muestra de 15 economías avanzadas con datos del periodo 1994-2017. Los resultados de las dos metodologías apoyan la validez de la relación teórica y sugieren que la competencia internacional reduce el poder de mercado de las empresas domésticas, frenando así las presiones inflacionistas. Los resultados muestran también que la pendiente de la curva de Phillips en economía abierta ha disminuido sustancialmente en los años posteriores a la Gran Recesión.

Abstract

Abstract

This thesis analyses the interaction between the external sector and the domestic macroeconomic performance. It is based on both theoretical and empirical analysis, working with a wide range of countries to better capture the underlying macroeconomic links. There is growing interest in the interaction between external and domestic variables as a result of the drastic acceleration of international economic integration brought about by amplified commercial, financial and migratory flows. This interaction is highly relevant since it affects macroeconomic outcomes and the effectivity of economic policy. Therefore, a precise understanding and diagnosis of such interactions is essential to the design of policies which help economies to become, and remain, robust and stable.

The interaction of macroeconomic internal and external imbalances and external sector stability are complex issues, raising multiple questions which can be studied from several perspectives. In this thesis, the study of these questions is divided into three main chapters, each one focused on particular issues. Specifically, the first chapter studies current-account stability spells and the determinants of current-account breaks. The second one examines the interaction between current-account imbalances, exchange rates and domestic and global output gaps. Finally, the third chapter analyzes how international developments may have modified the Phillips curve, in particular through the impact of foreign competition. Each of these three chapters is briefly summarized in the next paragraphs.

The first chapter focuses on the identification of structural breaks in the current account and the study of their characteristics and determinants. It also includes an analysis of the periods between breaks, an original concept labeled current account stability spells. The breaks are identified using the Lee and Strazicich (2003) unit root test and adopting

a global perspective, in particular using a wide sample of 181 economies between 1980 and 2018. This exercise identifies 212 breaks, including positive and negative breaks in both level and trend. As a result, 341 stability spells are distinguished. These spells are more volatile and shorter the further the current account is from equilibrium, and half of them last 10 years or less. Estimations also show that promoting growth and accumulating foreign reserves are particularly useful to prevent breaks, while lower per capita income increases exposure to break risks. Finally, the results indicate that active policy measures to induce breaks could be recommendable when a country registers structural current-account imbalances. In particular, properly designed breaks to face unsustainable imbalances can lead to periods of more stable current account balances.

The second chapter analyzes the relationship between internal, external and global imbalances by examining how the current account, real exchange rate misalignments and domestic and foreign output gaps interact. The chapter opens with an original approach to classic theories on the balance of payments which reinforces the theoretical basis of the relationship between these variables, and facilitates the subsequent estimations. The relationship is studied, first, through tests to check for cross-sectional dependence and, also, through panel VAR estimations, using a sample of 18 advanced economies between 1986-2017. Results show that current accounts and output gaps present an inverse relationship with bilateral causality links, concluding that variations in the output gap have a particularly relevant impact on current account figures and that policies that increase these current account figures could boost conjunctural and structural growth. Additionally, REER imbalances cause an opposite effect on the current account and growth in relation to its potential. Finally, results indicate that higher growth results in a real exchange rate appreciation, which supports the Balassa-Samuelson hypothesis.

The third chapter of the thesis starts with the theoretical development of an open economy Phillips curve (OEPC) with micro-founded analysis, in which external competition significantly impacts the domestic inflation rate. This influence is transmitted through two channels: a) the gap between the current and potential growth of imports, and b) real exchange-rate misalignment. Next, this OEPC is estimated by applying two econometric techniques, panel regressions and PVAR accompanied by impulse/response analysis. A sample of 15 advanced economies is used with data for the period 1994-2017. The results from both methodologies endorse the validity of the theoretical relationship and suggest that international competition reduces the pricing power of domestic firms, thus curbing inflationary pressures. Results also indicate that the slope of the OEPC has significantly declined in the years since the Great Recession.

Introduction

Introduction

This thesis analyses the interaction between the current account and domestic macroeconomic variables. In both theoretical and empirical analysis, we work with a wide range of countries to better capture the underlying macroeconomic relationships. We focus particularly on current-account imbalances and their adjustments -including current-account breaks-, analyzing, on the one hand, their main determinants and, on the other hand, their macroeconomic consequences. These topics have become a fundamental issue in the last decades, as a result of the drastic acceleration of international economic integration due to an amplification of commercial, financial and migratory flows. This integration has increased the interaction between international and domestic economic variables, impacting macroeconomic outcomes and the effectivity of economic policies. A precise understanding and diagnosis of such interactions is essential to design policies that help to prevent macroeconomic instability and economic crises.

The interaction of macroeconomic internal and external imbalances and external sector stability are complex issues, which raise multiple questions that can be studied from several perspectives. The study of these questions is divided into three main chapters. All three employ similar variables, such as current accounts, exchange rates and growth levels, but each one focuses on specific issues. The first chapter studies current-account stability spells and the determinants of current-account breaks. The second one examines the interaction between current-account imbalances, exchange rates and domestic and global output gaps. Finally, the third chapter analyzes how international developments may have modified the Phillips curve, in particular through the impact of foreign competition.

The first chapter of the thesis presents an examination of external sector stability, focusing on the characteristics of the periods with external stability, referred to as current-account stability spells. This is an original concept put forward in this thesis which refers to the periods between structural breaks. Additionally, this chapter includes an analysis of the determinants of current account breaks and the changes registered after these breaks. These breaks are identified using the Lee and Strazicich (2003) unit root test on a global database of 182 countries. Multiple authors have studied this issue since current-account breaks modify the relationship between a country and the rest of the world and alter the structural position of an economy, sometimes triggering major economic crisis. For instance, estimations of the costs of the reversals in the recent Eurozone crisis place the figures between 6% and 32% of GDP (García-Solanes *et al.*, 2018). Therefore, the study of current-account breaks, their determinants and stability spells is fundamental to understand external sector stability and design sound economic policies that prevent instability and crises.

In general, the literature on the issue focuses on specific groups of countries, selected by income level, region or other criteria, as Milesi-Ferretti and Razin (1998), Bagnai, and Manzocchi (1999), Freund (2005) or Aßmann and Boysen-Hogrefe (2010). The objective of the first chapter is to add to the previous literature in two ways. First, with an analysis of stability spells. Second, taking a global perspective to reduce the biases that result from focusing on a reduced group of countries and avoiding *ad hoc* definition of breaks which could ignore those that do not cause major immediate effects and could also overstate the number of breaks in countries with a volatile current-account.

The first chapter starts with the identification of the breaks through the Lee and Strazicich (2003) unit root test on an extensive database of 182 countries. The unit root test allows for the identification of 212 structural breaks and 341 stability spells. Half of the spells last 10 years or less, and become shorter and more volatile the further the current account is from equilibrium. Regarding the determinants of the breaks, the results from the application of a Heckman (1976, 1979) selection model indicate that high economic growth and accumulation of foreign reserves are particularly useful to prevent breaks, while lower per capita income increases exposure to break risks.

The second chapter aims to analyze the interaction between internal, external and global imbalances, through an examination of the relationship between the current account, real exchange-rate misalignments and domestic and foreign output gaps. It starts with a theoretical development to strengthen the foundations of the relationship between the referred variables and to provide a stronger basis for the estimations, using classic theories on the balance of payments with an original approach. Most previous research on this topic focuses on the empirical estimations, and thus this theoretical development is an innovation. In addition, a majority of previous papers on this issue employ observed variables to examine these relationships. These studies overlook the different structural conditions of each economy which might lead to diverse responses even when their observed variables register similar figures. An alternative approach to deal with this limitation, used in this second chapter of the thesis, is to focus on the relationships between macroeconomic imbalances, also in line with some recent papers, such as Gnimassoun and Mignon (2015, 2016) or Comunale (2017). The empirical results, using panel vector auto regressions (PVAR) estimations on a sample of 18 advanced economies between 1986-2017 and a robustness test that supports the results, show that current accounts and output gaps have an inverse relationship with bilateral causality links, while variations in the output gap have a particularly relevant impact on the current account. Other findings are that real effective exchange rate (REER) imbalances have the opposite effect on the current account and growth in relation to its potential, and that higher growth figures result in a real exchange-rate appreciation, supporting the Balassa-Samuelson hypothesis.

The relevance of the interaction between internal and external imbalances suggests that global economic integration could affect other key macroeconomic relationships. In this regard, the third chapter of this thesis explores whether the Phillips curve has been transformed as a result of international economic integration. Specifically, the objective of this third chapter is to examine if the Phillips curve has flattened, and how international economic variables might be affecting it, particularly due to foreign competitive pressure.

The analysis presented in chapter 3 is based on the idea that the pressure of international competitors could affect domestic prices, changing the relationship between economic slack and inflation. This question is fundamental since the Phillips curve is a basic element of macroeconomic theory and a key reference in the design of economic policy. Indeed, numerous authors have recently debated about how inflation has become less responsive to economic slack, reflecting a flattening of the Phillips curve. For instance, Gilchrist and Zakrajsek (2019) find that the US Phillips curve has flattened and argue that it is a consequence of international trade. Regarding the influence of foreign factors on this curve, numerous papers had already pointed out different external variables that might be affecting it: for instance, the price of imported goods in McCallum and Nelson (1999), Paloviita (2009), Blanchard et al. (2015) or Blanchard (2016). Other authors have explored the influence of foreign competition on inflation, such as Bean (2006), who argues that internationalization could reduce domestic firms' capacity to increase prices. Additionally, Carney (2015) suggests that globalization may have limited the sensitivity of inflation to domestic labor market conditions, while Ferroni and Mojon (2017) and IMF (2019) argue that stronger global competition reduces workers bargaining power, thus flattening the Phillips curve.

The analysis in chapter 3 builds on this previous research, yet it proposes a different approach in the analysis of whether this curve has flattened and the effect of foreign competition on the curve. In particular, the chapter starts with an innovative micro-foundation of an open economy Phillips curve (OEPC), which illustrates how external competition affects domestic inflation through two channels: a) the gap between the current and the potential growth of imports, and b) the real exchange-rate misalignment. The chapter continues with an empirical estimation of this OEPC though panel regressions, a panel VAR and a robustness test that reinforces the results. The findings of the empirical estimations support the theoretical development of the OEPC, underpinning the idea that international competition can curb inflationary pressures since it restrains the ability of domestic firms to increase prices. The empirical estimations also confirm the flattening of the OEPC in the years after the Great Recession.

Altogether, the three chapters aim to shed light on the macroeconomic impact of economic integration and external sector stability, in order to improve the understanding of how our economies function and to help design better policies for strong and stable economies.

Chapter 1

Current-account breaks and stability spells in a global perspective

1. Current-account breaks and stability spells in a global perspective

In this chapter, we identify current-account structural breaks and stability spells (i.e., periods between two breaks) and analyze their characteristics and determinants, using a sample of 181 countries with different degrees of economic development, for the period 1980-2018. To identify current-account breaks we apply the Lee and Strazicich (2003)'s test which, among other advantages, allows the endogenous identification of positive and negative structural breaks both in the levels and trends of current-account series. We examine simultaneously the determinants of both current-account breaks and changes in level after breaks, estimating a selection model based on Heckman (1976, 1979). Studying current-account breaks, the stability periods between them, and their determinants is key to understanding what factors and policies foster external sector stability, a particularly relevant issue at the present time when the pandemic generates so much uncertainty and instability worldwide.

We identify 212 significant structural breaks and 341 stability spells, or periods between breaks. We find that half of these spells last a decade or less, and that they tend to be shorter and more volatile the further the current account is from being balanced. Also, high-income countries tend to have stability spells with structural surpluses or moderate deficits and lower current-account volatility, while low-income economies register spells with major structural current-account deficits and high volatility.

Our results show that economic growth and foreign-exchange piling are particularly useful to prevent current-account breaks and enhance external stability. We also observe that low-income countries are more exposed to breaks. Our results also point out that both increases in the real interest or domestic-currency depreciations reduce the risk of breaks. The last finding curtails the effectiveness of the monetary policy in preventing current-account breaks since increasing the real interest rate and depreciating the currency are hard to combine.

The chapter is structured as follows: Section 1.1 reviews the main literature. In Section 1.2 we identify the structural breaks and current-account stability spells. In Section 1.3 we analyze these structural breaks and current-account stability spells. In Section 1.4 we examine the structural consequences of the breaks. In Section 1.5 we study the determinants of these breaks and, finally, Section 1.6 summarizes the main conclusions and policy implications.

1.1. State of the art

Structural breaks are abrupt shifts in the deterministic components in time series data, which could involve changes in the mean or changes in the slope of the process that generates the series. In the case of the current account, these breaks modify the relationship between a country and the rest of the world and alter the long-term level of the current account and/or its trend. The literature links these breaks with modifications in the long-term conditions of an economy, which include different factors related with its economic development, its macroeconomic fundamentals and its economic policies. Yet, there is no consensus about the level of influence of each of these factors on the probability of a break, a key aspect to identify the best policies and structural reforms which increase external-sector stability. Achieving this stability is especially relevant since current-account reversals involve great economic cost, as in the recent Eurozone crisis, where these costs were estimated between 6% and 32% of GDP (García-Solanes *et al.*, 2018).

In general, the literature analyzes the probabilities and determinants of current-account breaks by focusing on specific groups of countries, selected by income level, region or other criteria as, for instance, in Milesi-Ferretti and Razin (1998), Bagnai, and Manzocchi (1999), Freund (2005) or Aßmann and Boysen-Hogrefe (2010). In this chapter, we aim to add to these studies taking a world-wide perspective that includes countries with different degrees of economic development with the objective of reducing the biases that can result from a narrow focus on a reduced group of countries. Moreover, in contrast to existing studies, such as Milesi-Ferretti and Razin (1998) and Adalet and Eichengreen (2007), we avoid *ad hoc* definitions of breaks and do not concentrate exclusively on positive level breaks that occur when countries record current-account deficits (i.e., level current-account reversals). We identify breaks by using a unit-root test suggested by Lee and Strazicich (2003) that verifies whether a series is stationary with one or two breaks, and allows the endogenous identification of up to two structural breakpoints including breaks in both levels and trends of current-account series, and not only level reversals. Moreover, it avoids imposing arbitrary break thresholds, which could either exclude some breaks that do not present a major immediate effect or overstate the number of breaks in countries with a highly volatile current account.

Several previous papers have analyzed the determinants of current-account breaks. Milesi-Ferretti and Razin (1998, 2000) find that the current-account balance, openness, foreign exchange reserves, terms of trade, US real interest rates, real exchange rates and growth in industrial countries are relevant to explain current-account reversals. Edwards (2004a) discovers the relevance of external debt, debt service and domestic credit creation; and Liesenfeld *et al.* (2007), which focuses on emerging countries, observe that, apart from the determinants outlined by previous contributions, concessional debts are relevant determinants of current-account reversals in these economies. De Mello *et al.* (2012) examine the structural breaks in the current account of 101 countries between 1971 and 2007 and find that, in addition to usual factors mentioned in previous studies, budget balances and the monetary policy stance are also significant determinants of reversals.

Catao and Milesi-Ferretti (2014) analyze the determinants of external crisis and obtain that, while the level of foreign liabilities and the current-account balance are powerful predictors of those crisis, foreign exchange reserves reduce the probability of that event, and does so more effectively than foreign asset holdings. Das (2016) observes a relationship between the current-account balance and a group of variables including exchange-rate stability, commodity prices and real GDP growth. This author also suggests that the determinants might differ between developed, emerging and developing countries. Finally, other researchers investigate the impact of structural reforms on competitiveness and current-account stability. For instance, Xifré (2020) summarizes the literature on this issue and underlines the relevance of structural reforms focused not only on reducing wages, but mainly on increasing non-price competitiveness such as amending the education system, increasing I+D investments and improving the quality of institutions.

Most of these authors use probit modeling to examine the determinants of a current-account break or a reversal (for instance, Freund, 2005, or Catao and Milesi-Ferretti, 2014). Yet, this methodology does not allow for the analysis of the impact of the determinants on the magnitude of the change after a break, a relevant issue to minimize the impact of these breaks. Das (2016) performs dynamic panel regressions to assess the influence of each variable on the current-account, but he does not investigate the specific causes of breaks.

In this chapter, we examine what factors cause breaks and post-break changes in the current account using a selection model. This way, we can examine the determinants of the probability of breaks and the magnitude of the subsequent changes while avoiding selection bias, as not all countries present breaks. Our methodology is in line with De Mello *et al.* (2012), adding to it several novelties: first, we apply a more global perspective, nearly doubling the countries in the sample from 101 to 181 and investigate a more recent period (1980-2018); second, according to this we discover a different set of breaks' determinants, which prove to be relevant for the period span of our analysis, such as the real interest rate, GDP per capita or foreign reserves level. Finally, this chapter innovates by examining current-account stability spells with the conviction that the changes that follow the breaks are significant not just for their magnitude but also because of their duration and stability.

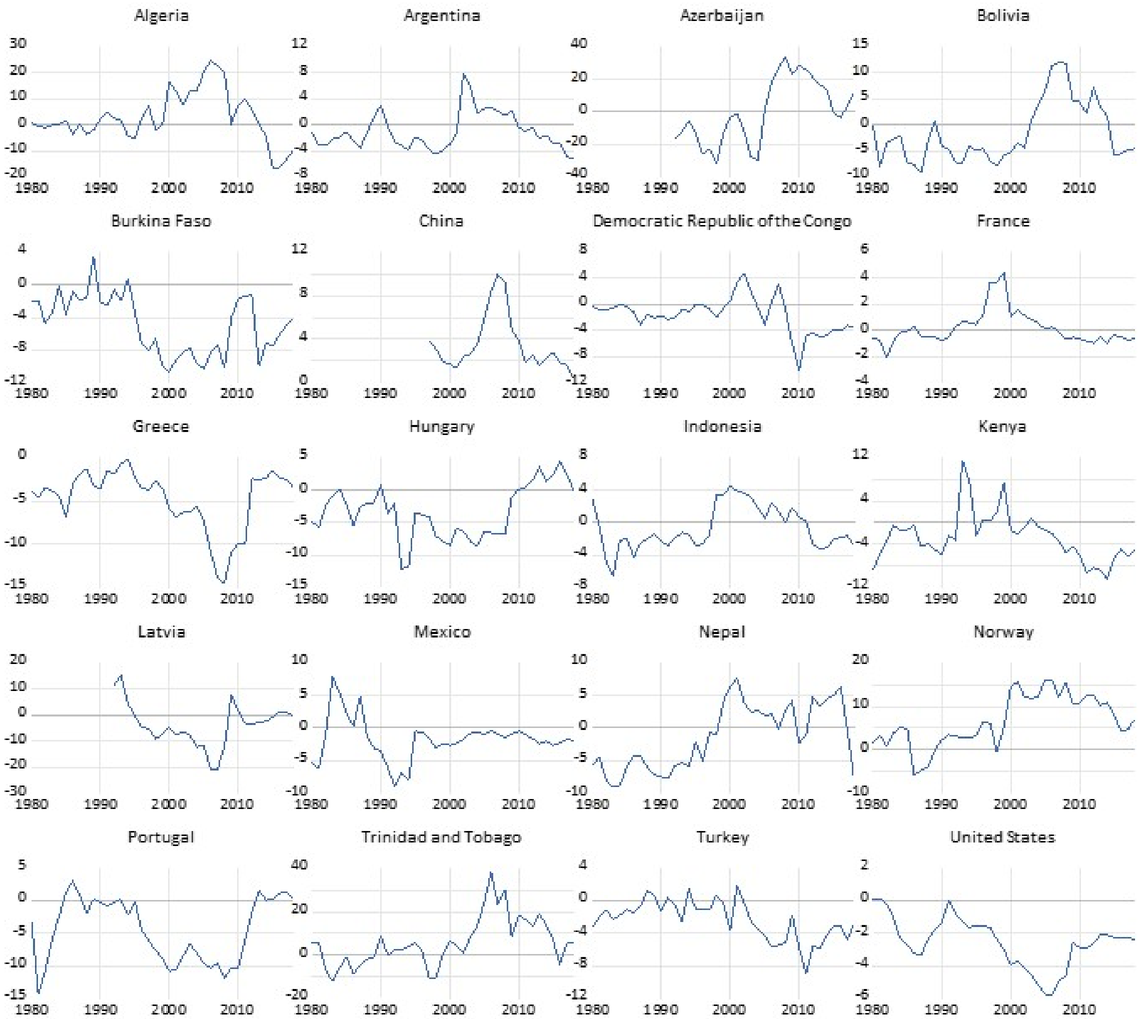
1.2. Identification of structural breaks.

1.2.1. First look at the data

We obtain the current-account data as a percentage of GDP from the IMF World Economic Outlook (April 2020). Taking all the countries with available data, resulted in a relevant dataset of 181 economies. The timeframe studied was determined by data availability, which goes from 1980, the earliest year available, to 2018. For countries with incomplete databases in the IMF, we start from the earliest year available.

For a first visual understanding of the issue, Graph 1 reports time series of the current account in a sample of 20 economies from various regions and different levels of economic development. In all cases, current accounts exhibit structural shifts in both levels and trends, understanding the current-account level as the mean of a given period, and trend as the slope of the linear tendency in the period.

Graph 1: Current-Account Balance (% GDP) – selected countries



1.2.2. *Methodology: identification of structural breaks*

The literature includes different approaches in identifying current-account reversals. On the one hand, several authors, such as Milesi-Ferretti and Razin (1998) and Adalet and Eichengreen (2007), establish *ad hoc* reduction levels on current-account deficits to GDP in order to identify reversals, such as a reduction of 3 percentage points over three years. This method suffers from the limitation that it can overlook relevant structural changes that do not cause immediate shifts. In addition, as Aßmann and Boysen-Hogrefe (2010) pointed out, it could over-identify breaks when the external accounts of a country exhibit high volatility. As an alternative, Bagnai and Manzocchi (1999) and De Mello *et al.* (2012) use unit root tests that endogenously identify these breaks without imposing thresholds.

To identify the structural breaks, and following De Mello *et al.* (2012), we apply a unit-root test proposed by Lee and Strazicich (2003), a methodology that circumvents the spurious rejection problems associated with the Perron (1989) and Zivot and Andrews (1992) endogenous break test. The Lee and Strazicich's test is a minimum Lagrange Multiplier test that verifies whether a series is stationary with one or two breaks and allows to endogenously identify up to two structural breakpoints, including breaks in both levels and trends. The null hypothesis of this test is that the series has a unit root with one or two breaks and, thus, it is not stationary with one or two breaks, while the alternative hypothesis is that the series does not have a unit root with one or two breaks. Hence, rejecting the null unambiguously implies a trend stationary process, indicating that the series is stationary with one or two breaks, confirming the stationarity of the series around breaks. This test contemplates a maximum of two breaks, a limit which, following our results, ensures that the external position is stationary for the majority of countries, in line with De Mello *et al.* (2012). This limit is also consistent with the general stability of the global macroeconomic policy framework from the beginning of the 80s onwards, a period frequently referred to as “the great moderation” with no major global shocks other than the 2009 crisis. In addition, the number of years of our sample is not particularly long and, therefore, it is unlikely that a significant number of countries present more than two structural breaks.

Overall, the Lee and Strazicich’s test allows us to avoid arbitrary thresholds to identify breaks and to include breaks both in current-account deficit and in surplus situations. Furthermore, it is able to discover breaks in situations in which, although current-account figures are not seemingly worrying, they do have important structural consequences for the country’s economy. Finally, this methodology avoids the potential biases that arise in the identification of breaks when economies present different patterns of volatility.

We apply this test to the current-account balance data of 181 economies between 1980 and 2018. To choose the number of lags, we follow Campbell and Perron (1991) and Ng and Perron (1995), among others, and apply the t-sig procedure, which selects the lag through a general-to-specific recursive procedure that is based on a t-statistic of the coefficient linked with the last lag. Since we are using annual data, we set the maximum lag in 2 periods ($k = 2$), as in De Mello *et al.* (2012), and we set the minimum significance level at 10%, which requires a t-statistic greater than 1.645 in absolute value. The existence of two structural breaks is allowed, both in levels and in trends, in a first assessment, and for countries where the result for two breaks is not significant, we proceed by applying the test allowing one break in levels and trends.

After identifying the structural breaks, and for the series where the null is rejected and thus are stable around breaks, we also estimate the current-account linear trendline for each of the periods separated by these breaks, periods that we call current-account stability spells. This is a similar concept to “growth spells” that can be found in the literature, for instance in Berg *et al*. (2012). In order to estimate these linear trendlines for each country and stability spell, *i*, we pose the equation:

$$CA_i = a_i + b_i T \quad (1)$$

Where CA_i is the current-account in percentage of GDP, a_i is the constant parameter, b_i is the slope parameter, which we use as a reference for the trend of a given spell, and *T* is the time variable which includes all years of each spell, being 1 the value of the first year in a given stability spell. We estimate equation (1) using OLS linear regression for each of the stability spells that starts either with a series or, alternatively, with the year after a break, and finish a break year or at the end of the series.

Table I presents the results of this test. In the first left columns of Table I, under the heading “Breaks”, we present the year of the breaks (columns 2 and 3), the significance levels (column 4) and the number of lags selected by the test (column 5). Hence, for instance, Table I indicates that Argentina presents 1 break in 2000 and rejects the null at 5% significance level, while China registered 2 breaks, in 2004 and 2011, with a significance level of 1%. The results for the full sample show that 129 economies of the 181 examined have at least 1 significant structural break at 10% significance level or higher (83 economies have 2 breaks, and 46 have 1), while 52 economies do not present significant breaks. Therefore, 71% of our world-economies sample have suffered at least one structural break in their current-account in the last four decades, totaling 212 significant structural breaks during the period.

Table I: Structural breaks and linear estimations

Country	Breaks				*Fisrt Spell* $CA_{it} = a_{i1} + b_{i1}T$					*Second Spell* $CA_{it} = a_{i2} + b_{i2}T$								*Third Spell* $CA_{it} = a_{i3} + b_{i3}T$							
	Break 1	Break 2	Sig.	lags	a_{i1}	b_{i1}				a_{i2}	b_{i2}				Change			a_{i3}	b_{i3}				Change		
					Const.	Slope	Spell	Mean	S.d.	Const.	Slope	Spell	Mean	S.d.	Mean	Slope	S.d.	Const.	Slope	Spell	Mean	S.d	Mean	Slope	S.d.
Afghanistan	2006	2011	***	2	38,02	-2,55	5	30,36	5,49	62,34	-7,8	5	38,95	13,23	8,59	-5,25	7,74	4,51	0,7	7	7,29	3,66	-31,66	8,49	-9,56
Albania	2005	2010	*	1	0,22	-0,34	26	-4,42	4,04	-7,7	-1,41	5	-11,94	3,37	-7,52	-1,07	-0,67	-12,62	0,76	8	-9,2	1,91	2,74	2,17	-1,45
Algeria	1993	2007	***	1	-1,35	0,21	14	0,23	2,31	-6,85	2,15	14	9,25	9,64	9,02	1,94	7,33	16,98	-3,07	11	-1,46	11,29	-10,71	-5,22	1,65
Angola	1995	2001	**	2	-0,8	-0,32	16	-3,52	3,82	18,49	-6,27	6	-3,45	22,27	0,07	-5,95	18,45	7,99	-0,41	17	4,33	8,71	7,78	5,86	-13,56
Argentina	2000		**	1	-1,23	-0,08	21	-2,14	1,78	5,25	-0,53	18	0,23	3,33	2,37	-0,45	1,55								
Armenia	2002		**	1	-22,4	1,09	11	-15,85	12,02	-7,33	0	16	-7,35	4,57	8,5	-1,09	-7,45								
Aruba	2003	2009	***	1	-6,44	0,56	5	-4,77	16	12,16	-1,26	6	7,73	4,54	12,5	-1,82	-11,46	-14,82	2,21	9	-3,78	8,21	-11,51	3,47	3,68
Australia	1985	2003	**	1	-2,61	-0,34	6	-3,79	0,81	-4,28	0,01	18	-4,15	1,02	-0,36	0,35	0,21	-6,53	0,28	15	-4,28	1,39	-0,14	0,27	0,37
Azerbaijan	2006		***	2	-20,37	0,91	15	-13,13	13,1	35	-2,78	12	16,91	11,44	30,04	-3,69	-1,66								
Bahrain	1989	2006	*	1	10,04	-1,35	10	2,63	5,19	-8,96	0,98	17	-0,11	7,27	-2,75	2,33	2,09	12,86	-1,48	12	3,27	6,11	3,39	-2,46	-1,16
Bangladesh	1984	2012	**	1	-1,87	-0,18	5	-2,4	0,81	-2,91	0,14	28	-0,81	1,46	1,58	0,32	0,65	3,08	-0,86	6	0,06	1,73	0,87	-1,01	0,27
Belarus	1997	2007	*	1	0,88	-1,19	6	-3,27	2,5	-3,89	0,06	10	-3,53	2,38	-0,26	1,25	-0,12	-13,07	1,11	11	-6,43	4,39	-2,9	1,04	2,01
Belgium	1995		**	0	-3,72	0,59	16	1,32	2,91	5,68	-0,29	23	2,2	2,33	0,89	-0,88	-0,58								
Belize	1989	2005	**	2	-4,76	0,56	10	-1,65	4,63	0,21	-1,09	16	-9,09	6,63	-7,43	-1,66	1,99	-2,67	-0,43	13	-5,72	3,34	3,37	0,66	-3,29
Benin	1988	2002	***	2	-14,69	1,27	9	-8,35	6,18	-0,68	-0,41	14	-3,78	1,85	4,57	-1,68	-4,33	-2,16	-0,12	16	-3,2	1,24	0,59	0,29	-0,61
Bolivia	2001	2007	***	2	-3,97	-0,09	22	-4,96	2,56	-6,58	3,32	6	5,05	5,76	10,01	3,41	3,2	10,71	-1,56	11	1,33	5,59	-3,72	-4,89	-0,17
Bosnia and Herzegovina	2002	2006	**	1	-2,62	-2,66	5	-10,59	4,2	-23,31	3,3	4	-15,06	4,23	-4,48	5,95	0,03	-11,1	0,62	12	-7,06	2,84	8,01	-2,67	-1,39
Burkina Faso	1995		**	0	-2,61	0,11	16	-1,69	1,87	-9,48	0,2	23	-7,05	2,84	-5,36	0,09	0,97								

Table I: Structural breaks and linear estimations (cont.)

Country	Breaks				*Fisrt Spell* $CA_{it} = a_{i1} + b_{i1}T$					*Second Spell* $CA_{it} = a_{i2} + b_{i2}T$								*Third Spell* $CA_{it} = a_{i3} + b_{i3}T$							
	Break 1	Break 2	Sig.	lags	a_{i1} Const.	b_{i1} Slope	Spell	Mean	S.d.	a_{i2} Const.	b_{i2} Slope	Spell	Mean	S.d.	Change Mean	Change Slope	Change S.d.	a_{i3} Const.	b_{i3} Slope	Spell	Mean	S.d	Change Mean	Change Slope	Change S.d.
Burundi	2005	2012	**	2	-8,15	0,23	26	-5,11	3,42	-7,21	-0,75	7	-10,19	8,2	-5,09	-0,97	4,78	-22,6	1,42	6	-17,65	3,63	-7,46	2,16	-4,57
Cambodia	2001		*	1	-2,79	-0,05	10	-3,04	2,4	-1,59	-0,54	17	-6,45	3,22	-3,4	-0,49	0,82								
Cameroon	2008		***	0	-4,74	0,12	29	-2,97	1,93	-3,58	0,03	10	-3,42	0,52	-0,46	-0,09	-1,42								
Central African Republic	2003	2010	**	1	-5,38	0,12	24	-3,85	2,14	-1,39	-1,25	7	-6,38	2,93	-2,53	-1,37	0,79	-6,18	-0,26	8	-7,36	2,88	-0,98	0,98	-0,05
Chad	2000	2005	***	2	3,63	-0,72	21	-4,26	5,18	-73,52	13,06	5	-34,35	29,01	-30,09	13,77	23,83	2,28	-1,04	13	-4,99	6,36	29,37	-14,09	-22,65
China	2004	2011	***	2	2,74	-0,04	8	2,55	0,84	9,98	-0,93	7	6,27	2,78	3,71	-0,89	1,95	2,8	-0,24	7	1,83	0,74	-4,44	0,68	-2,05
Comoros	1987		***	0	-4,33	-0,61	8	-7,06	4,1	-2,06	-0,04	31	-2,64	2,3	4,43	0,57	-1,8								
Côte d'Ivoire	2010		**	2	-9,78	0,43	31	-2,97	4,75	4,51	-1,01	8	-0,03	3,11	2,94	-1,43	-1,65								
Croatia	1998	2008	***	2	6,97	-2,27	7	-2,11	5,44	-2,86	-0,4	10	-5,08	2,06	-2,97	1,87	-3,38	-2,9	0,65	9	0,7	2,24	5,78	1,06	0,18
Cyprus	2006		**	0	-6,61	0,17	27	-4,24	3,44	-10,76	0,77	12	-5,73	4,08	-1,49	0,6	0,63								
Czech Republic	2000	2006	**	1	-4,29	0,14	6	-3,79	1,74	-6,28	0,65	6	-3,99	1,34	-0,2	0,51	-0,39	-4,22	0,49	12	-1,05	1,87	2,94	-0,16	0,53
Democratic Republic of the Congo	1999	2009	***	1	-0,98	-0,01	20	-1,11	0,88	3,78	-0,62	10	0,35	3,07	1,47	-0,61	2,19	-7,61	0,55	9	-4,89	1,93	-5,24	1,17	-1,15
Djibouti	2005	2010	***	1	19,69	1,54	15	32,03	12,4	-37,43	13,4	5	2,77	30,21	-29,26	11,86	17,81	-16,27	3,88	8	1,19	20,21	-1,58	-9,52	-10
Dominican Republic	2007		***	2	-4,46	0,14	28	-2,47	2,67	-9,34	0,84	11	-4,3	2,94	-1,84	0,7	0,27								
Ecuador	1997	2010	**	2	-4,65	0,09	18	-3,76	2,49	-1,05	0,19	13	0,29	3,77	4,04	0,1	1,28	-0,51	-0,03	8	-0,64	0,96	-0,92	-0,22	-2,81
El Salvador	1984	2007	**	1	2,57	-0,84	5	0,06	3,1	1,35	-0,29	23	-2,1	3	-2,15	0,55	-0,1	-5,83	0,23	11	-4,43	2,11	-2,34	0,52	-0,89

Table I: Structural breaks and linear estimations (cont.)

Country	Breaks				*Fisrt Spell* $CA_{it} = a_{i1} + b_{i1}T$					*Second Spell* $CA_{it} = a_{i2} + b_{i2}T$								*Third Spell* $CA_{it} = a_{i3} + b_{i3}T$							
	Break 1	Break 2	Sig.	lags	a_{i1} Const.	b_{i1} Slope	Spell	Mean	S.d.	a_{i2} Const.	b_{i2} Slope	Spell	Mean	S.d.	Change Mean	Change Slope	Change S.d.	a_{i3} Const.	b_{i3} Slope	Spell	Mean	S.d	Change Mean	Change Slope	Change S.d.
Eq. Guinea	1997	2003	***	2	0,95	-5,18	11	-30,1	35,58	-76,48	9,57	6	-42,99	26,39	-12,89	14,75	-9,2	13,88	-1,87	15	-1,06	11,82	41,93	-11,44	-14,57
Eritrea	2001	2009	***	1	34,1	-7,84	9	-5,12	23,9	2,76	-1,57	8	-4,3	4,03	0,82	6,28	-19,87	-1,64	2,87	9	12,73	10,01	17,03	4,44	5,98
Estonia	2008		*	2	-3,2	-0,63	16	-8,56	4,12	0,8	0,09	10	1,28	1,26	9,84	0,72	-2,86								
Eswatini	1994		**	2	-14,3	1,37	15	-3,35	8,88	-4,72	0,4	24	0,34	6,37	3,69	-0,96	-2,51								
Ethiopia	2000		***	1	-2,04	0,05	21	-1,45	1,91	-4,64	-0,2	18	-6,54	3,34	-5,09	-0,25	1,44								
France	1995	2002	***	2	-1,12	0,1	16	-0,3	0,67	3,42	-0,25	7	2,41	1,36	2,71	-0,35	0,69	0,35	-0,08	16	-0,36	0,52	-2,77	0,17	-0,84
Gabon	1987	2013	***	1	31,26	-5,01	8	8,72	13,95	-3,67	0,89	26	8,34	9,77	-0,38	5,9	-4,18	3,14	-2,28	5	-3,7	6,1	-12,04	-3,17	-3,67
Georgia	2004		**	1	-15,66	1,05	10	-9,88	3,7	-16,18	0,59	14	-11,76	4,18	-1,88	-0,46	0,48								
Ghana	2009		**	2	-0,24	-0,17	30	-2,9	2,18	-8,9	0,55	9	-6,13	1,93	-3,23	0,73	-0,24								
Greece	1993	2010	**	2	-5	0,25	14	-3,13	1,56	-0,14	-0,73	17	-6,72	3,97	-3,59	-0,98	2,41	-5,88	0,55	8	-3,39	2,53	3,33	1,28	-1,44
Guatemala	2006	2012	*	1	-3,54	-0,07	27	-4,47	1,65	-3,59	0,19	6	-2,94	1,69	1,53	0,25	0,04	-5,04	1,15	6	-1	2,13	1,94	0,97	0,43
Guinea	2000		***	1	-1,23	-0,24	21	-3,92	2,39	2,92	-1,27	18	-9,19	8,5	-5,26	-1,03	6,11								
Guyana	1994	2013	**	2	-41,26	1,9	15	-26,1	9,85	-3,13	-0,42	19	-7,3	3,28	18,8	-2,31	-6,57	3,54	-4,8	5	-10,85	10,86	-3,54	-4,38	7,57
Haiti	1988	1995	***	1	-6,08	0,53	9	-3,42	1,5	-7	0,22	7	-6,13	5,31	-2,71	-0,32	3,81	-0,08	-0,18	23	-2,27	2,19	3,87	-0,4	-3,12
Honduras	1987	2014	***	1	-9,09	0,81	8	-5,45	2,12	-2,5	-0,21	27	-5,49	2,98	-0,04	-1,02	0,85	-3,31	-0,02	4	-3,35	1,8	2,14	0,2	-1,18
Hungary	1991	2009	***	1	-3,83	0,2	12	-2,51	2,01	-7,27	0,08	18	-6,48	2,85	-3,97	-0,12	0,84	0,95	0,17	9	1,79	1,48	8,27	0,09	-1,37
Iceland	2007		**	2	0,29	-0,36	28	-4,89	5,46	-15,23	2,27	11	-1,62	8,5	3,27	2,63	3,04								
Indonesia	1998		***	1	-2,73	0,08	19	-1,9	2,21	4,72	-0,4	20	0,52	2,51	2,42	-0,48	0,3								
Iraq	2006	2014	***	2	-6,17	0,69	6	-3,77	10,81	0,08	0,51	8	2,39	7,2	6,16	-0,17	-3,61	-14,14	5,05	4	-1,52	6,19	-3,91	4,54	-1,01

Table I: Structural breaks and linear estimations (cont.)

	Breaks				*Fisrt Spell* $CA_{it} = a_{i1} + b_{i1}T$					*Second Spell* $CA_{it} = a_{i2} + b_{i2}T$								*Third Spell* $CA_{it} = a_{i3} + b_{i3}T$							
					a_{i1}	b_{i1}				a_{i2}	b_{i2}				Change			a_{i3}	b_{i3}				Change		
Country	**Break 1**	**Break 2**	**Sig.**	**lags**	**Const.**	**Slope**	**Spell**	**Mean**	**S.d.**	**Const.**	**Slope**	**Spell**	**Mean**	**S.d.**	**Mean**	**Slope**	**S.d.**	**Const.**	**Slope**	**Spell**	**Mean**	**S.d**	**Mean**	**Slope**	**S.d.**
Islamic Republic of Iran	1989	2011	**	1	-1,78	0,13	10	-1,08	2,14	-4,22	0,55	22	2,05	5,24	3,13	0,42	3,1	6,12	-0,59	7	3,74	2,02	1,69	-1,14	-3,23
Israel	1987	1996	*	1	-7,93	1,02	8	-3,34	4,43	0,87	-0,65	9	-2,37	1,93	0,97	-1,67	-2,5	-1,56	0,27	22	1,49	2,21	3,86	0,91	0,28
Japan	1989	2009	**	2	-0,15	0,39	10	2	1,51	1,8	0,09	20	2,74	0,8	0,74	-0,3	-0,71	1,51	0,22	9	2,6	1,35	-0,14	0,13	0,55
Kenya	1998		**	1	-5,84	0,44	19	-1,42	4,57	1,75	-0,54	20	-3,94	4,03	-2,52	-0,98	-0,54								
Kiribati	1986	2010	**	0	16,96	0,91	7	20,61	7,77	3,47	-0,56	24	-3,59	12,17	-24,21	-1,48	4,41	-13,11	6,75	8	17,25	18,78	20,85	7,31	6,61
Korea	1989		***	1	-11,86	1,81	10	-1,88	5,6	-1,62	0,24	29	2	3,22	3,88	-1,57	-2,39								
Kosovo	2007		**	1	-6,33	-0,17	8	-7,1	1,42	-11,28	0,5	11	-8,28	2,8	-1,18	0,67	1,38								
Kuwait	1990	1994	***	1	44,44	-2,03	11	32,25	11,69	-249,81	77,82	4	-55,26	108,08	-87,51	79,85	96,38	26,56	-0,08	24	25,57	13,78	80,83	-77,9	-94,3
Lao P.D.R.	1999		***	2	-2,88	-0,11	20	-4,04	1,97	-8,76	-0,56	19	-14,39	6,16	-10,35	-0,45	4,19								
Latvia	2008		**	1	9,21	-1,68	17	-5,89	9,3	1,48	-0,3	10	-0,15	3,21	5,74	1,38	-6,09								
Lebanon	1987	2006	*	2	-3,2	-1,3	8	-9,04	20,16	-32,95	1,1	19	-21,92	13,96	-12,89	2,4	-6,2	-15,01	-1,1	12	-22,17	5,44	-0,25	-2,21	-8,52
Liberia	2006	2010	***	1	-11,98	1,24	7	-7,02	5,02	-9,01	-3,23	4	-17,08	9,02	-10,06	-4,47	3,99	-12,27	-1,41	8	-18,63	3,81	-1,55	1,81	-5,21
Libya	2005	2012	***	2	-6,61	0,88	26	5,25	10,72	55,11	-5,75	7	32,11	15,28	26,85	-6,63	4,56	-54,38	8,51	6	-24,6	32	-56,7	14,26	16,72
Lithuania	2005	2009	**	1	-10,18	0,37	11	-7,93	2,16	-19,35	3,89	4	-9,64	6,6	-1,7	3,51	4,43	-2,27	0,32	9	-0,67	2,11	8,97	-3,56	-4,48
Luxembourg	2006	2010	***	2	10,93	-0,12	12	10,17	1,71	10,19	-0,96	4	7,8	1,16	-2,38	-0,84	-0,55	6,01	-0,17	8	5,24	0,41	-2,55	0,79	-0,76
Macao SAR	2007	2012	**	1	37,23	-3,17	6	26,15	6,66	15,01	5,91	5	32,75	9,52	6,6	9,08	2,86	35,55	-0,88	6	32,46	4,8	-0,29	-6,8	-4,72
Madagascar	2007		**	0	-4,96	-0,1	28	-6,36	2,48	-16,85	1,83	11	-5,86	6,29	0,5	1,93	3,81								
Malawi	1991		**	0	-8,2	0,48	12	-5,05	2,7	-2,57	-0,53	27	-9,94	6	-4,88	-1,01	3,3								

Table I: Structural breaks and linear estimations (cont.)

	Breaks				*Fisrt Spell* $CA_{it} = a_{i1} + b_{i1}T$					*Second Spell* $CA_{it} = a_{i2} + b_{i2}T$								*Third Spell* $CA_{it} = a_{i3} + b_{i3}T$							
					a_{i1}	b_{i1}				a_{i2}	b_{i2}				Change			a_{i3}	b_{i3}				Change		
Country	Break 1	Break 2	Sig.	lags	Const.	Slope	Spell	Mean	S.d.	Const.	Slope	Spell	Mean	S.d.	Mean	Slope	S.d.	Const.	Slope	Spell	Mean	S.d	Mean	Slope	S.d.
Malaysia	1997		*	2	-3,95	0,02	18	-3,75	4,98	14,45	-0,49	21	9,04	4,78	12,79	-0,51	-0,2								
Malta	2003	2013	***	1	-5,44	0,55	9	-2,67	2	-9,51	1,09	10	-3,5	3,91	-0,83	0,54	1,91	3,94	1,11	5	7,26	3,3	10,76	0,01	-0,6
Marshall Islands	2002	2009	**	1	-15,75	3,05	6	-5,06	6,88	9,08	-1,91	7	1,44	5,54	6,5	-4,96	-1,34	-10,08	2,69	9	3,37	9,57	1,93	4,6	4,03
Mauritania	1999		***	0	-5,8	0,6	10	-2,47	2,3	-7,26	-0,41	19	-11,34	8,08	-8,87	-1,01	5,78								
Mauritius	2005		***	1	-4,97	0,24	26	-1,75	4,2	-9,72	0,39	13	-7,01	2,72	-5,26	0,15	-1,48								
Mexico	1986	1994	***	1	-5,3	1,45	7	0,51	4,83	3,31	-1,66	8	-4,14	4,21	-4,65	-3,11	-0,63	-1,3	-0,02	24	-1,53	0,79	2,61	1,64	-3,41
Moldova	1999		*	0	-8,14	-0,59	8	-10,77	5,2	-6,4	-0,09	19	-7,34	3,99	3,43	0,49	-1,21								
Mongolia	2008		*	2	-0,29	-0,13	18	-1,54	5,36	-19,01	0,76	10	-14,85	8,29	-13,31	0,89	2,93								
Montenegro	2006	2012	***	2	-4	-3,02	6	-14,58	8,37	-51,49	6,73	6	-27,94	12,93	-13,36	9,75	4,56	-9,59	-1,27	6	-14,02	2,47	13,92	-7,99	-10,45
Myanmar	2004		**	1	-22,08	3,81	7	-6,85	7,83	4,96	-0,8	14	-1	4,06	5,85	-4,6	-3,77								
Nepal	1997		***	1	-7,65	0,2	18	-5,76	2,11	4,16	-0,16	21	2,34	3,48	8,1	-0,36	1,37								
Netherlands	1998	2005	**	2	1,63	0,16	19	3,19	1,48	0,64	0,9	7	4,23	2,21	1,04	0,74	0,73	6,26	0,27	13	8,15	1,89	3,92	-0,63	-0,31
Nicaragua	1984	1988	***	2	-28,03	2,47	5	-20,61	4,25	-2,1	-9,15	4	-24,97	13,55	-4,36	-11,62	9,3	-25,63	0,7	30	-14,74	9,69	10,23	9,85	-3,87
Niger	2008		**	2	-4,84	-0,05	29	-5,66	1,86	-16,19	0,5	10	-13,45	2,4	-7,79	0,55	0,54								
North Macedonia	1997	2003	**	1	-1,35	-1,21	6	-5,59	2,73	-5,12	-0,06	6	-5,34	2,76	0,25	1,15	0,03	-6,87	0,42	15	-3,54	3,41	1,8	0,48	0,65
Norway	1984	2000	**	1	0,71	0,77	5	3,03	1,59	-3,51	0,7	16	2,48	4,8	-0,55	-0,07	3,21	16,12	-0,51	18	11,29	3,4	8,81	-1,21	-1,4
Oman	1999		***	0	11,57	-1,09	20	0,15	9,46	17,43	-1,34	19	4,07	10,5	3,92	-0,25	1,04								
Pakistan	1998		**	2	-1,68	-0,1	19	-2,67	1,07	0,63	-0,23	20	-1,75	3,05	0,92	-0,13	1,97								

Table I: Structural breaks and linear estimations (cont.)

Country	Breaks				*Fisrt Spell* $CA_{it} = a_{i1} + b_{i1}T$					*Second Spell* $CA_{it} = a_{i2} + b_{i2}T$								*Third Spell* $CA_{it} = a_{i3} + b_{i3}T$							
	Break 1	Break 2	Sig.	lags	a_{i1}	b_{i1}				a_{i2}	b_{i2}				Change			a_{i3}	b_{i3}				Change		
					Const.	Slope	Spell	Mean	S.d.	Const.	Slope	Spell	Mean	S.d.	Mean	Slope	S.d.	Const.	Slope	Spell	Mean	S.d	Mean	Slope	S.d.
Panama	1989	2009	**	1	-10,56	1,94	10	0,13	7,19	-1,52	-0,24	20	-4,02	3,45	-4,15	-2,18	-3,73	-12,37	0,56	9	-9,56	2,28	-5,54	0,8	-1,18
Papua New Guinea	2007	2012	**	2	-7,3	0,34	28	-2,4	5,53	13,42	-10,01	5	-16,61	14,28	-14,21	-10,35	8,75	-19,64	9,57	6	13,84	20,7	30,45	19,57	6,43
Paraguay	1987	1994	*	1	-5,19	-0,41	8	-7,02	1,98	3,42	-0,38	7	1,91	3,88	8,92	0,03	1,9	-0,7	0,11	24	0,67	2,65	-1,23	0,49	-1,23
Peru	1993	2006	*	2	-6,02	0,14	14	-4,99	2,8	-9,31	0,88	13	-3,16	3,44	1,83	0,74	0,64	-1,58	-0,16	12	-2,59	1,89	0,57	-1,03	-1,55
Poland	1989	2003	*	2	-5,91	0,61	10	-2,57	2,23	-0,28	-0,33	14	-2,72	3,07	-0,15	-0,93	0,83	-6,36	0,39	15	-3,26	2,2	-0,54	0,71	-0,87
Portugal	1995	2010	**	1	-6,85	0,54	16	-2,25	4,41	-6,41	-0,31	15	-8,87	1,94	-6,62	-0,85	-2,47	-3,44	0,69	8	-0,34	2,33	8,53	1	0,39
Rep. Congo	1999	2013	**	2	-15,25	-0,15	20	-16,85	12,98	7,29	-0,08	14	6,69	12,9	23,54	0,07	-0,08	-41,28	6,25	5	-22,54	29,99	-29,23	6,33	17,09
Russia	2001	2008	**	1	-3,38	1,42	10	4,44	5,53	9,02	-0,33	7	7,69	1,7	3,25	-1,75	-3,82	3,45	0,03	10	3,61	1,57	-4,09	0,36	-0,14
Rwanda	1998	2006	*	1	-3,29	-0,18	19	-5,12	2,47	-4,9	0,59	8	-2,26	2,48	2,85	0,77	0,02	-4,09	-0,71	12	-8,67	3,81	-6,41	-1,29	1,33
Samoa	1989	1994	***	2	-16,03	2,99	10	0,39	9,02	-4,96	-0,99	5	-7,92	10,7	-8,31	-3,97	1,68	-2,34	-0,16	24	-4,38	4,29	3,54	0,82	-6,41
São Tomé and Príncipe	2005	2009	***	1	-22,79	0,12	26	-21,17	5,58	21,43	-7,83	4	1,85	48,27	23,02	-7,95	42,69	-27,11	2,08	9	-16,69	6,58	-18,54	9,92	-41,69
Senegal	2003	2007	**	1	-8,74	0,19	24	-6,31	1,7	-3,44	-1,29	4	-6,66	1,61	-0,35	-1,48	-0,09	-7,22	0,05	11	-6,93	2,14	-0,27	1,33	0,53
Serbia	2007	2012	***	2	2,09	-2,06	8	-7,16	5,5	-14,91	1,59	5	-10,13	5,18	-2,97	3,65	-0,32	-5,24	0,17	6	-4,63	1,07	5,5	-1,42	-4,11
Seychelles	1994	1999	***	1	-20,81	1,48	15	-8,98	8,13	1,91	-4,51	5	-11,62	6,75	-2,64	-5,99	-1,38	-10,7	-0,54	19	-16,13	6,08	-4,52	3,97	-0,67
Sierra Leone	2009	2013	***	1	-1,52	-0,25	30	-5,34	4,78	-46,48	4,89	4	-34,26	18,49	-28,92	5,13	13,72	-7,46	-2,42	5	-14,74	4,8	19,53	-7,31	-13,69
Singapore	1994	2002	**	1	-12,61	1,84	15	2,14	8,36	17,39	-0,36	8	15,76	2,85	13,62	-2,21	-5,51	24,17	-0,5	16	19,91	3,84	4,15	-0,14	0,99
Slovak Republic	2000	2011	***	2	-0,56	-0,8	8	-4,18	4,99	-7,69	0,3	11	-5,89	1,39	-1,71	1,1	-3,6	2,38	-0,79	7	-0,78	1,85	5,11	-1,09	0,45

Table I: Structural breaks and linear estimations (cont.)																									
	Breaks				*Fisrt Spell* $CA_{it} = a_{i1} + b_{i1}T$					*Second Spell* $CA_{it} = a_{i2} + b_{i2}T$								*Third Spell* $CA_{it} = a_{i3} + b_{i3}T$							
					a_{i1}	b_{i1}				a_{i2}	b_{i2}				Change			a_{i3}	b_{i3}				Change		
Country	Break 1	Break 2	Sig.	lags	Const.	Slope	Spell	Mean	S.d.	Const.	Slope	Spell	Mean	S.d.	Mean	Slope	S.d.	Const.	Slope	Spell	Mean	S.d	Mean	Slope	S.d.
Slovenia	2009		**	0	2,75	-0,37	18	-0,72	2,55	-1,43	0,93	9	3,24	2,57	3,96	1,3	0,02								
Solomon Islands	2006		**	0	-8,16	0,22	27	-5,02	8,01	-21,79	1,83	12	-9,92	9,63	-4,91	1,6	1,62								
South Africa	1983	1992	***	2	1,18	-1,16	4	-1,72	3,85	2,39	-0,04	9	2,17	2,21	3,89	1,12	-1,65	0,28	-0,2	26	-2,36	2,11	-4,53	-0,15	-0,09
Spain	2002	2011	**	2	-0,49	-0,12	23	-1,88	1,66	-7,4	0,27	9	-6,03	2,46	-4,16	0,39	0,8	0,76	0,3	7	1,95	0,89	7,98	0,02	-1,57
Sri Lanka	1987	2007	**	2	-16,09	1,58	8	-9	4,89	-6,84	0,25	20	-4,21	2,16	4,79	-1,33	-2,72	-5,21	0,27	11	-3,61	2,3	0,6	0,02	0,14
Sudan	1988	1993	***	1	-15,02	-0,13	9	-15,65	4,7	-62,98	2,1	5	-56,68	35,9	-41,04	2,23	31,2	-12,28	0,24	25	-9,12	5,48	47,56	-1,86	-30,42
Suriname	2005		**	1	-0,89	-0,28	26	-4,64	7,79	13,09	-1,6	13	1,89	8,57	6,54	-1,32	0,79								
Switzerland	2002	2011	**	1	1,02	0,37	23	5,45	2,87	14,39	-0,72	9	10,79	4,03	5,34	-1,09	1,15	11,88	-0,59	7	9,52	1,73	-1,27	0,13	-2,29
Syria	1987	1994	***	2	-4,37	0,29	8	-3,07	1,4	12,68	-1,89	7	5,11	7,57	8,18	-2,18	6,17	2,85	-0,33	16	0,08	3,28	-5,02	1,57	-4,28
Thailand	2007		**	2	-7,18	0,39	28	-1,51	5,61	0,51	0,62	11	4,21	4,06	5,72	0,23	-1,55								
The Bahamas	2004		**	1	-1,27	0,02	25	-0,96	2,96	-6,85	-0,52	14	-10,74	4,08	-9,78	-0,54	1,11								
Timor-Leste	2008		***	1	-111,76	37,74	9	76,95	110,62	262,95	-29,94	10	98,27	98,59	21,32	-67,69	-12,03								
Togo	2013		**	2	-3,49	-0,17	34	-6,47	2,8	-13,9	2,22	5	-7,26	3,75	-0,78	2,39	0,95								
Trinidad and Tobago	2004		**	2	-4,12	0,34	25	0,34	6,54	31,95	-2,17	14	15,67	10,76	15,33	-2,51	4,21								
Turkey	2003	2013	**	1	-1,5	0,05	24	-0,87	1,41	-3,7	-0,27	10	-5,18	1,76	-4,31	-0,32	0,34	-3,99	0,14	5	-3,58	0,76	1,6	0,4	-0,99
Turkmenistan	2001	2007	***	1	-21,38	3,29	6	-9,86	14,38	-1,07	2,51	6	7,71	5,9	17,57	-0,78	-8,48	-1,51	-0,79	11	-6,25	10,31	-13,95	-3,3	4,41
Tuvalu	2009	2013	***	2	-42,51	6,27	9	-11,15	25,81	-27,52	7,21	4	-9,49	19,89	1,66	0,94	-5,92	-25,32	8,58	5	0,4	28,14	9,89	1,36	8,25
United Arab Emirates	1989	2012	**	1	25,17	-1,76	10	15,5	5,93	4,8	0,26	23	7,97	5,44	-7,53	2,02	-0,49	16,23	-1,86	6	9,73	5,26	1,77	-2,12	-0,18

Table I: Structural breaks and linear estimations (cont.)

	Breaks				*Fisrt Spell* $CA_{it} = a_{i1} + b_{i1}T$					*Second Spell* $CA_{it} = a_{i2} + b_{i2}T$								*Third Spell* $CA_{it} = a_{i3} + b_{i3}T$							
	Break 1	Break 2	Sig.	lags	a_{i1}	b_{i1}				a_{i2}	b_{i2}				Change			a_{i3}	b_{i3}				Change		
Country					**Const.**	**Slope**	**Spell**	**Mean**	**S.d.**	**Const.**	**Slope**	**Spell**	**Mean**	**S.d.**	**Mean**	**Slope**	**S.d.**	**Const.**	**Slope**	**Spell**	**Mean**	**S.d**	**Mean**	**Slope**	**S.d.**
United Kingdom	1993		**	1	0,98	-0,28	14	-1,1	1,56	-0,33	-0,18	25	-2,63	1,46	-1,54	0,1	-0,1								
United States	2010		*	2	-0,39	-0,14	31	-2,57	1,69	-2,59	0,05	8	-2,35	0,26	0,22	0,19	-1,43								
Venezuela	2000	2007	***	1	2,63	0,03	21	2,98	6,6	6,57	1,07	7	10,84	5,37	7,86	1,03	-1,23	3,32	-0,1	11	2,74	4,21	-8,1	-1,16	-1,16
Vietnam	1997	2008	*	2	-1,47	-0,29	18	-4,21	2,82	2,4	-0,72	11	-1,9	3,63	2,31	-0,43	0,82	-1,64	0,39	10	0,48	2,95	2,38	1,1	-0,68
Yemen	1999	2010	*	2	-0,49	0,14	10	0,26	3,66	11,47	-1,79	11	0,71	6,41	0,45	-1,93	2,75	-3,21	0,15	8	-2,54	2,02	-3,25	1,94	-4,4
Average					**-4,11**	**0,33**	**15**	**-2,2**	**6,07**	**-2,95**	**0,44**	**12**	**-2,82**	**7,87**	**-0,62**	**0,11**	**1,8**	**-3,17**	**0,48**	**11**	**-1,59**	**5,37**	**1,22**	**0,04**	**-2,5**

H_0: the series has a unit root with one or two breaks. H_a: series does not have a unit root with one or two breaks. *** indicates significance at 1% level; ** 5% level; *10% level. Countries where the null was not rejected (52): Austria, Barbados, Bhutan, Botswana, Brazil, Brunei Darussalam, Bulgaria, Cabo Verde, Canada, Chile, Colombia, Costa Rica, Denmark, Egypt, Fiji, Finland, Germany, Guinea Bissau, Hong Kong SAR, India, Ireland, Italy, Jamaica, Jordan, Kazakhstan, Kyrgyz Republic, Lesotho, Maldives, Mali, Micronesia, Morocco, Mozambique, Namibia, New Zealand, Nigeria, Palau, Philippines, Qatar, Romania, Saudi Arabia, Sweden, Tajikistan, Tanzania, The Gambia, Tonga, Tunisia, Uganda, Ukraine, Uzbekistan, Vanuatu, Zambia and Zimbabwe.

In the three major sections in the right side of Table I, we present the results of the linear trendline estimations for each country and the stability spells, where countries with one break have two stability spells while countries with two breaks have three spells. In these three columns, for each country and stability spell, the level parameter is under column “Const.” and the slope parameter can be found in the column “Slope”. In addition, we also measure the duration of each spell in years and include it in the column “spell”. For each spell, we present its mean in the column “mean” and standard deviation under “S.d.”. The mean of the spells has a particular relevance in our analysis, since we use it as a reference for the structural position, or level, of the current account during each stability spell. Finally, in the right side of the two last sections we include three columns under the heading “Change” which present the variation of the mean, slope and s.d. in relation with the previous spell. For instance, Argentina has two stability spells since it registered only one break: the first one (third block of Table I) with a linear trendline where the constant parameter is -1.23, the slope -0.08, the spell lasts 21 years, it has a mean of -2.14% of GDP and a standard deviation of 1.78. Argentina’s second stability spell (fourth block in Table I) has a constant parameter of 5.25, trend of -0.53, it lasts 18 years, has an average of 0.23% of GDP and a standard deviation of 3.33. Finally, since the last three columns in the right side of the fourth and fifth block present the change between spells, we observe that, after the break in Argentina, the mean increased by 2.37 (0.23 - (-2.14)), the slope fell by -0.45 and the s.d. rose by 1.55. This indicates that, after the break in 2001, Argentina’s current account became more positive in its level, while it reduced its slope and increased its standard deviation and, thus, its volatility.

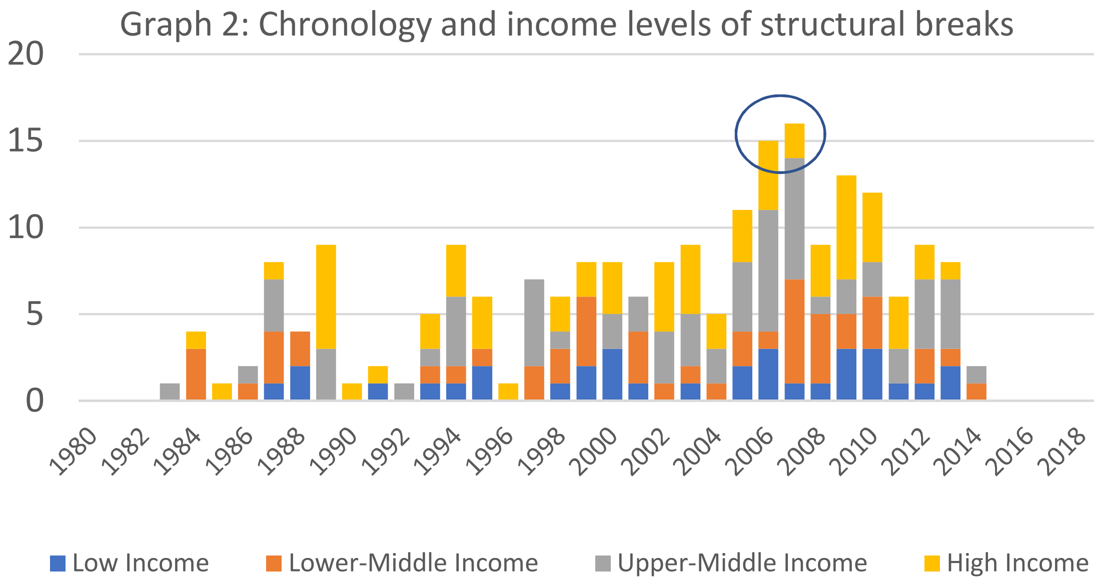
All in all, we find that a majority of countries experience current-account breaks, and we detect 341 stability spells; 92 of them for the economies with one structural break, and 249 for the economies with two breaks. In the next sections, we analyze these results.

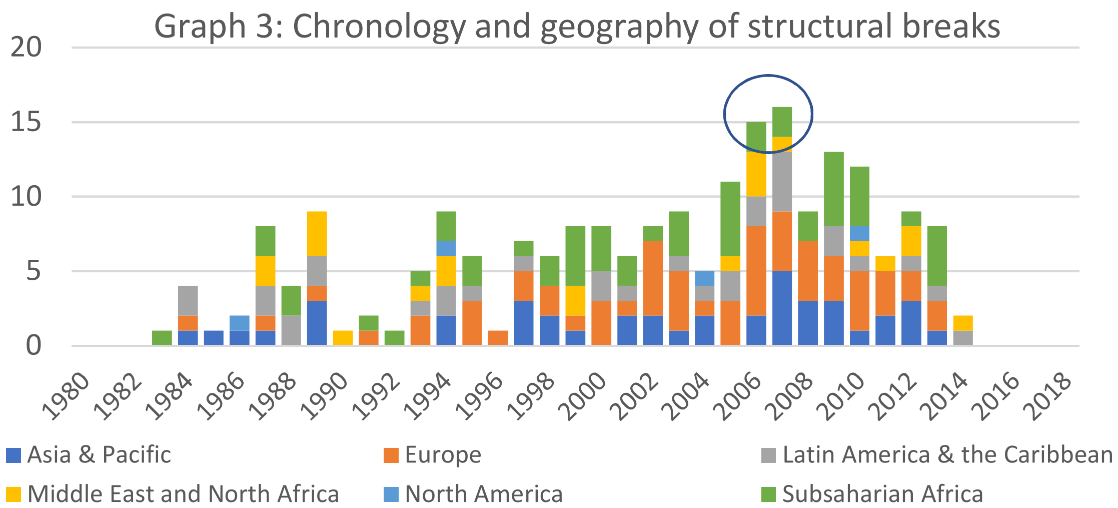
1.2.3. Chronology of structural breaks

We obtain a chronology of structural breaks from the 212 significant breaks, and we present it in Graph 2 and Graph 3, where we differentiate, respectively, for income levels and regional structure. In Graph 2, we use the World Bank income classification of July 2020 to divide countries into 4 income levels: low-income (GNI per capita of 1,035$ or less in 2019), lower-middle income (1,036$ - 4,045$), upper-middle income (4,046$ - 12,535$) and high income (12,536$ or more). In Graph 3, countries are categorized in 6 regions: Asia and Pacific, Latin America & Caribbean, Europe, Middle East and North Africa (MENA), North America, and Sub-Saharan Africa.

Looking at Graphs 2 and 3, we observe certain stability in the number of breaks, with a peak, unsurprisingly, around 2007. Nevertheless, in general, the 1990s present a lower number of breaks, suggesting more stability during that decade, while the first 15 years of the XXI century show more breaks, especially in Europe and Asia and Pacific (Graph 3) and in middle and high-income countries (Graph 2), which suggests that breaks have become more common in the last 20 years. Our chronology updates previous chronologies of authors such as Milesi-Ferretti and Razin (2000), Adalet and Eichengreen (2007) and De Mello *et al.* (2012), which study periods previous to the 'Great Recession'. Comparisons with these chronologies are difficult since they use different size samples and dates. Milesi-Ferretti and Razin (2000) study 105 low and middle-income countries between 1973 and 1994 finding 100 to 167 reversals, depending on the definition of reversals, which they define as sharp reductions of at least

3 or 5 percentage points in current-account to GDP deficits, in contrast with our definition of structural breaks as abrupt shifts in the deterministic components in time series data. Adalet and Eichengreen (2007) analyze 49 countries between 1972 and 1997, finding 106 reversals, and De Mello *et al.* (2012) use a sample of 101 countries between 1971 and 2007 to find 159 reversals.

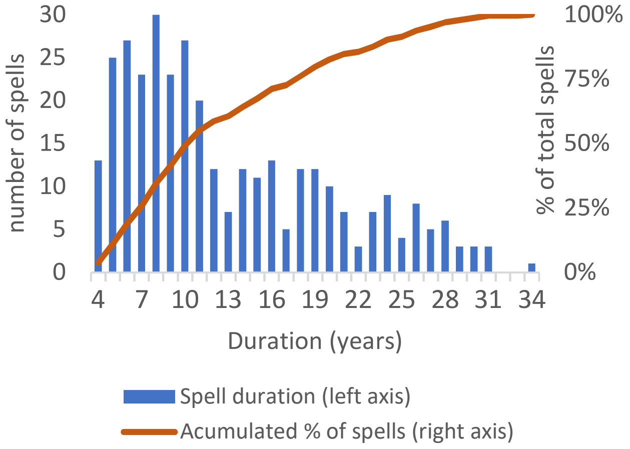

Graph 2: Chronology and income levels of structural breaks
20
15
10
5
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Low Income
Lower-Middle Income
Upper-Middle Income
High Income


Graph 3: Chronology and geography of structural breaks
20
15
10
5
0
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
Asia & Pacific
Europe
Latin America & the Caribbean
Middle East and North Africa
North America
Subsaharian Africa

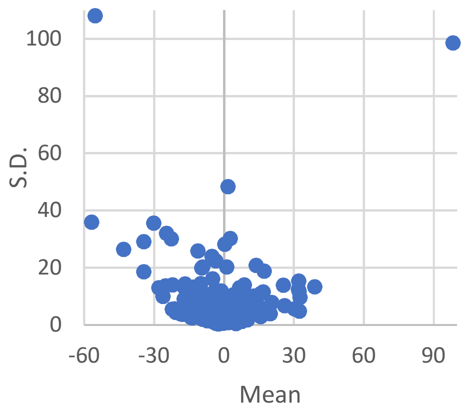
1.3. Analysis of structural breaks and current-account stability spells

Graph 4 presents the frequency of stability spells for each duration. It is apparent that 168 spells (49%) last 10 years or less, while their average duration is 13 years and their median duration is 11 years, as presented in Table II. Graph 5 plots the mean of spells against their standard deviation, while Graph 6 reports the relationship between the mean of spells and their duration in years. From Graphs 5 and 6, we observe that as spell means separate from zero, with positive or negative value but especially with negative value, they tend to have higher standard deviations (Graph 5) and shorter spell durations (Graph 6), which suggests that high current-account deviations from their balance tend to be more volatile and less sustainable.

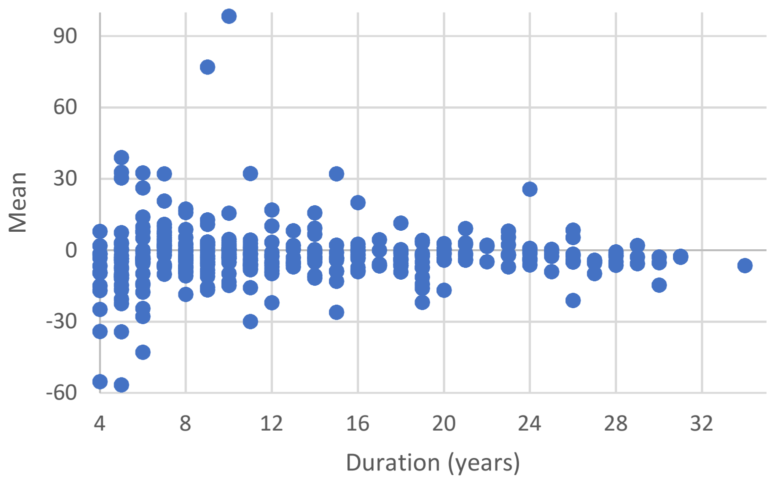
Graph 4: Duration of Current-Account Stability Spells



Graph 5: Current-Account Stability Spells



Graph 6: Spell duration and Current-Account mean



In Table II we present the combined statistics of the 341 current-account spells, also grouping them by income levels and regions. For instance, low-income countries present a mean current-account deficit of -5.95% of GDP, with a slightly negative average slope, an average standard deviation of 5.91 and an average duration of their spells of 13.34 years. They registered 33 breaks (1.65 breaks per country), 12 of them resulting in a positive variation of the mean and 21 in a negative one.

Analysis of the spells' characteristics reveals a relevant heterogeneity between income levels and regions. As regards the relationship between income levels and current-account stability spells, the results show that high-income countries have a positive average mean in their spells of 0.69% of GDP, while low-income countries' spells register a negative mean of -5.95% of GDP, as can be observed in the second column of Table II. The distribution of spells by region indicates that Asia & Pacific presents an average mean surplus of 4.08% of GDP. On the other extreme, Sub-Saharan Africa has an average stability spell deficit of -7.01% of GDP and a relatively high volatility, while Europe and the two American regions show a more moderate average deficit and relatively low volatility. Lastly, from a global perspective, spells with a positive average mean, or a structural current-account surplus, account for 106 of 341 spells (31%), and thus are less common than deficits spells. In addition, surplus spells are more volatile and somewhat shorter than spells with structural deficits.

Table II: Current account stability spells stats										
	Average				Median	Nº countries	Nº breaks	Breaks per country	Av. mean change post-break	
	Mean	Slope	S.d.	Duration	Duration				Increase	Decrease
Low Income	-5.95	-0.09	5.91	13.34	10	20	33	1.65	12	21
Lower-Middle Income	-1.34	0.33	9.38	14.43	13	32	48	1.5	26	22
Upper-Middle Income	-4.12	0.34	6.57	11.82	10	38	66	1.74	38	28
High Income	0.69	0.78	4.87	13.05	11	39	65	1.67	33	32
Asia & Pacific	4.08	0.68	9.14	12.71	10	27	42	1.56	28	14
Europe	-2.83	0.13	3.32	11.61	10	36	60	1.66	32	28
Latin America & Caribbean	-3.46	-0.10	4.71	13.66	11.50	18	32	1.78	17	15
Middle East & North Africa	0.49	2.27	11.48	12.19	10.50	11	21	1.91	11	10
North America	-3.11	-0.11	2.69	16.71	14	3	4	1.33	2	2
Subsaharian Africa	-7.01	0.14	7.83	14.54	12	34	53	1.56	19	34
Eurozone	-1.11	0.20	2.56	11.88	10.50	15	25	1.66	14	11
Spells w/positive av. mean	8.65	0.25	8.33	11.79	10	106*	59	0.55**	22	37
Spells w/negative av. mean	-7.21	0.48	5.83	13.60	11	235*	153	0.65**	87	66
Total	**-2.28**	**0.41**	**6.61**	**13.04**	**11**	**129**	**212**	**1.64**	**109**	**103**
* number of spells. ** breaks per spell.										

1.4. Consequences of current-account breaks

To examine the structural consequences of current-account breaks, we compare the level, slope, and volatility of current-account stability spells, aggregating and analyzing the information available in the database presented in Table I. This database includes the variation of the mean, slope and standard deviation (s.d.) of current accounts after each break. For example, the database shows that the Argentinian crisis at the turn of the century caused a break in 2000, which shrank the current-account structural deficit from -2.14% of GDP in the first spell (1980-2000) to a structural surplus of 0.23% of GDP in the second spell (2001-2018), decreased the current-account slope by -0.45 points (from -0.08 pre-break to -0.53 post-break) and increased the current-account volatility (the s.d. raised 1.55 points: from 1.78 pre-break to 3.33 post-break). As another example, China experienced a first break in 2004, shortly after entering the WTO, which increased its structural surplus by 3.71 percentage points, reduced its slope by 0.89 points, and raised its s.d. by 1.95 points.

Table III reports the average changes in the slope, mean, and s.d. observed after breaks, using a matrix that distinguishes between positive and negative current-account changes in both level and trend. For instance, results in the first row of the first column show that 51 breaks (24% of the total) resulted in positive changes in both the current-account levels and slopes. On average, they increased the slope by 2.04 points and the mean by 5.80 percentage points, while reducing the s.d. by -0.43 points.

Table III: Changes after breaks

		Mean (level)		
		Positive	Negative	Total
Slope (trend)	Positive	51 (24%) *slope: 2.04* *mean: 5.80* *sd: -0.43*	59 (28%) *slope: 4.17* *mean: -9.20* *sd: 2.28*	110 (52%) *slope: 3.18* *mean: -2.25* *sd: 1.02*
	Negative	58 (27%) *slope: -4.82* *mean: 10.25* *sd: -3.24*	44 (21%) *slope: -2.36* *mean: -5.42* *sd: 0.99*	102 (48%) *slope: -3.76* *mean: 3.49* *sd: -1.41*
	Total	109 (51%) *slope: -1.61* *mean: 8.17* *sd: -1.92*	103 (49%) *slope: 1.38* *mean: -7.59* *sd: 1.73*	212 (100%) *slope: -0.16* *mean: 0.51* *sd: -0.15*

Average changes in the *slope*, *mean* and *s.d*. in italics. Source: own calculations on the basis of Camba-Crespo et al. (2021).

Table III reveals that breaks are distributed relatively evenly within the four possibilities that arise when combining the signs of level and slope changes after breaks. Our results also indicate that, in total, variations in level, trend, and volatility after a break are slight (third row of the third column). However, a closer look reveals that the structural consequences of breaks are very heterogeneous depending on the sign of the level and slope changes.

Consequently, it is relevant to examine each combination. First, variations with a positive sign in trend and negative in level increase slope and volatility and reduce current-account levels (first row of the second column). Second, negative variations in slope and positive in level (second row of the first column) present opposite, and quite symmetric, results, i.e. decreases in both slope and volatility, and increases in levels. Third, volatility is conversely related to the mean: s.d. falls when the mean increases (first column) and rises when the mean decreases (second column). Finally, S.d. variations are higher when changes in mean and slope have opposite signs, and there is a particularly relevant volatility reduction when the mean increases and the slope declines (second row of the first column).

The consequences of breaks might vary depending on whether the country had a current-account structural surplus or deficit before the break. Therefore, we repeat the analysis, differentiating between spells with structural surpluses and structural deficits. Table IV shows current-account changes after breaks in structural surplus situations. Results indicate that only 28% of the 212 estimated breaks happened in structural surplus balances and that they reduce the current-account mean significantly: by 4.41% of GDP, while increasing both the slope and volatility (third row of the third column).

Surplus spells rarely suffer a break that increases both level and trend (first row of the first column), and volatility increases substantially when the break goes with a positive variation in the trend (first row).

Table IV: Changes after breaks in surplus spells

		Mean (level) Positive	Mean (level) Negative	Total
Slope (trend)	Positive	5 (2%) *slope: 3.48* *mean: 5.29* *sd: 2.74*	22 (10%) *slope: 7.13* *mean: -14.40* *sd: 3.64*	27 (12%) *slope: 6.46* *mean: -10.54* *sd: 3.48*
Slope (trend)	Negative	17 (8%) *slope: -5.68* *mean: 7.31* *sd: -0.20*	15 (7%) *slope: -3.07* *mean: -6.67* *sd: -0.81*	32 (15%) *slope: -4.46* *mean: 0.76* *sd: -0.49*
	Total	22 (10%) *slope: -3.60* *mean: 6.85* *sd: 0.47*	37 (17%) *slope: 3.00* *mean: -11.11* *sd: 1.84*	59 (28%) *slope: 0.54* *mean: -4.41* *sd: 1.33*

Average changes in the *slope*, *mean* and *s.d*. in italics. Source: own calculations.

Table V presents changes after breaks when an economy comes from a deficit spell. They account for 72% of the estimated breaks, and they cause an average increase in the mean, or reduction of the structural deficit, of 2.41% of GDP, and reduce both the slope and volatility (third row of the third column). Also, a positive change in level and negative in slope results in a relevant volatility decline (second row of the first column), while negative changes in level increase volatility (second column), signaling that current accounts with structural deficits tend to become more stable when a break reduces the deficit, otherwise becoming more volatile.

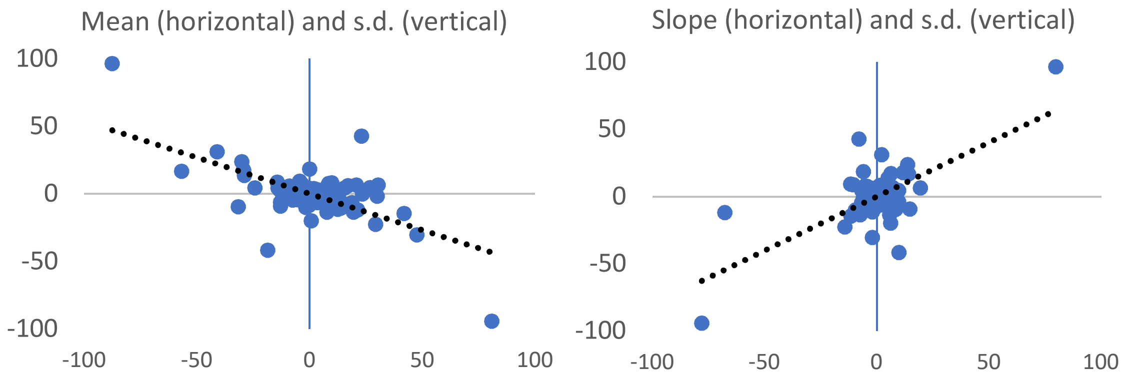
Table V: Changes after breaks in deficit spells

		Mean (level) Positive	Mean (level) Negative	Total
Slope (trend)	Positive	46 (22%) *slope: 1.88* *mean: 5.85* *sd: -0.78*	37 (17%) *slope: 2.41* *mean: -6.26* *sd: 1.47*	83 (39%) *slope: 2.12* *mean: 0.45* *sd: 0.22*
	Negative	41 (19%) *slope: -4.47* *mean: 11.46* *sd: -4.50*	29 (14%) *slope: -1.99* *mean: -4.77* *sd: 1.92*	70 (33%) *slope: -3.44* *mean: 4.74* *sd: -1.84*
	Total	87 (41%) *slope: -1.11* *mean: 8.50* *sd: -2.53*	66 (31%) *slope: 0.48* *mean: -5.61* *sd: 1.67*	153 (72%) *slope: -0.43* *mean: 2.41* *sd: -0.72*

Average changes in the *slope*, *mean* and *s.d*. in italics. Source: own calculations

The fact that the number of breaks is greater when there is a structural deficit than in structural surplus spells, observed in Tables IV and V, suggests that breaks are more common when the current account presents structural deficits rather than structural surpluses. Finally, Tables IV and V generally show an inverse relationship between changes in levels and in volatility and a direct relationship between variations in trend and in volatility. Graph 7 shows the scatterplots of these changes derived from our sample of 212 estimated breaks, and the fitted lines visually confirm these two relationships. Moreover, when these relationships conflict -for instance, a positive change in level and trend-, the direct "slope effect" seems to dominate in cases with structural surplus, and the inverse "level effect" seems to dominate when the country had a structural deficit.

Graph 7: Changes after breaks



1.5. Determinants of the current-account breaks

In this section, we study what elements are related with higher probabilities of a break and, in the event of a break, which factors determine the magnitude of the structural variations on the current-account level. A majority of the literature uses probit modeling to assess the probability of a current-account break or reversal (for instance, Freund, 2005, or Catao and Milesi-Ferretti, 2014). We choose to use a selection model, as in De Mello *et al.* (2012), on the basis of two advantages of this econometric methodology: a) it avoids selection bias, and b) it allows for the simultaneous analysis of determinants of the probability of a break and the extent of the changes. Indeed, focusing the analysis only on break years could cause a selection bias as not all countries present current-account breaks. Additionally, economies that record breaks present them only in specific years. We use the Heckman (1976, 1979) selection model to avoid this bias and to study, simultaneously, the determinants of the structural breaks and the determinants of the magnitude of the structural level variations after these breaks.

The Heckman selection model uses two equations:

$$B_{it} = \alpha X_{it} + \epsilon_i \quad (2)$$

$$V_{it} = \beta Y_{it} + u_i \quad (3)$$

The first selection equation, shown here as equation (2), where B_{it} is a binary variable for country *i* and period *t*, indicating the occurrence or not of a break. Its value is 1 in a break year, and 0 otherwise (a 0-1 dummy for breaks, a common approach in the literature on the issue). In this selection equation, X_{it} is the vector of explanatory variables of the model for each country *i* and year *t*, α is a vector of parameters for each explanatory variable and ϵ_i is the error term with zero average and constant variance. The second equation of the model – equation (3) - is the response equation: V_{it} is the value of the mean change for country *i* and period *t* between stability spells after a break, Y_{it} is the vector of explanatory variables, β is a vector of parameters for each variable and u_i is the error term with zero average and constant variance.

We obtain the break years B_{it} from the estimations presented for a sample of countries in Table I, and the value of the mean change after a break V_{it} from the two columns "Change Mean" also in Table I. We use the literature as a reference to select the variables for our model, including some classic papers on external crisis as Krugman (1979); Flood and Garber (1984) or Obstfeld (1994), and also others as Milesi-Ferretti and Razin (1998, 2000), Lane and Milesi-Ferretti (2012), De Mello *et al.* (2012), Catao and Milesi-Ferretti (2014), Das (2016), and the IMF External Balance Assessment Methodology (Cubeddu *et al.*, 2019). In particular, we use the current-account balance as a percentage of GDP, rate of GDP growth, real GDP per capita, net inflows of foreign direct investment (FDI) as a percentage of GDP, the real interest rate as a proxy of monetary policy stance, the net government lending/borrowing as a percentage of GDP as a proxy of fiscal policy, foreign reserves in months of imports and, finally, the year-on-year percentage variation of the average exchange rate of local currency units (LCU) per US$ of each period. As in Milesi-Ferretti and Razin (1998), Adalet and Eichengreen (2007) and De Mello *et al.* (2012), we use a three-year moving average for all the variables. To build our data panel from these variables, we use annual data from the IMF and World Bank between 1980-2018 as in the identification of breaks for the same 181 economies (details in Table VI).

Table VI: Data sources and definitions	
Source: IMF WEO April 2020 Database	
Current account balance (% of GDP)	All transactions between an economy and the rest of the world other than those in financial and capital items.
Source: World Development Indicators, World Bank (July 2020)	
Foreign direct investment, net inflows (% of GDP)	Net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor, and is divided by GDP.
GDP growth (annual %)	Annual percentage growth rate of GDP at market prices based on constant local currency.
GDP per capita (constant 2010 US$)	GDP divided by midyear population. Data are in constant 2010 U.S. dollars.
Net lending (+) / net borrowing (-) (% of GDP)	Net lending (+) / net borrowing (–) equals government revenue minus expense, minus net investment in nonfinancial assets.
Official exchange rate (LCU per US$, period average)	The exchange rate determined by national authorities or to the rate determined in the legally sanctioned exchange market. It is calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar).
Real interest rate (%)	Lending interest rate adjusted for inflation as measured by the GDP deflator.
Total reserves in months of imports	Total reserves comprise holdings of monetary gold, special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities. The gold component of these reserves is valued at year-end (December 31) London prices. This item shows reserves expressed in terms of the number of months of imports of goods and services they could pay for [Reserves/(Imports/12)].

Table VII shows the results of the estimation of factors that influence the probability of a break. In particular, Table VII presents in the first column the variables used in the estimation. In the next three columns of this Table, we present the estimated coefficient and significance levels of the selection equation. Finally, the three columns on the right present the estimated coefficients and significance levels of the response equation, which indicates how much each variable influences the magnitude of the change in mean when a break occurs, and whether each variable is significant. Table VII also includes the results of a Wald test of independent equations, which verifies whether the selection equation and the response equation are independent. This is relevant since this model is only appropriate if these two equations are not independent. The results of this tests indicate that the null hypothesis of independence between these equations is rejected, and thus this selection model is appropriate.

Table VII: Determinants of the current account breaks and of its impact on the c. account stability spell mean						
	Selection Equation – Break			Response Equation – Mean Variation		
Variable	Coefficient	Prob.	Sign.	Coefficient	Prob.	Sign.
C. Account (%GDP)	0.0247	0.036	**	-0.2968	0.440	
GDP growth (%)	-0.1157	0.000	***	12.533	0.127	
GDP per capita (constant 2010 US$ per 1,000$)	-0.0258	0.000	***	0.288	0.060	*
FDI net inflows (%GDP)	-0.0040	0.522		0.3363	0.076	*
Real interest rate (%)	-0.0348	0.025	**	0.5062	0.073	*
Government net lending/borrowing (%GDP)	-0.0186	0.119		0.5580	0.113	
Reserves (total, in months of imports)	-0.1556	0.000	***	19.689	0.042	**
Official exchange rate (% change of LCU per US$)	-0.0146	0.055	*	0.1843	0.162	
Break	N.A	N.A	N.A	75.964	0.006	***
Wald test of independent equations (rho = 0)	chi2(1) = 20.03			Prob > chi2 = 0.0000		
Method: ML Heckman Selection (Newton-Raphson / Marquardt steps) using a Maximum Likelihood estimation method, with robust standard errors, estimated using Stata 16.1. *** indicates significance at 1% level; ** 5% level; * 10% level.						

In Table VII, the first column presents the estimated coefficients of the “Selection Equation – Break”, which indicate how much each variable affects the probability of a break, including positive and negative breaks in level or trend. This shows that the following variables are statistically significant at high standards: growth, GDP per capita, and the level of reserves are significant at a 1% level, and the current-account balance and the real interest rate are significant at a 5% level, while variation in the exchange rate is significant at a 10% level. In particular, our results indicate that increases of the current-account to GDP ratio, lower GDP growth and lower real interest rates raise the probability of a break. Moreover, increasing foreign reserves, currency depreciation against the dollar and higher per capita income decrease the probability of a break. And, for all these results, the opposite would also be true.

Results in Table VII indicate that high growth and reserve accumulation are particularly effective in order to curb the probability of a break, possibly because they provide authorities with more flexibility in policy design to avoid breaks and, also, facilitate better access to international funding due to lower perceived risk of default. Estimations in the same Table show that low-income countries are more exposed to suffer these breaks, an unsurprising result since they are usually more unstable and show higher dependence on external financing and present more volatile stability spells, as observed in the previous section. Monetary policy can also help either by raising real interest rates or allowing currency depreciation. Nevertheless, as basic macroeconomic theory illustrates, it could be difficult to raise the real interest rate and depreciate one country’s currency at the same time, a circumstance that might limit the effectiveness of monetary policy to prevent breaks in some cases. Our results are in line with De Mello *et al.* (2012) in that the current-account level, GDP growth and monetary policy affect the probability of a break. Yet we do not find evidence that FDI net inflows nor current-account changes are significant, while we find evidence that foreign reserves, currency rate of change and per capita income influence the possibilities of a break.

We use the same variables in the response equation (3), with the addition of the breaks, to analyze the extent to which they affect the magnitude of the variation of the mean of stability spells before and after a break. The results, in "Response Equation – Mean Variation" columns of Table VII, show that GDP per capita, FDI net inflows, real interest rates, foreign exchange reserves and break years are significant at least at a 10% level, while we do not find that the other variables are significant. Therefore, FDI net inflows are not significant in influencing the probability of a break but, when the break happens, it affects the magnitude of the mean variation. This result could indicate that external stability is compatible with different levels of FDI but, when a break occurs, higher levels of FDI facilitate an increase in the mean. Finally, the other significant variables affect both the probability of a break and the magnitude of the mean variation.

Focusing on the other significant variables, the estimation in Table VII indicates that a break tends to increase the mean. Furthermore, higher real interest rates increase the mean after a break, a possible consequence of its contractive effect on domestic demand. Greater foreign reserves and per capita income also increase the mean variation after a break. Regarding fiscal policy, we do not find that it has a significant impact on the magnitude of the mean change after a break, since its significance level is again slightly over 10%. Our results are in line with De Mello *et al.* (2012) in that most significant factors influence both the probability of a break and the magnitude of the change that follows it.

1.6. Conclusions and policy implications

The present research is focused on the characteristics and determinants of current-account breaks and current-account stability spells –i.e. the periods between breaks and/or the start or end of the studied period- from a global perspective. In this way, we aim to understand which factors, structural reforms and policies promote stability in the external sector, which is now particularly relevant due to the current fragile economic situation, high volatility and uncertainty as a result of the pandemic. In our analysis, we use a wide sample of 181 countries so as to avoid a possible selection bias. We identify breaks endogenously, avoiding *ad hoc* break definitions which could exclude some breaks and including positive and negative breaks in both levels and trends.

We identify 212 significant breaks in 129 economies between 1980 and 2018, and observe that breaks have become more common in the XXI century and, unsurprisingly, they peak around the Great Recession. From the breaks, we obtain 341 stability spells, half of them lasting a maximum of 10 years. Results also suggest that major deviations from its equilibrium tend to make the current account more volatile and less sustainable.

We note that current-account behavior varies substantially depending on countries' income levels. Thus, while high-income countries have an average structural surplus in their spells of 0.69% of GDP, low-income countries have a major average structural current-account deficit: -5.95% of GDP. Differences are also remarkable in view of the geographical situation of countries: Asia & Pacific presents a moderate surplus in their spells and a low number of breaks per country despite the fact that the spells are highly volatile; Sub-Saharan Africa has a major average deficit, -7.01% of GDP, and a relatively high volatility in the current-account spells. Finally, Europe, North America and Latin America & Caribbean show moderate average deficits and lower volatility. Therefore, results confirm the general assumption that advanced economies record a more balanced and less volatile current-account position in comparison with the rest, while Sub-Saharan Africa presents particularly high deficits and volatility.

The analysis of the consequences of current-account breaks on the structural level, slope, and volatility of the current account reveals that current-account structural surpluses are less severe and pose fewer adjustment risks than deficits. Additionally, breaks on structural surplus spells reduce the current-account level significantly, by 4.41% of GDP; these spells rarely suffer a break that results in positive variations of both level and trend and, when breaks increase the trend, volatility increases notably. Regarding structural deficit spells, breaks result in an average reduction of the structural deficit of 2.41% of GDP. Additionally, when a break curbs the structural deficit, it also enhances stability, while volatility increases when the break results in higher structural deficits. Indeed, we generally observe an inverse relationship between volatility and level changes after a break and a direct relationship between volatility and slope changes. When these two effects collide, the inverse “level effect” dominates in deficit spells and the direct “slope effect” dominates in surplus spells.

Regarding the determinants of the breaks, our estimations indicate that the possibility of a current-account break can be reduced by an increase in growth levels, real interest rates and foreign reserves, or by currency depreciation. Additionally, we do not find strong evidence that neither fiscal policy nor FDI net inflows have significant influence on the probability of a break. We also find that lower income levels increase the probability of suffering breaks. With respect to the variables that influence the magnitude of the level change after a break, income per capita, FDI net inflows, real interest rates, and the level of foreign reserves have a positive impact on this level change.

From these results, the important effect of foreign reserves in the prevention of breaks could be highlighted, which is in line with both what the literature indicates and with widespread policies applied especially by emerging economies. Furthermore, foreign reserves not only reduce the chance of a current-account break, but they also help to achieve positive variations in level when the break happens, a common objective in countries that register important current-account deficits. GDP growth is also relevant in the prevention of breaks, and thus policies and structural reforms that boost growth can enhance external stability while recessions can increase break risks. Our results also indicate that the effectiveness of the monetary policy in reducing the probability of breaks is seriously curtailed by the fact that the required variations in the two monetary weapons included in our analysis (real interest-rate variations and exchange-rate changes) are difficult to achieve simultaneously.

Results allow us to derive some policy implications. First, since growth levels and foreign reserves are particularly efficient in order to curb the probability of breaks, governments should take them into account to enhance external stability. Structural reforms might be particularly effective in the reduction of break risks since, as shown by numerous papers, they can provide a sustainable economic boost. For instance, Bouis and Duval (2011) estimated potential gains from product and labor markets reforms in OECD countries to be close to 10% of GDP in 10 years. Yet, as pointed out in Xifré (2020), structural reforms should be aimed not only at moderating wages, but also fostering productivity and improving institutional quality. Second, governments of low-income countries should be particularly careful when designing measures to prevent current-account break risks, since lower income per capita increases their exposure to these risks. Third, governments can use contractive monetary policies to reduce the probability of a break, but they must take into consideration that this policy will be useful if it increases real interest rates without appreciating the exchange rate. Therefore, monetary policy could require a careful design and application to curb break risks since it could be ineffective, or even counterproductive, in some cases, when the exchange-rate reacts strongly to these measures. Finally, our results support active policy measures to reverse structurally unbalanced current accounts by inducing the breaks that the situation of each country advises, particularly as properly designed current-account breaks generate spells with more stable -less volatile- current-account balances. Additionally, measures to promote stability are particularly advisable when breaks result in a reduction of the current-account level or an increase in its slope, since they are associated with volatility increases.

Chapter 2

Current-account imbalances, real exchange-rate misalignments and domestic and foreign output gaps

2. Current-account imbalances, real exchange-rate misalignments, and domestic and foreign output gaps

2.1. Introduction

This chapter examines the relationship between four macroeconomic imbalances, namely current-account imbalances, domestic and foreign output gaps, and real exchange misalignments, in 18 advanced economies during the period 1986-2017. The main motivation is that these imbalances have been increasingly relevant – with a variety of signs and sizes - over the past three decades, in both developed and developing countries, and that accurate understanding and diagnosis of such relations are key for Governments to design policies to address macroeconomic instability and economic crises.

The literature has devoted special attention to the current account imbalances studying, on the one hand, their main determinants and, on the other hand, the question of how the correction of these imbalances impacts on other macroeconomic variables. As regards the determinants, the traditional theoretical approach highlights the linkages between the current account and the real exchange rate, as in Mundell (1961) or Dornbusch and Fischer (1980). However, there is, as yet, no consensus on the causal links between these two variables in recent literature. Arghyrou and Chortareas (2008) examine this relationship for Eurozone countries, concluding that the current account and the real effective exchange rate (REER) influence each other on a two-way causality. Blanchard and Giavazzi (2002) and Stevens (2011) focus on the levels and behavior of savings and investment to explain current account imbalances. By estimating an SVAR model using a sample composed of the G-7 plus Spain, García-Solanes, Rodríguez-López, and Torres (2011) find that most of the variability of trade and current-account imbalances are caused by real demand shocks.

As far as the corrections of the current-account imbalances are concerned, authors have generally found a strong negative impact of external deficit correction on growth and employment, or even have linked growth forecasts with current-account figures (Lane and Pels 2012). Edwards (2004b) emphasizes that the negative effects caused by current-account reversals are less intense when the adjustments are implemented gradually in a context of flexible exchange-rates, and with high economic openness. In another paper, Edwards (2005) estimates the effects of current-account reversals in a panel of 157 countries for the period 1970 to 2000 and obtains that in large countries a 5% reversal in the current account reduces GDP by 5.25% in the year after the adjustment.

Lane and Milesi-Ferretti (2012) and Atoyan, Manning, and Rahman (2013) analyze the rebalancing process of the current account of EU countries in the aftermath of the financial crisis and find that the economies exhibiting the biggest current-account deficits before the crisis are those that suffered the greatest costs in terms of GDP. Darvas (2012a, 2012b) and Tressel and Wang (2014) examine the adjustment processes in externally indebted countries of the Eurozone and find that the reversion of the current account of these economies practically ended in 2012. To accelerate the process, Darvas (2012a) suggested the ECB depreciate the Euro. Wolf (2012) and De Grauwe (2012) stress that external rebalancing within the Eurozone is very asymmetric, forcing the Southern countries to suffer the greatest sacrifices in terms of GDP and employment. Sinn and Valentinyi (2013) advised internal devaluations as the only weapon to revert the strong current-account deficits of the Southern countries of the Eurozone. Finally, Stockhammer and Sotiropoulos (2014) estimate that rebalancing the current-account deficit of the peripheral countries of the Eurozone in 2007 would had required a 47% GDP loss to all of these countries.

Other authors have examined the relationships between other pairs of macroeconomic variables discussed here. For instance, Rodrik (2008) documents the relationship between real exchange rates and growth; and Béreau et al. (2012) associate currency misalignments and growth. Therefore, all these papers support the existence of linkages between the variables included in our analysis.

The common feature of all the above-mentioned contributions is that they focus on the linkages between observed values of the variables, expressed either in levels or in variation rates. Nevertheless, some recent papers take a different perspective and focus on the interactions between estimated imbalances of the macroeconomic variables; i.e. on the relationship between current-account imbalances, output gaps, and real exchange-rate misalignments. In particular, Gnimassoun and Mignon (2015) study a panel of 22 industrialized countries between 1980 and 2011 and conclude that the persistence of current-account imbalances depends on currency misalignments, particularly in the Eurozone, although they invite to examine the interactions between the three main imbalances. These authors follow their suggestion in Gnimassoun and Mignon (2016) where they study the interactions between the current account, the output gap, and exchange-rate misalignments, finding that internal imbalances and exchange-rate misalignments cause current-account imbalances. In the same line, Comunale (2017) explores the relationship between current-account imbalances, REER misalignments, and financial or output gaps in EU countries, concluding that financial and output gaps and especially REER misalignments have an impact on the current account.

In this chapter, we adhere to that empirical methodology, but including as a novelty the foreign output gap into the analysis in correspondence with the theoretical setup laid down in Section 2.2. Consequently, we examine the relationships between four imbalances: current-account, domestic and foreign output gaps, and REER misalignments. Our theoretical setting, based on the elasticities and absorption approaches of the balance of payments, is another innovation within recent literature, usually focused on empirical analysis exclusively. According to our framework, the current account has a negative relationship with the real exchange rate misalignment and the domestic output gap, and a positive one with the foreign output gap. However, there may be other unidirectional or bidirectional linkages between the four variables, which we intend to unravel with our econometric analysis.

We investigate empirically the interactions between the four imbalances using a panel of 18 advanced economies for the period 1986-2017 applying a panel VAR (PVAR), which is a methodology well suited to address the potential endogeneity between these variables. We also apply a Granger test to examine possible causality links and perform impulse-response analysis to study the effects of different shocks on the significant variables. Knowledge of the causal links between the four imbalances and of the responses of the variables to different shocks is essential to find out, for instance, whether a widening of the current-account deficit is caused by currency misalignments or by variations in the output gap. Finally, we repeat the PVAR estimates using a panel of observed variables, instead of their estimated imbalances, to overcome potential biases in the estimates. We obtain results that basically confirm our previous findings and therefore endorse robustness to the whole empirical investigation.

Our main findings are summarized as follows. First, the current account and the domestic output gap show an inverse relationship with bilateral causality links. Consequently, measures to reduce the output gap are particularly efficient to increase the current account; and policies that raise the current account, such as successful export promotion or import substitution policies, reduce the output gap. Second, shocks on REER misalignments cause an opposite reaction of the current and output gap, which implies that boosting REER undervaluation increases the current account and enhances cyclical economic growth. Third, a positive shock in the current account stimulates economic growth. Finally, we observe that higher growth levels result in real exchange-rate appreciations, a finding that supports the Balassa-Samuelson hypothesis when increases in productivity growth are triggered by factors' productivity gains.

The rest of the chapter is structured as follows: the theoretical approach to the relationship between current-account imbalances, real exchange-rate misalignments, and domestic and foreign output gaps is presented in Section 2.2. In Section 2.3 we estimate those relationships for 18 advanced economies and the period 1986-2017 applying PVAR estimations accompanied by causality tests, impulse-response analysis and a robustness check. Finally, Section 2.4 summarizes the main conclusions and derives some policy prescriptions.

2.2. Theoretical framework

In this section, we build a basic model to clarify and make more explicit the relationships between internal, foreign, and external (current account) imbalances. Our starting points are the Marshall-Lerner elasticity framework and the absorption approach to the balance of payments.

We assume a small, open economy with a flexible exchange rate. Based on the most accepted tradition in the open-economies literature, we consider that the current account as a whole of tis economy depends on domestic and foreign demand levels and on the real exchange rate, as well as on other structural factors such as regulations, preferences, etc. We denote, for period t: CA_t the current-account; Q_t the real exchange-rate, being an increase of Q_t an appreciation of the domestic currency; Y_t the domestic demand, and Y_t^f the foreign demand. In our notation, *α* stands for the structural factors, which we assume constant. Thus, the current account of this economy can be represented by the following function, in which the signs below the letters indicate the sign of the partial derivatives of the current account with respect to each of its determinants:

$$CA_t = f\left(\alpha, \underset{-}{Q_t}, \underset{-}{Y_t}, \underset{+}{Y_t^f}\right) \qquad (1)$$

Equation (1) is, indeed, close to net exports equations or current-account equations reported in standard macroeconomics textbooks (see, for instance, Blanchard et al. 2010) or in the international economics literature (as in Greenhalgh et al. 1994, which use a similar equation but excluding the foreign demand). Let's now introduce in equation (1) the parameters *θ*, λ, and *φ* which reflect, respectively, the impact of the real exchange rate, foreign demand and domestic demand on the current account:

$$CA_t = \alpha \frac{{Y_t^f}^{\lambda}}{{Q_t}^{\theta}{Y_t}^{\varphi}} \qquad (2)$$

Denoting the equilibrium values in period *t* of the current-account, real exchange-rate, foreign demand and domestic demand by ${CA_t}^*$; ${Q_t}^*$; ${Y_t}^{f^*}$; and ${Y_t}^*$; respectively, and considering that parameters θ, λ, and φ remain constant, as well as α for structural reasons, we arrive at the following equation:

$$ {CA_t}^* = \alpha \frac{{Y_t}^{f^*\lambda}}{{Q_t}^{*\theta}{Y_t}^{*\varphi}} \tag{3} $$

To examine the relationship between the current account and its equilibrium level in period *t*, we divide the two previous equations (2) and (3), and simplify the result to obtain:

$$ \frac{CA_t}{{CA_t}^*} = \frac{{Q_t}^{*\theta}{Y_t}^{*\varphi}\,{Y_t^f}^{\lambda}}{{Q_t}^{\theta}\,{Y_t}^{\varphi}\,{Y_t}^{f^*\lambda}} \tag{4} $$

To put the equation above in rates of change, we take logs on both sides of the equation and take derivatives with respect to time. As a result, we obtain the following equation (5), where capital letters with hat denote the rate of change in period *t* of the respective variable:

$$ \widehat{CA}_t - {\widehat{CA}_t}^* = -\theta\left(\hat{Q}_t - \hat{Q}_t^*\right) - \varphi\left(\hat{Y}_t - \hat{Y}_t^*\right) + \lambda\left({\hat{Y}_t}^f - \hat{Y}_t^{f*}\right) \tag{5} $$

Note that, for the case of domestic demand, the difference between the two rates of growth is:

$$(\hat{Y}_t - \hat{Y}_t^*) = \frac{Y_t - Y_{t-1}}{Y_{t-1}} - \frac{Y_t^* - Y_{t-1}^*}{Y_{t-1}^*} \tag{6}$$

Assuming that the economy is in equilibrium in the initial period *t-1* ($Y_{t-1} = Y_{t-1}^*$), we have:

$$\frac{Y_t - Y_{t-1}}{Y_{t-1}} - \frac{Y_t^* - Y_{t-1}^*}{Y_{t-1}^*} = \frac{Y_t - Y_{t-1}^* - Y_t^* + Y_{t-1}^*}{Y_{t-1}^*} = \frac{Y_t - Y_t^*}{Y_{t-1}^*} = (y_t - y_t^*) \tag{7}$$

where y_t and y_t^* are the logs of Y_t and Y_t^*, respectively. Consequently:

$$(\hat{Y}_t - \hat{Y}_t^*) = (y_t - y_t^*) \tag{8}$$

The same procedure can be applied to the deviation of the current account from its equilibrium level $(\widehat{CA}_t - \widehat{CA}_t{}^*)$, the real exchange-rate misalignment $(\hat{Q}_t - \hat{Q}_t^*)$ and the foreign output gap $(\hat{Y}_t{}^f - \hat{Y}_t{}^{f*})$, so that:

$$(\widehat{CA}_t - \widehat{CA}_t{}^*) = (ca_t - ca_t{}^*) \tag{9}$$

$$(\hat{Q}_t - \hat{Q}_t^*), = (q_t - q_t{}^*) \tag{10}$$

$$(\hat{Y}_t{}^f - \hat{Y}_t^{f*}) = (y_t^f - y_t{}^{f*}) \tag{11}$$

Where lowercase letters denote logs of the corresponding variables.

Taking into account the above derivations, equation (5) can be rewritten as:

$$ca_t - ca_t{}^* = -\theta(q_t - q_t{}^*) - \varphi(y_t - y_t{}^*) + \lambda(y_t^f - y_t{}^{f*}) \tag{12}$$

According to equation (12), we should expect that the deviation of the current-account from its equilibrium level $(ca_t - ca_t{}^*)$, depends negatively on the real exchange-rate misalignment $(q_t - q_t{}^*)$ and the domestic output gap $(y_t - y_t{}^*)$, and positively on the foreign output gap $\left(y_t^f - y_t{}^{f^*}\right)$. We expect, then, that overvaluation of the domestic currency, an overheated economy and/or a global demand performing below its potential level push the domestic current account towards levels below equilibrium.

Equation (12) is in line with Arghyrou and Chortareas (2008) and Gnimassoun and Mignon (2015, 2016), among others, concerning the relationship between the variations of the current account and the real exchange rate. It is also in line with Gnimassoun and Mignon (2016) and Comunale (2017) in including domestic output gaps in the analysis of these imbalances. The introduction of the foreign output gap is, to our best knowledge, an innovation in this chapter, and is indirectly consistent with previous literature as Comunale (2017), who uses world GDP growth to control for global factors. It is also consistent with the common idea, also pointed out by several authors as Roeger *et al*. (2019), that buoyant external demand conditions can foster current-account surplus.

2.3. Empirical analysis

In the case of a panel of *N* counties and T periods, equation (12) is presented as:

$$(ca - ca^*)_{it} = \theta_i + \beta_1 (q - q^*)_{it} + \beta_2 (y - y^*)_{it} + \beta_3 \left(y^f - y^{f^*}\right)_{it} + \varepsilon_{it} \qquad (13)$$

i = 1, 2…N *t = 1, 2…T*

The term ε_{it} is the random error, which is distributed with zero mean and constant variance, and θ_i is a fixed effect. Finally, $\beta_1, \beta_2, \beta_3$ are the model parameters that we will estimate.

Our empirical analysis consists of the following steps. We first use the panel data to estimate a PVAR based on equation (13) and then we perform causality tests; next we carry out impulse response analysis based on our previous PVAR estimations. This methodology is well suited to address the potential endogeneity between the variables, and also allows us to examine the interactions and the causal links between the involved variables. Finally, as a robustness check, we use a new panel of observed variables to repeat the PVAR estimation and the impulse response analysis using observed macroeconomic variables – instead of deviations from equilibrium - in order to avoid potential estimation biases from using variables that are not observable.

Data

Our panel includes 18 advanced economies: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, Portugal, Spain, Sweden, the UK and the US over a 32 year period between 1986 and 2017, for which there is sufficient information in data sources of recognized institutions. Our analysis starts from the second half of the 1980s, once the economies overcame the structural changes that characterized the first half of that decade, including a general revision of the macroeconomic policy framework, which led to the start of the period known as 'the great economic moderation'.

As detailed in Table 1, we obtain most of the data for our panel from the IMF and the World Bank. We use the current account balance as a percentage of GDP as a proxy for current-account imbalances. This assumes that the equilibrium level of the current account is zero for each country, avoiding this way *ad hoc* estimations of the equilibrium current account, which are controversial and not provided by internationally recognized sources. In addition, we use the output gap of advanced economies as the foreign output gap. It is an appropriate proxy of the 'effective' foreign output gap since most of the external economic relationships of the countries in the sample concentrate on advanced economies. Another advantage of the latter assumption is that the IMF database includes this variable, and thus it is calculated using criteria consistent with the rest of domestic output gap data of our panel.

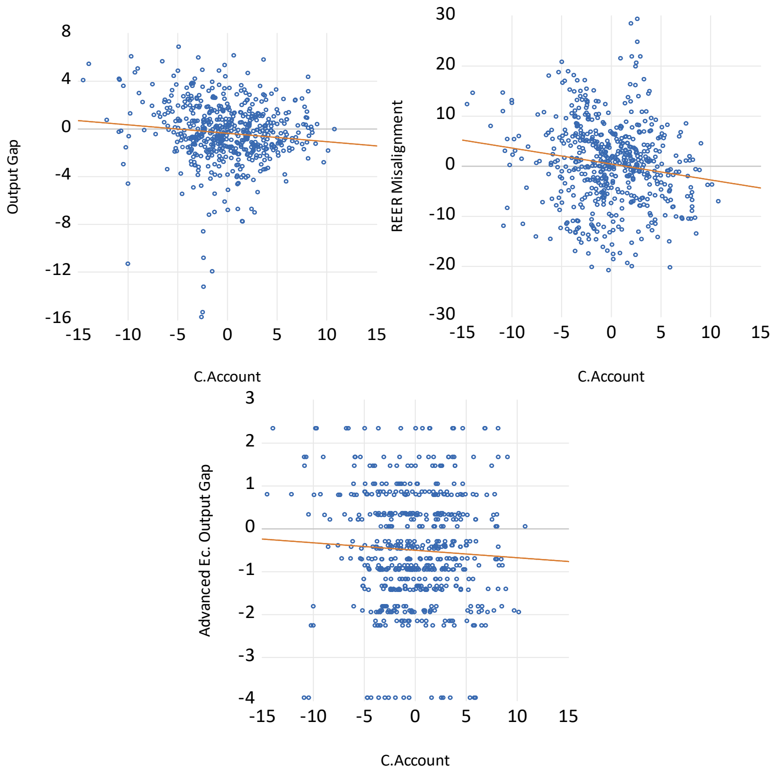
As far REER misalignments are concerned, the literature includes several approaches to calculate equilibrium exchange-rates and REER misalignments. For instance, one common method is the fundamental equilibrium exchange-rate approach (FEER) developed by Williamson (1983, 1994), which considers that the equilibrium real exchange-rate must be compatible with a balanced internal and external equilibria, and thus uses medium to long term fundamentals to estimate the equilibrium exchange rate. Another popular method is the behavioral equilibrium exchange-rate approach (BEER) proposed, among others, by Faruqee (1995), Clark and MacDonald (1999) and Alberola *et al.* (1999), which relies on the estimation of a long-term relationship between the real exchange-rate and its determinants. In this chapter, we use REER misalignments from the CEPII Exchange database of Couharde *et al.* (2018). In this database, REER misalignments are expressed as a percentage of their equilibrium level, with an increase in that variable representing an appreciation of the domestic currency. We believe that this estimation is appropriate for our research since it uses a BEER methodology, which has a long-run approach coherent with our time sample of more than three decades. Moreover, it contains a large number of countries and years calculated with a consistent methodology, and therefore it provides enough consistent data for our panel and our estimations. The definitions and sources of the data that we use in our panels to perform our empirical analysis are summarized in Table 1.

Table 1 - Data sources and definitions

Current-account balance	IMF World Economic Outlook October 2019. Current-account balance in percentage of GDP.
Real Effective Exchange-rate (REER) misalignments	CEPII Exchange, Couharde *et al.* (2018). Currency misalignments are the difference between the observed REER and its equilibrium level, for 186 trading partners, with a moving weighting scheme based on 5-year non-overlapping averages. Data from November 2019. More details in http://www.cepii.fr/CEPII/fr/bdd_modele/presentation.asp?id=34.
Output Gap and Advanced Economies Output Gap	IMF World Economic Outlook October 2019. Actual GDP less potential GDP (in % of potential GDP).
GDP growth	World Bank World Development Indicators. Data from December 2020. Annual percentage growth rate of GDP at market prices.
REER change	Obtained calculating interannual % change from the REER index from the World Bank World Development Indicators. Data from December 2020. In year-on-year % change.

To gain a first insight on the relationship between the current account and the output gap, the REER misalignment, and the advanced economies output gap, in Figure 1 we represent the three respective scatter plots with a regression line that suggests negative relationships. In the case of the first two scatter plots, which include the output gap and the REER misalignment, these negative relationships are coherent with our theoretical development. In the case of the foreign output gap this is not in line with the theory, an outcome that could suggest a lack of significance of the variable and, additionally, that could be a result of the influence of other variables or of the atypical structure of the scatter plot due to the fact that the series is the same for all countries in the sample. In any case, as presented in our theoretical development, other variables affect these interactions. Therefore, it is appropriate to apply a quantitative analysis to our panel to analyze these relationships.

Figure 1: Scatter plots of the variables



2.3.1. *Panel VAR*

2.3.1.1. Panel stationarity

A panel VAR approach is particularly useful to examine the interactions between these imbalances for the whole sample and their causal relationships, since it appropriately addresses the potential endogeneity problems between the involved variables. First, we test for cross-sectional dependence between the variables, which is usually present in international macroeconomic panels as a result of external shocks, contagions between countries or other unobservable factors (more in Baltagi and Pesaran, 2007). We apply four cross-sectional dependence tests: the Breusch-Pagan LM test (1980), the Pesaran LM scaled test (2004), the Pesaran CD test (2004), and the Baltagi, Feng, and Kao bias-corrected scaled LM test (2012). The results, shown in Table 2, indicate that there is cross-sectional dependence with a 1% significance level in all cases but one. Thus, we consider reasonable to assume that there is cross-sectional dependence in the data.

Table 2
Cross-Sectional Dependence Tests

	Breusch-Pagan LM		Pesaran scaled LM		Bias-corrected scaled LM		Pesaran CD	
C.Account	926.3828	***	44.21135	***	43.92103	***	1.479441	
REER misalign.	824.1825	***	38.36895	***	38.07863	***	3.955010	***
REER change	1070.868	***	52.47100	***	52.18068	***	14.58008	***
Output Gap	1393.277	***	70.90194	***	70.61162	***	34.43644	***
GDP growth	1603.438	***	82.91602	***	82.62570	***	37.59289	***

Null hypothesis: no cross-sectional dependence.

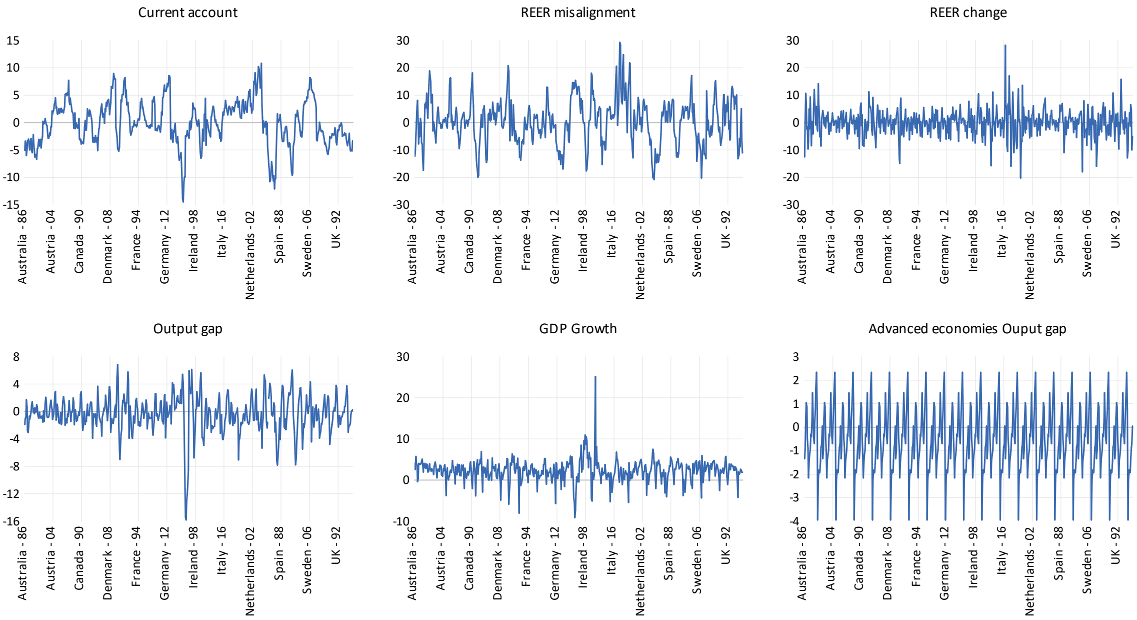
Unit Root Tests

	Levin, Lin & Chu t*		Breitung		Hadri		Pesaran CADF			
							w/constant		w/constant & trend	
Current-account	-36.443	***	-28.983	***	272.446	***	2.076		2.334	
REER misalign.	-63.151	***	-20.801	**	287.948	***	-1.149		0.865	
REER change	-181.388	***	-38.867	***	-0.3977		-6.428	***	-4.754	***
Output Gap	n.a.(1)		n.a.(1)		n.a.(1)		-3.274	***	-2.842	***
GDP growth	-122.922	***	-18.879	**	63.721	***	-5.112	***	-2.272	**
Adv. Ec. Output Gap	ADF test		-3.08	***						

Null hypothesis: series is no stationary.
N: 18; t: 32 (1986-2017); obs.: 576. ***indicates significance at 1% level; **5% level; *10% level. Hadri test applied in a variant that is robust to heteroskedasticity across panels. ADF and Levin, Lin & Chu t* test applied with no constant; ADF, Levin, Lin & Chu t* test and Im, Pesaran and Shin test applied with a number of lags chosen by the Akaike information criterion with a maximum of 2, and Breitung test and Pesaran CADF tests applied with 2 lags.
(1)n.a.: not applicable since it requires a balanced panel.

Estimation of a PVAR requires verifying the stationarity of the variables. A visual analysis of the series (available in Figure 2) suggests that they are stationary, as theoretically expected. To test formally whether the variables are stationary, we use four different unit root tests with specific properties to address the presence of cross-sectional dependence: the Levin, Lin and Chu test (2002); Breitung test (2000) using a version of the statistic based on Breitung and Das (2005) that is robust to cross-sectional dependence; and the Hadri Lagrange multiplier stationarity test (2000) using a variant that is robust to heteroscedasticity across panels. As suggested by Levin, Lin and Chu (2002), we remove cross-sectional means in Levin, Lin & Chu test and Hadri test to mitigate the impact of cross-sectional dependence. In addition, to address the cross-sectional correlation problem, the Breitung test uses a version of the statistic based on Breitung and Das (2005) that is robust to cross-sectional correlation. Finally, we apply a second-generation test also robust to cross-sectional dependence problems, the CADF unit root test (Pesaran, 2007), for 2 lags and alternatively with only a constant and with a constant and a trend. In the case of the advanced economies output gap series, we use the augmented Dickey-Fuller test (ADF) on the individual time series, since it is the same for all countries. The results (available in Table 2) show stationarity at 5% significance level for a vast majority of the tests and variables, and most of them at 1% significance level. We then conclude that all the variables in the model are I(0), as would be theoretically expected.

Figure 2: Series graphs (1986-2017)



2.3.1.2. Panel VAR estimation

We estimate a PVAR with the current-account balance, REER misalignment, domestic output gap and the advanced economies output gap as endogenous variables. To choose the number of lags we start estimating the PVAR with 4 lags, since the data is annual, and then use the information criteria of Akaike, Hannan-Quinn, Schwarz and the final prediction error to select the optimum number of lags (results in Table 3). Two of the four tests select 3 lags, while the Hannan-Quinn criteria is nearly equal for 2 or 3 lags. Thus, we use 3 lags.

Table 3: VAR Lag Selection Criteria

	Lags 1	2	3	4
Final prediction error	46.096	33.996	32.312*	32.519
Akaike I.C.	15.182	14.878	14.827*	14.833
Schwarz I.C.	15.351	15.182*	15.266	15.407
Hannan-Quinn I.C.	15.249	14.997*	14.999	15.059

*indicates number of lags selected by the criterion

Balanced panel. N: 18; t: 32 (1986-2017); obs.: 499.

Table 4: PVAR Residual Serial Correlation LM test

Lags	LRE stat	Prob.	
1	25.17	0.07	*
2	20.63	0.19	
3	16.13	0.44	
4	25.56	0.06	*
5	21.41	0.16	

Null hypothesis: no serial correlation at lag X.
N: 18; t: 32 (1986-2017); obs.: 518.
***indicates significance at 1% level; **5% level; *10% level.

Then, we test whether there is residual autocorrelation using a Residual Serial Correlation LM Test based on Breusch-Godfrey with the Edgeworth corrective expansion. The results, in Table 4, indicate that the residuals do not present autocorrelation for 3 lags at 5% significance level. Finally, we confirm that the Panel VAR is stationary since all the inverse roots of its characteristic polynomials are inside the unit circle. The estimated PVAR with 3 lags (available in Table 5) shows that variables have relevant t-statistics in general, thus supporting their significance, with the exception of the advanced economies output gap, which presents low t-statistics.

Table 5: PVAR estimation 1986-2017
Included observations: 518 after adjustments
t-statistics in [ ]

	C.Account	REER Misalign.	Output Gap	Adv.Ec.Output Gap
C.Account(-1)	0.914475	0.068720	-0.102953	0.000624
	[20.1362]	[0.49389]	[-2.06422]	[0.01803]
C.Account(-2)	0.079988	-0.243346	-0.047764	-0.050511
	[1.25371]	[-1.24492]	[-0.68169]	[-1.03877]
C.Account(-3)	-0.041874	0.067874	0.207635	0.065240
	[-0.87788]	[0.46445]	[3.96373]	[1.79460]
REER Misalign.(-1)	0.009485	1.103619	-0.029279	0.003488
	[0.65869]	[25.0167]	[-1.85155]	[0.31780]
REER Misalign.(-2)	-0.060310	-0.340853	0.035605	0.000133
	[-2.88066]	[-5.31398]	[1.54857]	[0.00832]
REER Misalign.(-3)	0.066557	0.070681	-0.030181	-0.008069
	[4.58476]	[1.58919]	[-1.89312]	[-0.72934]
Output Gap(-1)	-0.242164	0.218350	1.078313	-0.025738
	[-4.31719]	[1.27055]	[17.5045]	[-0.60205]
Output Gap(-2)	0.255283	-0.201170	-0.456250	-0.010060
	[3.19703]	[-0.82231]	[-5.20285]	[-0.16531]
Output Gap(-3)	-0.039932	0.030293	0.068520	-0.000490
	[-0.73770]	[0.18266]	[1.15264]	[-0.01188]
Adv.Ec.Output Gap(-1)	0.023512	-0.094651	-0.116282	0.813164
	[0.28606]	[-0.37588]	[-1.28826]	[12.9814]
Adv.Ec.Output Gap(-2)	-0.063756	0.081512	0.071704	-0.270693
	[-0.60831]	[0.25385]	[0.62297]	[-3.38880]
Adv.Ec.Output Gap(-3)	-0.022727	0.089430	-0.016230	-0.048547
	[-0.29784]	[0.38254]	[-0.19368]	[-0.83478]
Constant	0.021869	0.086341	-0.137800	-0.260076
	[0.33598]	[0.43296]	[-1.92772]	[-5.24258]
R-squared	0.900294	0.765365	0.711208	0.460061
F-statistic	379.9916	137.2732	103.6387	35.85752
Number of coefficients		52		

2.3.1.3. *Granger causality tests and impulse-response analysis*

To examine the structure of the causal links between these variables, we apply a VAR Granger causality/Block exogeneity Wald Test. This is a statistical hypothesis test to determine whether one variable is useful for forecasting another. We present the results in Table 6, with the excluded variables listed in the first column under the heading “Excluded”, and the dependent variables heading the rest of the columns. The null hypothesis is that the excluded variable does not Granger cause the dependent variable. Hence, if the null is rejected, the results from this test verify that the excluded variable Granger causes the variable on the corresponding column.

Table 6: VAR Granger Causality/Block Exogeneity Wald Tests

	Dependent										
	C.Account			REER Misalign.			Output Gap			Adv.Ec.Output Gap	
Excluded	Chi-sq	Prob.		Chi-sq	Prob.		Chi-sq	Prob.		Chi-sq	Prob.
C.Account	N.A.	N.A.		6.70	0.08	*	28.31	0.00	***	4.18	0.24
REER Misalign.	21.70	0.00	***	N.A.	N.A.		9.07	0.03	**	1.25	0.74
Output Gap	20.22	0.00	***	1.69	0.64		N.A.	N.A.		2.36	0.50
Adv.Ec.Output Gap	1.58	0.66		0.67	0.87		1.80	0.61		N.A.	N.A.
All	56.65	0.00	***	9.56	0.39		46.73	0.00	***	6.99	0.64

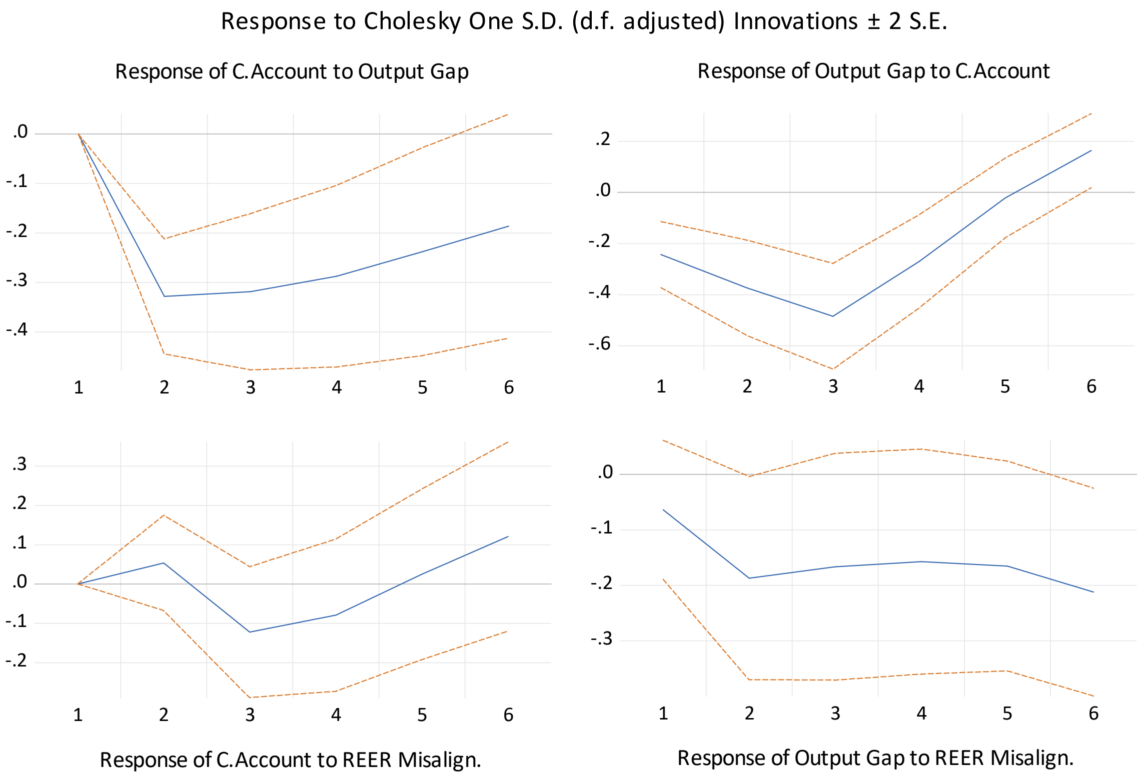
N: 18; t: 32 (1986-2017); obs.: 518. Null: Excluded variable does not Granger-cause the dependent variable.
***indicates significance at 1% level; **5% level; *10% level.

Results in Table 6 indicate that some variables have causality links in both directions. In particular, the current account and the output gap Granger cause each other at 1% significance level. The current account and the REER misalignment also Granger cause each other, even though the significance level is higher for the REER misalignment Granger causing the current account than the other way around. In Table 5 we observe that REER misalignments Granger cause output gaps, while we do not find evidence on the opposite being true. These results are coherent with findings by Arghyrou and Chortareas (2008), Gnimassoun and Mignon (2015, 2016) and Comunale (2017) in determining that current account and real exchange rates are closely linked, with stronger evidence supporting the causality direction from the REER misalignment to the current account rather than vice versa. Additionally, they are in tune with Lane and Pels (2012), Gnimassoun and Mignon (2016) and Comunale (2017) in that variations in output gaps, or growth, impact on the current account. The results are consistent too with Lane and Pels (2012), among others, which link economic growth forecasts with the current-account balance. They are also coherent with Rodrik (2008) and Béreau *et al.* (2012), among others, who associate currency misalignments with GDP growth.

Finally, as observed in Table 6, we do not find evidence of causality in any direction between the advanced economies output gap and the other variables. This result is fully consistent with the low t-statistics, suggesting lack of significance, of the coefficients of this variable in the PVAR estimation. It might be one of the reasons why the foreign output gap has been traditionally excluded in the analysis of this issue. It could also reveal a difficulty to analyze this variable at an aggregate level since not all current-accounts can evolve in the same direction as a response to a variation of the foreign output gap, and due to its close links to domestic output gaps, in particular of major economies.

Next, to analyze the dynamic of this Panel VAR, we perform an impulse-response analysis using a time horizon of 6 periods, as in Gnimassoun and Mignon (2016), and focusing on the 4 relationships with a Granger causality significant at 5% level. The results are presented in Figure 3.

Figure 3: Impulse-response analysis



Solid lines represent impulse-responses and dashed lines are standard error bands created by Montecarlo simulations with 10,000 repetitions.

The impulse-response analysis indicates that domestic economic overheating generates current-account deficits. In particular, the results in Figure 3 show that a shock in the output gap causes an opposite response in the current account. These responses are in line with our theoretical setting, and with other research in the literature such as Phillips *et al.* (2013), Gnimassoun and Mignon (2016) or Comunale (2017). We also observe in Figure 3 that a currency overvaluation shock increases current-account deficits in the medium term and restrains economic activity from the outset. In more detail, a REER misalignment positive shock, which could reflect a REER appreciation, causes an inverted “J curve” effect on the current account: a slightly positive response in the first two periods and then a negative response between periods 3 and 5. Nevertheless, this response is not assured in all cases since the confidence interval also includes the possibility of neutral or positive reactions. The negative impact of the REER misalignment on the current account would agree with Gnimassoun and Mignon (2015, 2016) and Comunale (2017). Additionally, the REER misalignment shock also causes a negative response of the output gap, which would be in tune with the common idea that a currency appreciation curbs demand of domestic goods and thus moderates economic activity.

Finally, a positive shock on the current account reduces the output gap. This negative impact is less conventional and suggests that positive current-account shocks could increase the potential output more than the current output; i. e. their permanent or structural effects on output are greater than temporary ones.

2.3.2. *Robustness check using observed variables*

The REER misalignment and output gap data – domestic and foreign - used in our panel analysis are constructed as the difference between the observed value of the variable and the estimated equilibrium values. While this procedure is consistent with the concept of macroeconomic imbalance and with the theoretical relationships derived in the section 2.2 of this chapter, we have to be aware that it could cause estimation bias. Moreover, it is worth noting that, in practice, government policy actions are often guided more by the observed or predicted changes in the macroeconomic variables than by estimates of their corresponding imbalances, which are non-observable and thus controversial. For those reasons, we repeat the PVAR estimate, the Granger causality test and the impulse-response analysis but using a new panel with observable variables, as in Gnimassoun and Mignon (2016). Note that in this way we carry out a robustness exercise of the results obtained in the previous sections of this chapter.

We work in this Section with a new panel with the same sample of countries and the same time span (1986-2017) as in the previous section, but using the following variables: the current-account as a percentage of GDP, the interannual REER percentage change and economic growth measured as the GDP interannual percentage change (data sources and definitions in Table 1). We exclude from this analysis foreign growth figures due to its lack of significance in our previous PVAR. Given the close relationships between these observed variables and the ones used in the previous PVAR, we should expect patterns of behavior and responses similar to those in the previous analysis, although not strictly identical.

To estimate this new PVAR, we first repeat the cross-sectional dependence tests to the variables used in this estimation (results in Table 2). They confirm the existence of cross-sectional dependence, and thus we repeat the same unit root tests presented before (results in Table 2), which verify that these variables are stationary. Next, we estimate the PVAR with current-account balance, REER change and GDP growth as endogenous variables. To choose the number of lags, we start estimating the PVAR with 3 lags, which was the number used in the previous PVAR, and then use the information criteria of Akaike, Hannan-Quinn, Schwarz and the final prediction error to select the optimum number of lags, which in most cases select 3 lags, as in the previous PVAR (results in Table 7). Then, we test whether there is residual autocorrelation using a Residual Serial Correlation LM Test based on Breusch-Godfrey with the Edgeworth corrective expansion. The results (in Table 8) indicate that the residuals do not present autocorrelation for 3 lags. Finally, we confirm that the PVAR is stationary since all the inverse roots of its characteristic polynomials are inside the unit circle. The estimated PVAR with 3 lags (available in Table 9) presents high t-statistics for most variables, suggesting that the variables are significant in general.

Table 7: VAR Lag Selection Criteria				
	Lags			
	1	2	3	4
Final prediction error	180	173	167*	169
Akaike I.C.	13.70	13.66	13.63*	13.64
Schwarz I.C.	13.81*	13.84	13.88	13.97
Hannan-Quinn I.C.	13.744	13.733	13.728*	13.769
*indicates number of lags selected by the criterion				
Balanced panel. N: 18; t: 32 (1986-2017); obs.: 504.				

Table 8: PVAR Residual Serial Correlation LM test			
Lags	LRE stat	Prob.	
1	10.88	0.28	
2	13.10	0.16	
3	11.17	0.26	
4	18.32	0.03	**
5	12.19	0.20	
Null hypothesis: no serial correlation at lag X. N: 18; t: 32 (1986-2017); obs.: 522. ***indicates significance at 1% level; **5% level; *10% level.			

Table 9: PVAR estimation 1986-2017 Included observations: 522 after adjustments t-statistics in [ ]			
	C.Account	REER change	Growth
C.Account(-1)	0.950790 [21.3693]	-0.054159 [-0.37054]	-0.065884 [-0.84652]
C.Account(-2)	0.062125 [1.00207]	-0.044733 [-0.21965]	0.320478 [2.95516]
C.Account(-3)	-0.055114 [-1.22927]	0.074167 [0.50357]	-0.187641 [-2.39258]
REER change(-1)	-0.006408 [-0.49104]	0.215287 [5.02160]	-0.013791 [-0.60409]
REER change(-2)	-0.057731 [-4.25385]	-0.111725 [-2.50600]	-0.011224 [-0.47280]
REER change(-3)	0.004474 [0.35041]	-0.181748 [-4.33318]	0.016907 [0.75698]
Growth(-1)	-0.191301 [-7.73859]	0.225394 [2.77554]	0.488745 [11.3026]
Growth(-2)	0.051754 [1.77058]	-0.118899 [-1.23827]	-0.058152 [-1.13733]
Growth(-3)	-0.005552 [-0.20157]	0.246943 [2.72905]	0.129443 [2.68647]
Constant	0.367798 [4.17120]	-0.916996 [-3.16577]	0.891798 [5.78188]
R-squared	0.906480	0.132743	0.284539
F-statistic	551.4176	8.707419	22.62477
Number of coefficients		30	

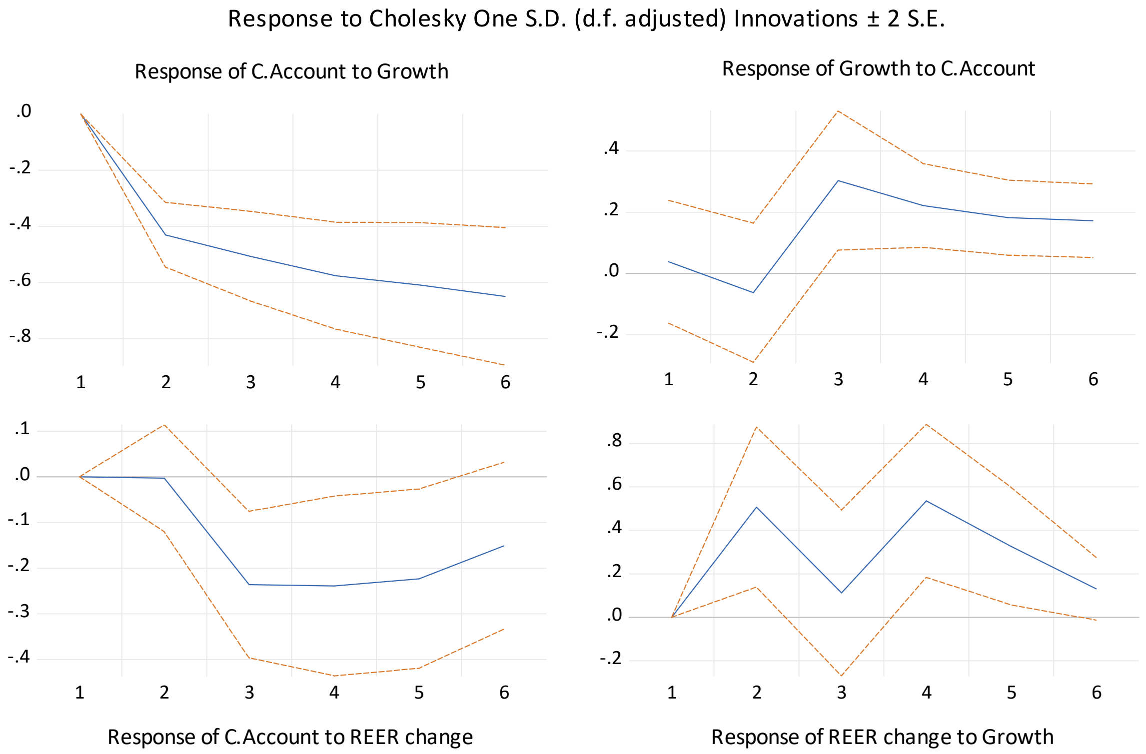
To examine the structure of the causal links between these variables, we apply again a VAR Granger causality/Block exogeneity Wald Test, using the same procedure as in the previous PVAR (results in Table 10). These results show that the current account and growth Granger cause each other at 1% significance level, in line with the results of the previous PVAR, while we also find evidence of growth Granger causing REER change, and REER change Granger causing the current account all at 1% significance level. These results are consistent with the findings in the previous PVAR.

Table 10: VAR Granger Causality/Block Exogeneity Wald Tests									
	Dependent								
	Current account			REER change			GDP growth		
Excluded	Chi-sq	Prob.		Chi-sq	Prob.		Chi-sq	Prob.	
Current account	N.A.	N.A.		0.75	0.86		17.37	0.00	***
REER change	21.30	0.00	***	N.A.	N.A.		1.31	0.73	
GDP growth	63.67	0.00	***	16.49	0.00	***	N.A.	N.A.	
All	84.02	0.00	***	19.75	0.00	***	18.82	0.00	***

N: 18; t: 32 (1986-2017); obs.: 522. Null: Excluded variable does not Granger-cause the dependent variable. ***indicates significance at 1% level; **5% level; *10% level.

To analyze the dynamic of this Panel VAR, we perform an impulse response analysis (in Figure 4), focusing on the 4 relationships with a significant Granger causality. Responses are very similar in most cases to our previous results, supporting their robustness. A positive growth shock results in a decline of the current-account figures and an appreciation of the REER, reducing the competitiveness of the country. It is interesting to note that, while in the previous analysis the variations of the output gap do not influence the real exchange-rate, in the present exercise an increase in economic growth significantly appreciates the real exchange-rate, and Granger causes that appreciation, which confirms the Balassa-Samuelson hypothesis provided that increases in economic growth are led by improvements in factors' productivity as usual in the vast majority of cases with long-term horizons. Figure 4 also shows that REER appreciation results in a deterioration of the current account, which can be explained by adverse switching effects on the demand for domestic products as stipulated by conventional macroeconomics textbooks. And, again, results do not rule out a "J curve" effect, since this effect is possible within the standard error bands.

Figure 4: Impulse-response analysis



Solid lines represent impulse responses and dashed lines are standard error bands created by Montecarlo simulations with 10,000 repetitions.

Finally, a current-account shock impacts slightly negatively on economic growth during the first two periods, even though this first response is uncertain due to confidence intervals that include positive and negative responses, while the response is positive from period 3 onwards. The final effect of a current-account shock on economic growth is consistent with the negative response of the output gap to the same shock found in the previous impulse response analysis once we take into account that behind the effects on the output gap there is an increase in both the current and the potential output (the latter to a greater extent, in particular during the first periods). All in all, this robustness check is in general coherent with our previous results and with the literature explored previously in this chapter.

2.4. Concluding remarks

The expansion of global imbalances and the integration of world economies have drawn attention to macroeconomic imbalances and their causes. In this chapter, we tried to shed light on this issue by analyzing the interactions and causality links between current-account imbalances, REER misalignments and domestic and foreign output gaps. Since these imbalances can result in macroeconomic instability and crisis, it is key for economic authorities to gain a fuller understanding of these forces to design sound economic policies.

Prior to our empirical analysis, in order to clarify the relationships between the four imbalances involved, we set up a theoretical framework based on the elasticities and absorption approaches of the balance of payments. We perform then empirical estimates on a panel of 18 advanced economies between 1986-2017. We carry out Panel VAR estimates with causality tests, and impulse-response analysis based on the previous econometric estimates.

We derive empirical results that are in general consistent with our theory and with previous literature on the issue. They indicate that there is a significant and inverse interaction between the current account and the output gap with bilateral causality links. We also find that an increase in REER overvaluation could deteriorate the current account. Finally, our analysis reveals unidirectional causality between the REER and the domestic output gap, in the sense that while an increase in REER overvaluation decreases the output gap, there is no significant impact the other way around.

To gain further insight into the relationships between the three macroeconomic variables and to avoid estimation biases, we perform new PVAR estimates using a different panel of observed variables - instead of their corresponding imbalances - namely the current-account balance as a percentage of GDP, the REER interannual percentage change and the interannual GDP growth. In general, the new results go in the same direction as our previous findings, including the fact that a positive shock on the current account stimulates economic growth, in correspondence with a decline in the output gap – found in the former PVAR estimate - that is caused by an increase in the potential output of the economy. We get a new noticeable finding: higher growth levels result in real exchange-rate appreciations, which fully supports the Balassa-Samuelson hypothesis when the increase of economic growth obeys to improvements in factors' productivities.

Finally, from our results some policy guides can be drawn to address or to prevent external economic crisis: REER undervaluation helps to curb current account deficits and boosting cyclical economic growth. Also, macroeconomic policies that increase the output gap and, thus, favor overheating, hurt the current account. Furthermore, it is possible that measures that increase the current account balance, such as successful export promotion or import substitution policies, have a relevant positive impact on both potential output and economic growth.

Chapter 3

External competition flattens the Phillips curve

3. External competition flattens the Phillips curve

In this chapter, we examine the contribution of globalization to lowering domestic inflation, and to making this variable less sensitive to changes in economic slack throughout the last decades. Technically speaking, we analyze how international developments may have shifted the Phillips curve downwards and affected its slope.

Several recent contributions stress the relevance of global linkages in weakening the domestic Phillips curve relationship. Rogoff (1985, 2003) and Romer (1993) argue that openness, by causing excessive variations on the real exchange rates, incentivizes central banks to stabilize inflation at low levels. Bean (2006, p.308), in a commentary on Rogoff (2006), points out that globalization could limit firms' ability to increase prices, thus changing the slope of the Phillips curve. Carney (2015, p.443) suggests that increased trade and deeper global value chains may have reduced the sensitivity of consumer price index (CPI) inflation to local labor market conditions. Additionally, Seydl and Spittler (2016), using US sectorial data between 1986 and 2014, point out that the growing importance of globalization and of the service sector could be contributing to the flattening of the Phillips curve. Szafranek (2017) examines the Phillips curve of a small, open economy -the Polish economy- between 2002 and 2015, concluding that this curve has flattened partly due to underutilization of labor and that the influence of global factors on this curve has increased. Ferroni and Mojon (2017, p.87) and IMF (2019) emphasize that greater international competition shrinks workers' capacity to negotiate wage increases and accentuates mark-ups' counter cyclicality. Finally, Bobeica and Jarocinski (2019) stress the spillovers from US to euro-area inflation, particularly during the Great Recession.

The traditional channel through which external opening impacts on the Phillips curve is the price of imported intermediate goods. See, for instance, McCallum and Nelson (1999), Paloviita (2009), Blanchard, Cerutti and Summers (2015) or Blanchard (2016). However, as Carney (2015, p.443) points out, the net effect on the slope of the Phillips curve of opening an economy to imported goods is, in principle, ambiguous. On the one hand, there is a downward pressure on inflation as consumers and firms can substitute domestic goods and inputs with cheaper foreign equivalents, an argument also put forward by Andrews, Gal and Witheridge (2018) and IMF (2019, pp.19-21), therefore restraining price increases as a result of changes in domestic macroeconomic conditions. But, on the other hand, more frequent price changes brought about by stronger competition could increase the pass-through of both price variations of imported inputs and of nominal exchange rate fluctuations to domestic inflation (Cavallo 2018). This ambiguity underlines the relevance of examining the effect of external variables on the Phillips curve.

Another traditional path through which external opening impacts on the Phillips curve is the real exchange rate, included, for instance, in Galí and Monacelli (2005) or Forbes (2019). The impact of the real exchange rate on domestic macroeconomic conditions has been examined by numerous authors. Frenkel and Ros (2006) highlight the impact of this rate on unemployment, in particular affecting the labor intensity of the economic process, that is, changing the capacity to create employment of an economy due to variations in international relative wages. They also underline the relevance of considering in the analysis the existence of tradable and non-tradable goods, as we do in this chapter, since it can affect how external opening influences macroeconomic outcomes.

Several authors have recently analyzed the influence of participation in global value chains (GVC) on macroeconomic variables. For instance, Gereffi and Luo (2015) point out that participation in GVC threatens the survival of less efficient firms. Indeed, even though trade liberalization in general has a positive impact on growth (Inwin, 2019) and productivity (Topalova y Khandelwal, 2011), authors such as Dix-Carneiro (2014) and Dix-Carneiro and Kovak (2017) have pointed out that it may take several transition years for welfare gains to be registered. In this regard, Acemoglu, Autor, Dorn, Hanson and Price (2016) and Autor, Dorn and Hanson (2016) expose the relevance of import competition, showing how China's emergence as a trade giant reduced US employment, a result that highlights the major influence of competition from foreign firms on macroeconomic outcomes. Regarding specific research on the Phillips curve, Auer, Borio and Filardo (2017), in their study of GVCs, find that proxies of global economic slack improve the explanatory power of traditional Phillips curve approaches. Forbes (2019), using a sample of 43 economies in the period from 1990 to 2017 and Moretti, Onorante and Saber (2019), analyzing the Eurozone between 1999 and 2018, also highlight the relevance of the global output gap, jointly with world oil prices, import price deflators, and real effective exchange rates, in explaining domestic inflation. Gilchrist and Zakrajsek (2019) in a study of the U.S. between 1962 and 2017 find that exposure of the U.S. economy to international trade is flattening its Phillips curve. Finally, Eser, Karadi, Lane, Moretti and Osbat (2020) examine inflation in the Eurozone through the Phillips curve models used in the European Central Bank and point out that mark-up fluctuations play an important role in accounting for the variation in inflation, and call for further work to analyze this issue in order to insert it into central banks' analysis. We follow this suggestion and analyze how foreign competition affects the Phillips curve through its impact on mark-ups.

Building on the Eser et al. (2020) suggestion and on the previous literature on the issue, we develop a new approach to analyze foreign influence on domestic macroeconomic outcomes. In our framework, one key aspect is that mark-ups depend on the amount of competitive pressure from foreign firms. In particular, we present two routes by which foreign competition impacts mark-ups in domestic markets: first, the gap between the current and potential growth of imports and, second, the real exchange-rate misalignment. The rationale for the first channel is that higher market share of foreign goods in domestic markets can curb market power of local firms and, as a result, reduce mark-ups. Indeed, as a country's exposure to imports grows (i.e., as the degree of imports openness increases), the greater foreign competitive pressure will induce domestic producers to keep prices low to avoid market-share losses. The influence of the second channel derives from relative prices: foreign competitive pressure will be higher when foreign products are relatively cheap, reducing mark-ups. To our knowledge, the application of this dual mechanism to capture the impact of globalization on the Phillips curve is an innovation of this Thesis.

So, in this chapter, we derive an open economy Phillips curve (OEPC) in which both these external factors play an important role. We test the OEPC by using a sample of 15 advanced countries with annual data for the period 1994-2017. That way, we echo Lane's (2019, p.25) suggestion that the use of panel and cross-country variation and/or external instruments are promising routes to identify the Phillips curve slope. The initial year of our time sample is based on the findings of IMF (2013), which examines advanced economies between 1975 and 2012, Blanchard et al. (2015) and Blanchard (2016), using in both cases a sample of 20 economies between 1961 and 2013, showing that the Phillips curve in advanced countries has remained stable since the early 1990s.

Our research also innovates in both the theoretical approach and the applied methodology. As regards theory, we perform a micro-funded analysis to derive a Phillips curve for an open economy, in which inflation depends on expected inflation, the output gap, the imports gap (the difference between the current growth of imports and the long-run imports growth) and real exchange-rate misalignment[1]. In the applied section of the chapter, we perform two types of tests. We first estimate the main equation for our sample of 15 advanced countries. We execute panel regressions instead of regressions based on individual countries, or on cross-country means, as usually done in the literature. Then we estimate a panel VAR (PVAR) and perform impulse-response analysis to check and derive the dynamic impact of changes in the explanatory variables.

Our empirical analysis shows that all the explanatory variables are statistically significant and have the sign predicted by the theoretical model. We so confirm that the Phillips curve is alive, and that competitive pressures coming from abroad, captured by the two relevant variables, reduce domestic firms' pricing power. Our estimate of the Phillips curve slope is small, in line with Blanchard et al. (2015), Blanchard (2016), Forbes (2019) and Moretti et al. (2019). Thus, for the average country of the sample, a 1 percentage point increase in the output gap raises the domestic rate of inflation by 0.03 percentage points. We also find that the slope of the Phillips curve has notably declined since 2010.

The rest of the chapter is structured as follows. The micro-founded analysis and derivation of the Phillips curve for an open economy is presented in Section 3.1. In Section 3.2 we estimate the main equation using two different econometric techniques, panel regressions and PVAR estimations accompanied by impulse-response analysis.

[1] As many other authors, for instance Galí and Monachelli (2005), we use the output gap instead of the cyclical unemployment as an indicator of economic slack. Thus, our approach is based on the aggregate supply curve, which is the other side of the coin of the traditional Phillips curve.

Finally, Section 3.3 summarizes the main conclusions and derives some policy considerations.

3.1. Micro-foundations of the open economy Phillips curve

Following a standard approach (for example, in Ireland, 2004, or Galí and Monachelli, 2005), we assume a small, open economy with two representative agents: (i) households, who try to maximize their utility from consumption and leisure; and (ii) firms, which seek to maximize profits. Both agents are rational and face uncertainty about future prices, in line with Paloviita (2009).

We also assume the existence of imperfect competition in the domestic goods market, a usual assumption found, among others, in Galí and Monacelli (2005), Rumler (2007) or Paloviita (2009), and that there are not any other restrictions or market failures besides those mentioned. As a result, the representative domestic firm will enjoy some market power in the domestic market. It is proposed in this chapter that foreign competition limits this market power.

3.1.1. Households and labor supply

The representative household makes consumption-leisure decisions based, firstly, on their preferences, represented by a well-behaved utility function in which leisure is a normal good; secondly, on the real wage; and, finally, on the cost of the consumer goods, which will also be normal. We propose an intertemporal utility function in terms of working time, L, after replacing leisure (H) with D - L, D being the time divided between work and leisure. We assume a family dynasty with intergenerational solidarity, so that the time horizon approaches infinity. Each period will be represented by t. There are no credit constraints or other market failures, except uncertainty about future prices.

We also assume that households want to smooth their consumption and leisure patterns, and, as a result, the temporary discount rate δ, which measures the time preferences of the representative household, will be equal to the real interest rate r (that is, $\delta = r$). In addition, from the discount rate we define the discount factor β as: $\beta = \frac{1}{(1+\delta)}$. We denote the variables of interest as follows: C_t, is consumption in period t, which includes both domestic and imported products ($C_t = C_t^d + M_t$, where C_t^d is consumption of domestic goods in period t and M_t stands for consumer goods imports in period t); W_t is the nominal wage in period t; and P_t^c is the price index of the basket of goods consumed by the representative household in period t. As a result, we pose the following optimization problem:

$$\max U = \sum_{t=0}^{\infty}\left\{\beta^t f\left(C_t, L_t\right)\right\}$$

$$sa \sum_{t=0}^{\infty}\left\{\frac{C_t}{(1+r)^t}\right\} = \sum_{t=0}^{\infty}\left\{\frac{\left[W_t / P_t^c\right] L_t}{(1+r)^t}\right\} \qquad (1)$$

This problem indicates that the household wants to maximize its utility over time, but they face budget constraints. Therefore, they must decide how much leisure they want to sacrifice in favor of work to obtain an income with which to consume. Solving this problem, we obtain the intra-temporal equilibrium condition from the first order condition (F.O.C.):

$$-\frac{\partial U / \partial L_t}{\partial U / \partial C_t} = \frac{W_t}{P_t^c} \qquad (2)$$

This indicates that the supply of labor is such that the utility per monetary unit provided by the last leisure unit (or, alternately, the marginal disutility per monetary unit of the last working hour offered) is equal to the marginal utility of consumption per monetary unit paid. From this condition, we deduce that a real wage $\frac{W_t}{P_t}$ rise will increase labor supply and consumption, and vice versa.

We can also obtain the intertemporal equilibrium condition from the F.O.C. We must recall that, as aforementioned, $\delta = r$ and therefore $\beta(1 + r) = 1$. Since there is uncertainty about future prices, households have to forecast in period t the price level in $t + 1$ and, therefore, they also forecast the real wage in that period $t + 1$. Based on the expected real wage, they will also estimate the labor they will supply in $t + 1$:

$$\frac{\partial U / \partial L_t}{E\left[\partial U / \partial L_{t+1}\right]} = \frac{\left[W_t / P_t^c\right]}{E\left[W_{t+1} / P_{t+1}^c\right]} \qquad (3)$$

As previously noted, households prefer to smooth their consumption and leisure patterns and, therefore, their labor supply. Thus, the amount of work they supply in a period is part of their optimal long-term path. All in all, in equilibrium, and in the absence of unexpected shocks, the optimal amount of work in period *t* and what they expect to work in *t + 1* will be the same, as will the real wage they receive in *t* and the one they expect to receive in *t + 1*:

$$\partial U / \partial L_t = E\left[\partial U / \partial L_{t+1}\right] \qquad (4)$$

$$\left[W_t / P_t^c\right] = E\left[W_{t+1} / P_{t+1}^c\right] \qquad (5)$$

Considering that agents agree on nominal wages at the beginning of each period, and thus that at the start of *t + 1* uncertainty only affects future prices, equation (5) can be rewritten as:

$$\left(W_{t+1} \middle/ W_t \right) = \left(E\left[P_{t+1}^c \right] \middle/ P_t^c \right) \tag{6}$$

This implies that agents want their nominal wages to vary at the same rate as they expect prices to change in order to keep their real wages and their work supply stable. Therefore, in equilibrium, the variation of nominal wages between periods is equal to the expected inflation. This idea is expressed more directly in the following equation (7). In this equation, $\hat{W}_t$ is the change rate of the nominal wage for the period *t* with respect to the previous period and $E\{\pi_t^c\}$ is the expected inflation rate for the period *t*:

$$\hat{W}_{t+1} = E\{\pi_{t+1}^c\} \text{ and, in general, in equilibrium } \hat{W}_t = E\{\pi_t^c\} \tag{7}$$

3.1.2. Firms and labor demand

Following the extensive literature on the Phillips curve that establishes labor and wages as key elements in real marginal costs and inflation dynamics (for example, Chen *et al.*, 2004, Galí, 2011, or Blanchard, 2016), we assume that there is only one input, labor *L* and, therefore, we do not explicitly consider capital nor intermediate goods. Thus, the representative firm has a single-factor production function, with labor (*L*), and diminishing returns to scale:

$$Y_t = AL_t^{\sigma} \tag{8}$$

In the equation above, Y_t is the production in period *t*, L_t the amount of work in period *t*, *A* represents technology, *σ* is a parameter that reflects labor productivity, where $0 < \sigma < 1$ since there are diminishing returns. The firm is a profit maximizer in a market with imperfect competition, which implies that it is not a price-taker, and that it incorporates the demand function in its optimization problem, which is the following:

$$\max B^o = \sum_{t=0}^{\infty} \left\{ P_t \left[Y_t (L_t) \right] Y_t (L_t) - W_t L_t \right\} \tag{9}$$

In the equation above, B^o is the profit; $P_t\left[Y_t(L_t)\right]$ is the inverse demand function in period *t* where P_t is the index of domestic prices; $Y_t (L_t)$ is the production that depends on labor

L_t; and, finally, W_t is the nominal wage in period *t*. From its F.O.C.[2], we obtain the following equilibrium condition:

$$P_t\, MP_{Lt}\left(\frac{1+\varepsilon_t}{\varepsilon_t}\right)=W_t \qquad (10)$$

MP_{Lt} stands for the marginal productivity of labor in period *t*; and ε_t is the price-elasticity of demand for goods in period *t*. Taking the MP_{Lt} obtained from the production function (8) ($MP_{Lt} = \sigma\ A\ L_t^{\sigma-1}$), and substituting into the previous equation (10), the resulting equilibrium condition is:

---

[2] F.O.C. from $\frac{dB^o}{dL_t}=0$ → $\frac{\partial P_t}{\partial Y_t}\frac{\partial Y_t}{\partial L_t}Y_t + P_t\frac{\partial Y_t}{\partial L_t} - W_t = 0$;

(i) replacing $\frac{\partial Y_t}{\partial L_t}$ by marginal productivity of labor MP_{Lt}

and solving for W_t: $\frac{\partial P_t}{\partial Y_t}MP_{Lt}Y_t + P_t\, MP_{Lt} = W_t$;

(ii) taking MP_{Lt} as common factor: $MP_{Lt}\left[\frac{\partial P_t}{\partial Y_t}Y_t + P_t\right] = W_t$;

(iii) multiplying $\frac{\partial P_t}{\partial Y_t}Y_t$ by $\frac{P_t}{P_t}$: $MP_{Lt}\left[\frac{\partial P_t}{\partial Y_t}\frac{Y_t}{P_t}P_t + P_t\right] = W_t$;

(iv) replacing $\frac{\partial P_t}{\partial Y_t}\frac{Y_t}{P_t}$ by $\frac{1}{\varepsilon}$ and taking P_t as common factor: $P_t MP_{Lt}\left[\frac{1}{\varepsilon}+1\right] = W_t$;

(v) from $\left[\frac{1}{\varepsilon}+1\right]$ we can multiply to obtain $\left(\frac{1+\varepsilon_t}{\varepsilon_t}\right)$: $P_t\, MP_{Lt}\left(\frac{1+\varepsilon_t}{\varepsilon_t}\right) = W_t$.

$$P_t \sigma A L_t^{\sigma-1}\left(\frac{1+\varepsilon_t}{\varepsilon_t}\right)=W_t \tag{11}$$

The mark-up is represented by ν_t, which emerges as a consequence of imperfect competition, and we define it as follows:

$$\nu_t=\left(\frac{1+\varepsilon_t}{\varepsilon_t}\right) \tag{12}$$

As pointed out earlier, we propose that the mark-up depends on the amount of competitive pressure from foreign firms. This approach is in line with Chen *et al.* (2004), who consider that economic integration can increase competition and price flexibility, and it is also in line with the idea that foreign competition will affect inflation dynamics, as suggested, for example, by Bean (2006), Carney (2015), Andrews *et al*. (2018), Gilchrist and Zakrajsek (2019) or by IMF (2019). In this chapter, we assume that such pressure is stronger in economies that are most open to imports, and where the degree of substitution between domestic and foreign goods is high. Therefore, if there is easy access to competitive foreign goods, the market power of the domestic firm will be limited. On the other hand, if domestic production is not tradable or if importing is difficult or expensive, then domestic firms will enjoy strong market power.

The relationship between external competition and the mark-up of domestic firms facilitates the representation of the mark-up as a function of external competition. Hence, we propose that the mark-up depends on the presence of imported goods in relation to the size of the economy in period *t*, which we denote $\left[\frac{M_t}{Y_t}\right]^{\varphi}$, where M_t stands for imports in period *t*, which we assume are final consumer goods, and, as before, Y_t is the production in period *t.* This imports-to-GDP ratio is adjusted by parameter φ, which comprises the structural aspects in the relationship of an economy with foreign markets, such as preferences for imported goods and services, as well as international trade regulations, tariffs, transport costs and other import costs.

The level of competitive pressure will also depend on the real exchange rate, which measures the relative price of the foreign goods with respect to the domestic goods. The real exchange rate is a common component of Phillips curves in open economies (for instance, Galí and Monacelli 2005 and Forbes 2019), but in our case it is not the transmission channel of price variations in imported inputs on the costs of domestic firms, but rather the relative price of domestic goods compared to foreign ones. Q_t stands for the real exchange rate, and its influence is adjusted by parameter α, which reflects the impact of the real exchange rate on foreign competitive pressure. An increase in Q_t represents an appreciation of the real exchange rate that causes a loss of competitiveness in domestic goods and, consequently, an increase in the competitive pressure exerted by foreign products.

The parameters α and φ that accompany $\left[\frac{M_t}{Y_t}\right]$ and Q_t play a key role. The size of α and φ are very sensitive to, respectively, the proportion of tradable goods in the economy, and to the substitutability between imported and domestically produced goods. We assume that an economy with a high degree of tradable goods and high substitutability between imported and domestic products exhibits high values α and φ, and suffers strong competitive pressure from abroad that shrinks the mark up of their firms.

Finally, we define μ as the other domestic structural elements that affect the mark-up, such as domestic market regulations, competition enforcement policies or other local aspect that influence competition levels. We assume that it is stable in time and, therefore, constant.

According to the above reasoning, we assume that the mark-up obeys the following expression:

$$\nu_t = \mu \left[\frac{M_t}{Y_t} \right]^{\varphi} Q_t^{\alpha} \qquad (13)$$

Combining equations (13), (12) and (11), and solving for labor, we obtain labor demand:

$$L_t = \left(\frac{P_t \, \sigma \, A \, \mu \left[\frac{M_t}{Y_t} \right]^{\varphi} Q_t^{\alpha}}{W_t} \right)^{1/1-\sigma} \qquad (14)$$

Therefore, labor demand in period *t* has a positive relationship with domestic prices, technology and productivity, and a negative relationship with nominal wages. It also depends positively on foreign competitive pressure, represented by equation (13), since greater competition levels reduce market power and boost production.

3.1.3. The open economy Phillips curve

We can then introduce labor demand, in equation (14), into the production function represented in equation (8) $Y_t = A\, L_t^{\sigma}$ to obtain the production level of the economy:

$$Y_t = A \left(\frac{P_t\, \sigma\, A \mu \left[\frac{M_t}{Y_t} \right]^{\varphi} Q_t^{\alpha}}{W_t} \right)^{\sigma/1-\sigma} \tag{15}$$

Denoting the equilibrium values in period *t* of production, nominal wages, domestic price level, imports and real exchange rate by Y_t^*; W_t^*; P_t^*; M_t^*; and Q_t^* respectively, and considering that parameters *σ*, *α* and *φ* are stable in equilibrium, we arrive at the following equation:

$$Y_t^* = A\left(\frac{P_t^* \sigma A \mu \left[\frac{M_t^*}{Y_t^*}\right]^{\varphi} Q_t^{*\alpha}}{W_t^*}\right)^{\sigma/1-\sigma} \tag{16}$$

To examine the relationship between current production and its equilibrium level in period *t*, we divide the two previous equations (15) and (16):

$$\frac{Y_t}{Y_t^*} = \frac{A\left(\frac{P_t \sigma A \mu \left[\frac{M_t}{Y_t}\right]^{\varphi} Q_t^{\alpha}}{W_t}\right)^{\sigma/1-\sigma}}{A\left(\frac{P_t^* \sigma A \mu \left[\frac{M_t^*}{Y_t^*}\right]^{\varphi} Q_t^{*\alpha}}{W_t^*}\right)^{\sigma/1-\sigma}} \tag{17}$$

Simplifying (17), we obtain:

$$\frac{Y_t}{Y_t^*} = \left(\frac{Y_t^{*\varphi} P_t W_t^* M_t^{\varphi} Q_t^{\alpha}}{Y_t^{\varphi} P_t^* W_t M_t^{*\varphi} Q_t^{*\alpha}}\right)^{\left(\frac{\sigma}{1-\sigma}\right)} \tag{18}$$

In order to put the equation above in rates of change, we take logs on both sides of the equation and take derivatives with respect to time. As a result, we obtain the following equation (19), where capital letters with hat denote the rate of change in period *t* of the respective variable, while π_t is domestic inflation in *t*, and π_t^* represents the long-term equilibrium rate of inflation:

$$\hat{Y}_t - \hat{Y}_t^* = \left(\frac{\sigma}{1-\sigma}\right)(\varphi\hat{Y}_t^* + \pi_t + \hat{W}_t^* + \varphi\hat{M}_t + \alpha\hat{Q}_t - \varphi\hat{Y}_t - \pi_t^* - \hat{W}_t - \varphi\hat{M}_t^* - \alpha\hat{Q}_t^*) \qquad (19)$$

According to equation (7) $\hat{W}_t = E\{\pi_t^c\}$. And, since the real wage remains constant in equilibrium ($\hat{W}_t^* = \pi_t^*$), we can simplify equation (19) to obtain the following expression:

$$\hat{Y}_t - \hat{Y}_t^* = \left(\frac{\sigma}{1-\sigma}\right)\left[\pi_t - E\{\pi_t^c\} + \varphi\left(\hat{Y}_t^* - \hat{Y}_t\right) + \varphi\left(\hat{M}_t - \hat{M}_t^*\right) + \alpha\left(\hat{Q}_t - \hat{Q}_t^*\right)\right] \qquad (20)$$

For simplicity of notation of the parameters, we establish that $\gamma = \varphi + \left(\frac{1-\sigma}{\sigma}\right)$, and solve for the rate of inflation:

$$\pi_t = E\{\pi_t^c\} + \gamma\left(\hat{Y}_t - \hat{Y}_t^*\right) - \varphi\left(\hat{M}_t - \hat{M}_t^*\right) - \alpha\left(\hat{Q}_t - \hat{Q}_t^*\right) \tag{21}$$

Note that, for the case of output, the difference between the two rates of growth is:

$$\left(\hat{Y}_t - \hat{Y}_t^*\right) = \frac{Y_t - Y_{t-1}}{Y_{t-1}} - \frac{Y_t^* - Y_{t-1}^*}{Y_{t-1}^*} \tag{22}$$

Assuming that the economy is in equilibrium in the initial period *t* ($Y_{t-1} = Y_{t-1}{}^*$), we have:

$$\frac{Y_t - Y_{t-1}}{Y_{t-1}} - \frac{Y_t^* - Y_{t-1}^*}{Y_{t-1}^*} = \frac{Y_t - Y_{t-1}^* - Y_t^* + Y_{t-1}^*}{Y_{t-1}^*} = \frac{Y_t - Y_t^*}{Y_{t-1}^*} = \left(y_t - y_t^*\right) \tag{23}$$

where y_t and y_t^* are the log of Y_t and Y_t^*, respectively. Consequently:

$$\left(\hat{Y}_t - \hat{Y}_t^*\right) = \left(y_t - y_t^*\right)$$

The same procedure can be applied to the difference between the growth rates of the real effective exchange rate (REER) and of the imports:

$$\left(\hat{M}_t - \hat{M}_t^*\right) = \left(m_t - m_t^*\right)$$

$$\left(\hat{Q}_t - \hat{Q}_t^*\right) = \left(q_t - q_t^*\right)$$

Where lowercase letters denote logs of the corresponding variables.

Taking into account the above derivations, equation (21) can be written as:

$$\pi_t = E\left\{\pi_t^c\right\} + \gamma\left(y_t - y_t^*\right) - \varphi\left(m_t - m_t^*\right) - \alpha\left(q_t - q_t^*\right) \tag{24}$$

Equation (24) is the open economy Phillips curve (OEPC), with the activity slack represented by the output gap instead of the unemployment differential.

The most conventional Phillips curve for a closed economy can be derived from equation (24) - as a particular version of it – by making $\alpha = 0$, $\varphi = 0$.

This OEPC innovates including two factors that explicitly capture the influence of foreign competition: the imports gap term $\varphi\left(m_t - m_t^*\right)$ and the real exchange-rate misalignment. The rationale is that when imports deviate upwards from their equilibrium level, and/or the domestic currency appreciates excessively in real terms, mark-ups shrink as domestic firms perceive greater threat of losing market share. Thus, a positive deviation in these variables could foster price contention of domestic firms, and vice versa.

3.2. Quantitative analysis of the open economy Phillips curve

3.2.1. Methodology, data and its statistical properties

In this section, we perform a quantitative analysis of the OEPC presented in this chapter. The relationship that we estimate with a sample of *i* countries, based on equation (24), contains the variables included in that equation: domestic inflation, expected inflation, output gap, imports gap and REER misalignment (details of data definition and sources in Table I):

$$\pi_{it} = \theta_i + \beta_1 E\left\{\pi_{it}^c\right\} + \beta_2\left(y - y^*\right)_{it} + \beta_3\left(m - m^*\right)_{it} + \beta_4\left(q - q^*\right)_{it} + \rho_{it} \tag{25}$$

The term ρ_{it} is the random error, which is distributed with zero average and constant variance, and θ_i is a fixed effect. Finally, $\beta_1, \beta_2, \beta_3, \beta_4$ are the model parameters to estimate. Hence, the two parameters that affect the imports gap and the REER misalignment, β_3 and β_4, reflect how much inflation reacts when these variables deviate from their equilibrium level. Additionally, as indicated in the theoretical development, their value depends on structural factors such as preferences for imported products, trade regulations and tariffs, import costs, etc. in the case of β_3, and the REER misalignment pass-through to inflation in the case of β_4.

The fact that, according to some studies (Blanchard 2016, Leduc and Wilson 2010 or IMF 2019), the Phillips curve has remained stable since the early 1990s, has led us to use a sample that begins in the early 1990s. We choose 1994 as the initial year because it is the first year after the crisis of the European Monetary System. So, our time sample is 1994-2017. We include 15 advanced economies in the analysis: Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, Japan, Netherlands, Portugal, Spain, UK and US. These are major advanced economies for which there is sufficient information of the required variables in data sources of recognized institutions (full details of data sources in Table I).

Table I: Data sources and definitions

Domestic inflation: consumer prices (CPI) year on year (end of the period) % change. Source: IMF World Economic Outlook January 2019.
Inflation expectations: consumer prices (CPI) year on year (end of the period) % change. The inflation expectation figure for a given year is the expected inflation of the next year's inflation published in the October IMF WEO (i.e. 1990 inflation expectation figure is the inflation expectation forecast figure for 1991 published in the IMF WEO of October 1990). Source: IMF Historical WEO Forecasts database.
Output Gap: actual GDP less potential GDP (in % of potential GDP). Source: IMF World Economic Outlook January 2019.
Imports: volume of imports of goods and services, year on year (end of the period) % change. Source: IMF World Economic Outlook January 2019.
Potential output, volume growth, is used as a proxy for potential volume of goods and services growth. Potential output, volume growth is expressed in year on year % change. Source: OECD, Dataset Economic Outlook No 105 – May 2019.
Real Effective Exchange Rate (REER) misalignments: Source: CEPII Exchange, Couharde *et al.* (2018), currency misalignments are the difference between the observed REER and its equilibrium level, for 186 trading partners, with time-varying weights: 5-year Windows. Data from November 2019.
REER change: in year on year % change. Source: obtained calculating interannual % change from the REER index from the World Bank World Development Indicators. Data from July 2020.
Trade openness (in % of GDP): is the sum of exports and imports of goods and services measured as a share of GDP. Source: World Bank World Development Indicators. Data from July 2020.

We obtain most of the data from the International Monetary Fund (IMF), including domestic inflation, expected inflation[3] and imports growth data, which are expressed as interannual percentage change rates, and output gap, which is presented as a percentage of potential GDP. Finally, we obtain REER misalignment from the Centre d'Études Prospectives et d'Informations Internationales (CEPII) Exchange database of Couharde *et al.* (2018)[4], which is expressed as a percentage of its equilibrium level, and an increase represents an appreciation of the domestic currency.

Regarding imports gap $\left(m-m^{*}\right)_{it}$, the data series is constructed as follows: for each period we subtract from the imports growth the equilibrium imports growth rate, which we approximate by the potential output growth expressed as interannual percentage change rate, obtained from the Organisation for Economic Co-operation and Development (OECD) database (details on how it is estimated in Chalaux and Guillemette, 2019)[5].

In the following sub-section, we perform tests on the data to verify its statistical properties.

[3] Expected inflation is obtained from the IMF fall forecasts in its 'World Economic Outlook' dating from October 1990 to 2017, using the year after the corresponding publication as the data for expected inflation in the current year. This approach to expected inflation is in line with other authors such as Paloviita (2007), which uses OECD inflation expectations data, or Forbes (2019) which uses five years expected inflation from the IMF.

[4] Specifically, we use the REER misalignment data with a moving weighting scheme based on 5-year non-overlapping averages. More details in http://www.cepii.fr/CEPII/fr/bdd_modele/presentation.asp?id=34

[5] The use of potential GDP growth as a proxy of m^* assumes that, in equilibrium, imports growth rate is equal to that of production, so that imports weight with respect to production remains stable.

2.1.1 Cross-sectional dependence

Cross-sectional dependence is common in international panels due to unobservable factors, external effects or contagions between countries (more details in Baltagi and Pesaran, 2007). It can reduce estimator's efficiency and it can skew, or even invalidate, test results. To verify its existence in the data, we apply four tests: the Breusch-Pagan LM test (1980), the Pesaran LM scaled test (2004), the Pesaran CD test (2004), and the Baltagi, Feng, and Kao bias-corrected scaled LM test (2012). The results, shown in columns 2 and 3 of Table II, indicate that there is cross-sectional dependence with a 1% significance level in all cases.

Table II. Cross Sectional Dependence Tests

Test	Statistic		Prob.
Breusch-Pagan LM	598,6447	***	0,0000
Pesaran scaled LM	34,0647	***	0,0000
Bias-corrected scaled LM	33,7386	***	0,0000
Pesaran CD	21,8973	***	0,0000

Null hypothesis: no cross sectional dependence.
Balanced panel. N: 15; t: 24 (1994-2017); obs.: 360.
*** indicates significance at 1% level; ** 5% level; * 10% level.

2.1.2 Stationarity

To analyze whether the variables are stationary in this balanced panel with cross-sectional dependence, we use the CADF unit toot test (Pesaran, 2007). This test, which is part of the second-generation unit root tests, is specifically designed to address the problem of cross-sectional dependence. The test is performed for 1 and 2 lags with a constant and a trend. The results, shown in Table III, indicate that for 1 lag we can reject the null of no stationarity at 10% significance level for all the variables both with constant or with constant and trend, indeed at 1% for most of them, only excepting REER misalignment with constant and no trend. For 2 lags the results are mixed: we can reject the null at 5% for the output gap and imports gap both with constant and with constant and trend, while we cannot reject it for the rest. All in all, we consider that these results in general indicate that the variables are stationary, and thus they are integrated of order zero, as would be theoretically expected.

Table III. Panel Unit Root Pesaran CADF Test

	Statistic Zt-bar With constant				Statistic Zt-bar With constant and trend			
	1 lag		2 lags		1 lag		2 lags	
Domestic inflation	-2,817	***	-0,037		-3,004	***	-0,192	
Expt. Inflation	-2,727	***	-0,716		-1,370	*	1,661	
Output Gap	-2,708	***	-3,087	***	-2,664	***	-2,781	***
Imports gap	-5,183	***	-4,103	***	-2,934	***	-2,022	**
REER misalignment	-0,231		2,701		-2,005	**	1,183	

Null hypothesis: series is no stationary. Balanced panel. N: 15; t: 24 (1994-2017); obs.: 360. *** indicates significance at 1% level; ** 5% level; * 10% level.

3.2.2. *Estimation with FGLS panel regressions*

Since the variables in equation (26) are integrated of order zero, we can estimate the OEPC by creating a panel with these variables and estimating a panel model. Since there is cross-sectional dependence, we use a feasible generalized least squares (FGLS) estimation, which is appropriate to handle cross-sectional dependence, in particular in situations, as this case, where the number of time periods is higher that the number of cross-sections. Results are shown in Table IV.

Table IV: OEPC FGLS estimation

Dependent Variable: Domestic inflation

Coefficient (variable)	Coefficient	Prob.	
θ	0.169453	0.026	**
β_1 (expt. Inflation)	0.9634444	0.000	***
β_2 (output gap)	0.0292835	0.021	**
β_3 (imports gap)	-0.0222545	0.000	***
β_4 (REER misalign.)	-0.0117945	0.000	***

Method: FGLS with heteroskedastic and correlated error structure. Balanced panel. N: 15. t: 24 (1994-2017). Obs.: 360. *** indicates significance at 1% level; ** 5% level; * 10% level.

In the second column of Table IV (coefficient column), we observe that all of the coefficients have the signs predicted by the theory presented in this chapter. In addition, the coefficients are statistically significant at 5%; indeed, most of them at 1%. The results indicate that a 1 percentage point increase of the output gap rises inflation by 0.03 percentage points, the same increase in imports gap reduces inflation by 0.02 percentage points and, finally, a 1 percentage point increase in REER overvaluation reduces inflation by 0.02 percentage points.

The moderating effect of the two external factors considered here is consistent with the findings of Auer *et al.* (2017), Ferroni and Mojon (2017), Forbes (2019) and Moretti *et al.* (2019), using a different set of external variables, and are also in line with Romer (1993) and Rumler (2007) in that there is a negative relationship between the degree of openness and inflation. It also supports that exposure to international trade flattens the Phillips curve, as Gilchrist and Zakrajsek (2019) found for the US economy.

Some recent analysis, as Leduc and Wilson (2017), Forbes (2019) and IMF (2019), suggest that the Phillips curve might have reduced its slope after the 2009 crisis. In order to test this hypothesis, we repeat the last estimation introducing a multiplicative dummy with value 0 between 1994-2009 and 1 between 2010 and 2017 on the output gap's coefficient, which we call "output gap*d10-17", to check whether this coefficient has changed and, if so, find out how and to what extent the change has been.

Results, presented in Table V, show that all the variables again have the sign predicted by this chapter's theoretical proposals, and are statistically significant at 1% level, including the "output gap*d10-17" variable. The output gap has a coefficient of nearly

0.09 until 2009, but its influence on inflation wanes in the 2010-2017 period, where it becomes close to zero. Therefore, these results clearly indicate that the slope of the Phillips curve decreased remarkably from 0.09 to nearly zero from that year 2010, a result consistent with Forbes (2019).

Table V: OEPC FGLS estimation with a time dummy for 2010-2017

Dependent Variable: Domestic inflation

Coefficient (variable)	Coefficient	Prob.	
θ	0.147206	0.063	*
β_1 (expt. Inflation)	0.961216	0.000	***
β_2 (output gap)	0.0864108	0.000	***
β_3 (imports gap)	-0.0256644	0.000	***
β_4 (REER misalign.)	-0.0137117	0.000	***
β_5 (output gap*d10-17)	-0.0918362	0.000	***

Method: FGLS with heteroskedastic and correlated error structure. Balanced panel. N: 15. t: 24 (1994-2017). Obs.: 360. *** indicates significance at 1% level; ** 5% level; * 10% level.

Since the slope of the Phillips curve derived from our theoretical model depends negatively on the productivity of labor, we may infer from our second empirical result – with the multiplicative dummy for 2010-2017- that globalization has probably increased the efficiency and productivity of domestic firms in the years after the Great Recession. Two likely explanations can be provided: first, international competition leads firms to adopt more efficient technologies and, second, the expanded pool of available labor – through immigration and potential offshoring- induces employees to work with more interest and productivity, and firms to engage the most productive workers.

It could be highlighted that estimations of the external variables in Tables IV and V remain very similar in both cases. Finally, these results are also consistent with the idea that foreign competition could be one of the factors encouraging recent price moderation, in line with the findings of different authors as Auer *et al.* (2017), Ferroni and Mojon (2017), Gilchrist and Zakrajsek (2019), Forbes (2019) and Moretti *et al.* (2019).

3.2.3. *PVAR estimation*

In this section we estimate a panel VAR (PVAR), in which inflation, output gap, imports gap and REER misalignment are endogenous variables. The time sample in this estimation starts two years earlier (1992-2017) in order to incorporate the data of the two lagged variables with which we work in our PVAR. We consider inflation expectations exogenous since the process by which the IMF elaborates inflation expectations has no relationship to the structure and functioning of our model[6].

We use the information criteria of Akaike, Hannan-Quinn, Schwarz and on the final prediction error to choose the number of lags of the PVAR, and all of them coincide in 2 lags (results in Table VI). Therefore, we use 2 lags to estimate the PVAR.

[6] Moreover, IMF estimates are produced long before the actual data of a given year is available, and through a complex process which has gone through significant changes over the last 30 years. Nowadays, the IMF mixes different estimation methods: on the one hand, the respective country analysts choose the forecast method that best adapts to each country context. On the other hand, the departments of financial markets, global commodities, and global macroeconomics also develop their own forecasts. All these estimations are put in common, and then a coordination and review process are carried out until the results converge and are consistent. The elaboration of these estimates can take from 3 to 6 months (more details in Genberg *et al*., 2014).

Table VI: PVAR Lag Selection Criteria

	Lags				
	0	1	2	3	4
Final prediction error	7310.092	179.4318	135.7091*	138.0727	138.8156
Akaike I.C.	20.24852	16.54128	16.26192*	16.27902	16.28408
Schwarz I.C.	20.34729	16.83758	16.75576*	16.97039	17.17299
Hannan-Quinn I.C.	20.28805	16.65986	16.45956*	16.55571	16.63982

* Indicates number of lags selected by the criterion. Balanced panel. N: 15; t: 26 (1992-2017); obs.: 390.

Afterwards, we test if there is residual autocorrelation in the PVAR with 2 lags. First, we perform a visual analysis (residual graphs in Figure 1) which does not show residual autocorrelation, and then we apply a Residual Serial Correlation LM Test based on Breusch-Godfrey with the Edgeworth corrective expansion, using from one to four lags. The results of this test, available in Table VII, indicate that the residuals of the OEPC estimation do not suffer from autocorrelation.

Figure 1

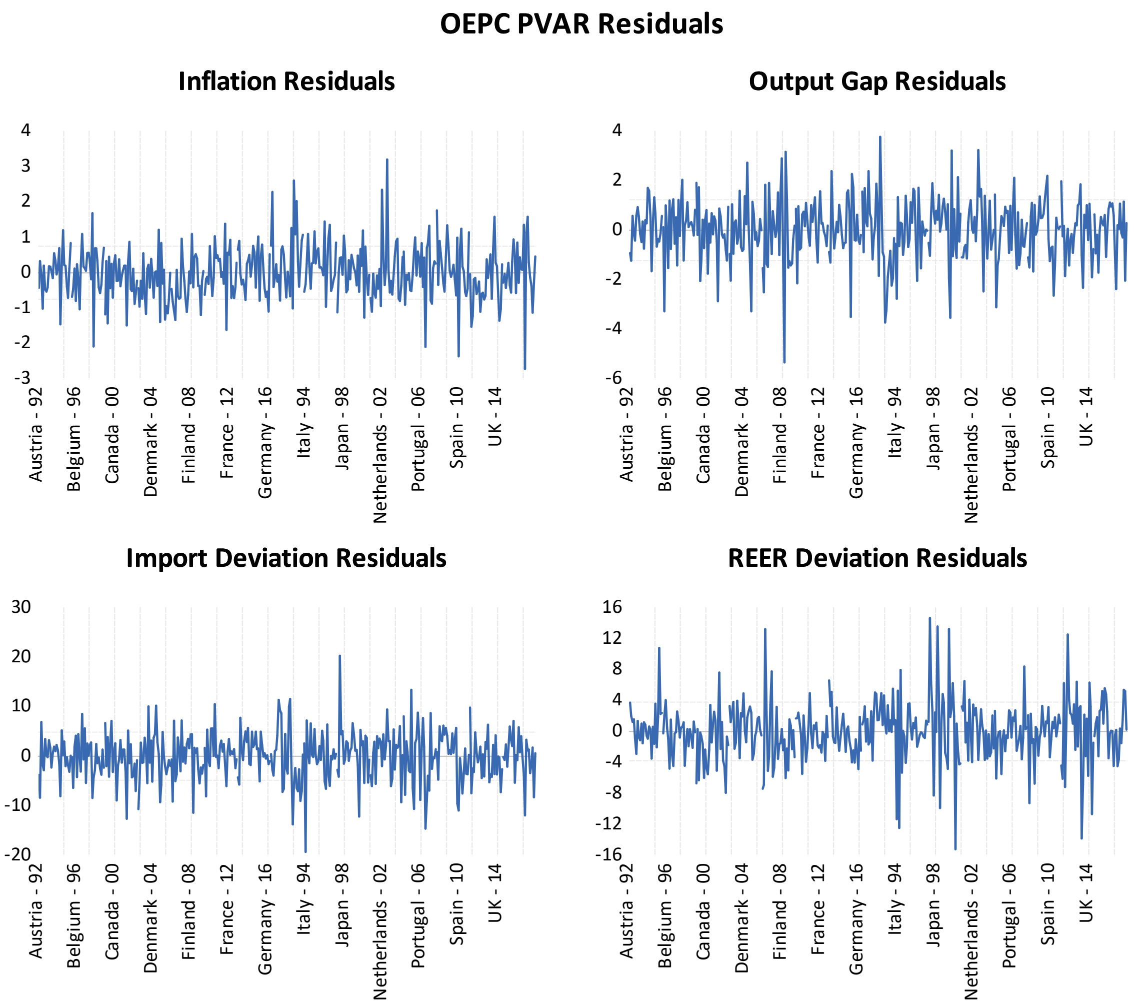

OEPC PVAR Residuals
Inflation Residuals
Output Gap Residuals
Import Deviation Residuals
REER Deviation Residuals
Austria - 92
Belgium - 96
Canada - 00
Denmark - 04
Finland - 08
France - 12
Germany - 16
Italy - 94
Japan - 98
Netherlands - 02
Portugal - 06
Spain - 10
UK - 14

Table VII: OEPC PVAR Residual Serial Correlation LM test 1992-2017

Lags	LRE stat	Prob.	
1	21,12	0,17	
2	19,75	0,23	
3	22,44	0,13	
4	26,60	0,05	**

Null hypothesis: no serial correlation at lag X. Balanced panel. N: 15; t: 26 (1992-2017); obs.: 390. *** indicates significance at 1% level; ** 5% level; * 10% level.

To test whether the OEPC PVAR is stationary, we analyze the inverse roots of its characteristic polynomials, and we find that all of them are inside the unit circle. Thus, we confirm that the PVAR is stationary.

We now analyze the results of the estimated PVAR, which are presented in Table VIII. As observed in the four columns of this Table, the high t-statistics in most of the OEPC estimates, particularly in the case where inflation is the dependent variable, are statistically significant. If we focus on the column 2, where inflation is the dependent variable, we find that the estimates' signs are consistent with our theoretical approach, since expected inflation and output gap have a positive influence, while the external variables have a negative one. Adding up the coefficients of both retarded estimations for each variable in that column, we find that the combined effect of inflation is 0.3, of the output gap is 0.08, of imports gap is -0.05, and of the REER misalignment is -0.01. The robustness of the results is enhanced by the similarities between our theoretical approach and both the Panel and the PVAR results.

Table VIII: PVAR Estimates
Open Economy Phillips Curve (OEPC)

	domestic inflation	output gap	imports gap	REER misalig.
domestic inflation(-1)	0.273459 (0.04262) [6.41568]	-0.777414 (0.06973) [-11.1483]	-2.747880 (0.27630) [-9.94541]	0.827017 (0.21468) [3.85234]
domestic inflation(-2)	0.026197 (0.03864) [0.67806]	0.186485 (0.06321) [2.95023]	1.178189 (0.25045) [4.70432]	-0.306399 (0.19460) [-1.57454]
output gap(-1)	0.150394 (0.03885) [3.87127]	0.936129 (0.06356) [14.7286]	-0.608591 (0.25183) [-2.41669]	0.408463 (0.19567) [2.08754]
output gap(-2)	-0.074633 (0.03854) [-1.93665]	-0.152957 (0.06305) [-2.42601]	0.162237 (0.24981) [0.64945]	-0.398674 (0.19410) [-2.05398]
imports gap(-1)	-0.021511 (0.00984) [-2.18529]	0.031983 (0.01610) [1.98597]	0.209473 (0.06381) [3.28283]	-0.078704 (0.04958) [-1.58747]
imports gap(-2)	-0.026244 (0.00688) [-3.81453]	0.009737 (0.01126) [0.86505]	-0.055794 (0.04460) [-1.25106]	-0.078688 (0.03465) [-2.27083]
REER misalig.(-1)	-0.033881 (0.00947) [-3.57803]	0.005236 (0.01549) [0.33801]	0.035253 (0.06138) [0.57432]	1.116091 (0.04769) [23.4018]
REER misalig.(-2)	0.026571 (0.00955) [2.78259]	-0.029954 (0.01562) [-1.91730]	-0.072962 (0.06190) [-1.17871]	-0.299049 (0.04810) [-6.21778]
c	0.061929 (0.08529) [0.72614]	-0.603985 (0.13953) [-4.32868]	0.384290 (0.55284) [0.69512]	1.063069 (0.42955) [2.47483]
expected inflation	0.750171 (0.05545) [13.5288]	0.807546 (0.09072) [8.90166]	2.396752 (0.35944) [6.66801]	-0.819863 (0.27928) [-2.93562]
R-squared	0.820683	0.787088	0.307398	0.772612
Adj. R-squared	0.816437	0.782045	0.290994	0.767227
F-statistic	193.2398	156.0857	18.73954	143.4615
Akaike AIC	2.287208	3.271776	6.025347	5.520686
Akaike information criterion		16.54984		
Schwarz criterion		16.95663		

Sample (adjusted): 1992 2017. Included observations: 390. Number of coefficients: 40. Standard errors in ( ) and t-statistics in [ ].

We apply a VAR Granger causality/Block exogeneity Wald Test to analyze the structure of the causal links between these variables. This test allows to determine whether one variable is useful for forecasting another. We present the results in Table IX, where the null hypothesis is that the excluded variable does not Granger cause the dependent variable, with the excluded variables listed in the first column under the heading "Excluded", and the dependent variables heading the rest of the columns. Thus, if the null is rejected, the results from this test verify that the excluded variable Granger causes the variable on the corresponding column. Results of this test verify that in most cases these variables have causal links between them and, in particular, that all the studied variables Granger-cause inflation at a 1% significance level.

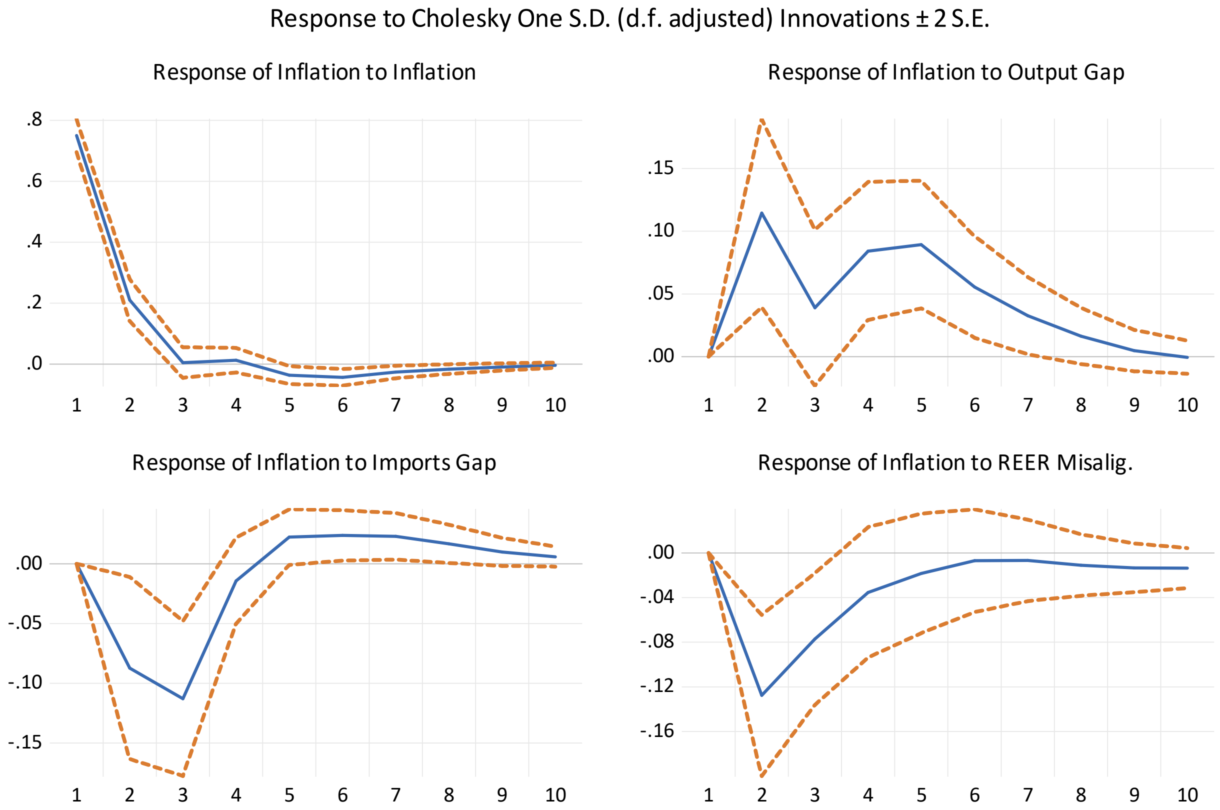
Table IX: VAR Granger Causality/Block Exogeneity Wald Tests

	Dependent							
	Domestic inflation		Output Gap		Imports Gap		REER Misalign.	
Excluded	Chi-sq	Prob.	Chi-sq	Prob.	Chi-sq	Prob.	Chi-sq	Prob.
Domestic inflation	N.A.	N.A.	152.26	***	103.09	***	16.08	***
Output Gap	27.10	***	N.A.	N.A.	17.67	***	4.52	
Imports Gap	18.80	***	4.58		N.A.	N.A.	7.45	**
REER Misalign.	13.00	***	9.38	***	2.00		N.A.	N.A.
All	45.53	***	156.56	***	153.06	***	25.12	***

N: 15; t: 26 (1992-2017); obs.: 390. Null: Excluded variable does not Granger-cause the dependent variable. ***indicates significance at 1% level; **5% level; *10% level.

We perform an impulse response analysis based on this estimated OEPC, focusing on inflation's response. We apply a shock of one standard deviation, with confidence margins projected using Monte Carlo simulations with 10,000 repetitions and ± 2 standard deviations. Results, in Figure 2, show that the responses are again consistent with both our theoretical approach and with the previous results: a shock in inflation creates a positive response in inflation that starts with an impact of 0.8 in the first period, then adds another 0.2 in the second period, and stops having additional impacts in period 3. A shock in the output gap also creates an increase in inflation that adds between 0.04 and 0.12 each period for 5 initial periods, and afterwards reduces its impact gradually over the next 5 periods.

Figure 2: Impulse–response analysis



Solid lines represent impulse responses and dashed lines are standard error bands created by Monte Carlo simulations with 10,000 repetitions.

Regarding the external variables, the impulse analysis shows that they both have statistically significant disinflationary effects that accumulate for 4-6 periods after the initial shock. Specifically, the results indicate that an increase of one standard deviation of imports gap reduces inflation for 3 periods, with a maximum effect of -0.11 in the third period, and then the effect wanes or even reverts slightly, a result consistent with our theoretical development, in which causality runs from import shocks to inflation. Finally, a shock on REER misalignment is associated with a disinflationary effect with a maximum annual average fall of 0.13 percentage points after two periods, and afterwards it keeps having additional disinflationary effects that decrease gradually until period 6, a result also consistent with our theoretical development. These results are in line with Auer *et al.* (2017), Gilchrist and Zakrajsek (2019) and Forbes (2019) in that external factors influence inflation. They also coincide with Romer (1993) and Rumler (2007) in that there is a negative relationship between the degree of openness and inflation, although we did not explicitly consider the degree of openness in this estimation, as these authors do.

To test the hypothesis of a reduction of the Phillips curve's slope, we proceed to re-estimate the OEPC, but with the same 2010-2017 dummy variable multiplying the output gap used in the panel estimation (output gap*d10-17). Once estimated (in Table X), we confirm that the inverse roots of the characteristic polynomials lay within the unit circle, so that this new PVAR is stationary.

Table X: PVAR Estimates
Open Economy Phillips Curve (OEPC) with a time dummy for 2010-2017

	domestic inflation	output gap	imports gap	REER misalig.	output gap*d10-17
domestic inflation(-1)	0.234780	-0.681391	-2.388915	0.766603	-0.079465
	(0.04451)	(0.07120)	(0.28111)	(0.22616)	(0.03884)
	[5.27498]	[-9.56948]	[-8.49823]	[3.38960]	[-2.04592]
domestic inflation(-2)	0.032945	0.169891	1.116312	-0.295994	0.039064
	(0.03840)	(0.06144)	(0.24256)	(0.19515)	(0.03351)
	[0.85785]	[2.76516]	[4.60227]	[-1.51677]	[1.16558]
output gap(-1)	0.180151	0.876709	-0.816061	0.442547	0.132223
	(0.03993)	(0.06388)	(0.25218)	(0.20289)	(0.03484)
	[4.51183]	[13.7247]	[-3.23597]	[2.18118]	[3.79466]
output gap(-2)	-0.073279	-0.256877	-0.328240	-0.310332	-0.097950
	(0.04219)	(0.06750)	(0.26649)	(0.21440)	(0.03682)
	[-1.73676]	[-3.80554]	[-1.23174]	[-1.44745]	[-2.66019]
imports gap(-1)	-0.021888	0.020191	0.152482	-0.068379	0.029598
	(0.01001)	(0.01602)	(0.06325)	(0.05089)	(0.00874)
	[-2.18562]	[1.26028]	[2.41081]	[-1.34375]	[3.38684]
imports gap(-2)	-0.020831	0.010101	-0.040436	-0.082068	-0.017482
	(0.00737)	(0.01178)	(0.04652)	(0.03743)	(0.00643)
	[-2.82824]	[0.85724]	[-0.86923]	[-2.19276]	[-2.71989]
reer misalig.(-1)	-0.034349	0.013146	0.071664	1.109574	-0.003499
	(0.00947)	(0.01516)	(0.05984)	(0.04815)	(0.00827)
	[-3.62533]	[0.86728]	[1.19756]	[23.0464]	[-0.42322]
reer misalig.(-2)	0.025957	-0.032084	-0.084635	-0.296873	-0.004173
	(0.00949)	(0.01519)	(0.05997)	(0.04824)	(0.00829)
	[2.73395]	[-2.11232]	[-1.41141]	[-6.15352]	[-0.50371]
output gap*d10-17(-1)	-0.166904	0.264632	0.837442	-0.132313	1.271830
	(0.06008)	(0.09612)	(0.37948)	(0.30531)	(0.05243)
	[-2.77788]	[2.75309]	[2.20683]	[-0.43338]	[24.2564]
output gap*d10-17(-2)	0.121394	-0.005726	0.278430	-0.063898	-0.427977
	(0.06035)	(0.09655)	(0.38116)	(0.30666)	(0.05267)
	[2.01150]	[-0.05931]	[0.73048]	[-0.20837]	[-8.12634]
C	0.011047	-0.476026	0.864311	0.982187	-0.112072
	(0.08657)	(0.13850)	(0.54677)	(0.43990)	(0.07555)
	[0.12761]	[-3.43707]	[1.58075]	[2.23274]	[-1.48345]
expected inflation	0.794082	0.713526	2.060476	-0.764132	0.051016
	(0.05713)	(0.09140)	(0.36082)	(0.29029)	(0.04985)
	[13.8998]	[7.80700]	[5.71056]	[-2.63227]	[1.02330]
R-squared	0.824458	0.800700	0.356339	0.773426	0.897556
Adj. R-squared	0.819349	0.794901	0.337609	0.766832	0.894575
F-statistic	161.3932	138.0582	19.02419	117.3025	301.0746
Akaike AIC	2.276193	3.215962	5.962319	5.527358	2.003793
Akaike information criterion		18.31467			
Schwarz criterion		18.92485			

Sample (adjusted): 1992 2017. Included observations: 390. Number of coefficients: 60. Standard errors in ( ) and t-statistics in [ ].

To check for residual autocorrelation, we perform a visual analysis (in Figure 3), and then apply a Residual Serial Correlation Test based on Breusch-Godfrey with the Edgeworth corrective expansion. Results from both types of analysis support the absence of residual correlation. Focusing on the results where domestic inflation is the dependent variable, we find that the estimates' signs are again consistent with our theoretical approach and the previous PVAR and panel estimations. We find that the impact of the output gap on inflation is halved after 2010. Hence, the PVAR estimations confirm again the flattening of the Phillips curve since 2010, in line with Forbes (2019) and Gilchrist and Zakrajsek (2019).

Figure 3

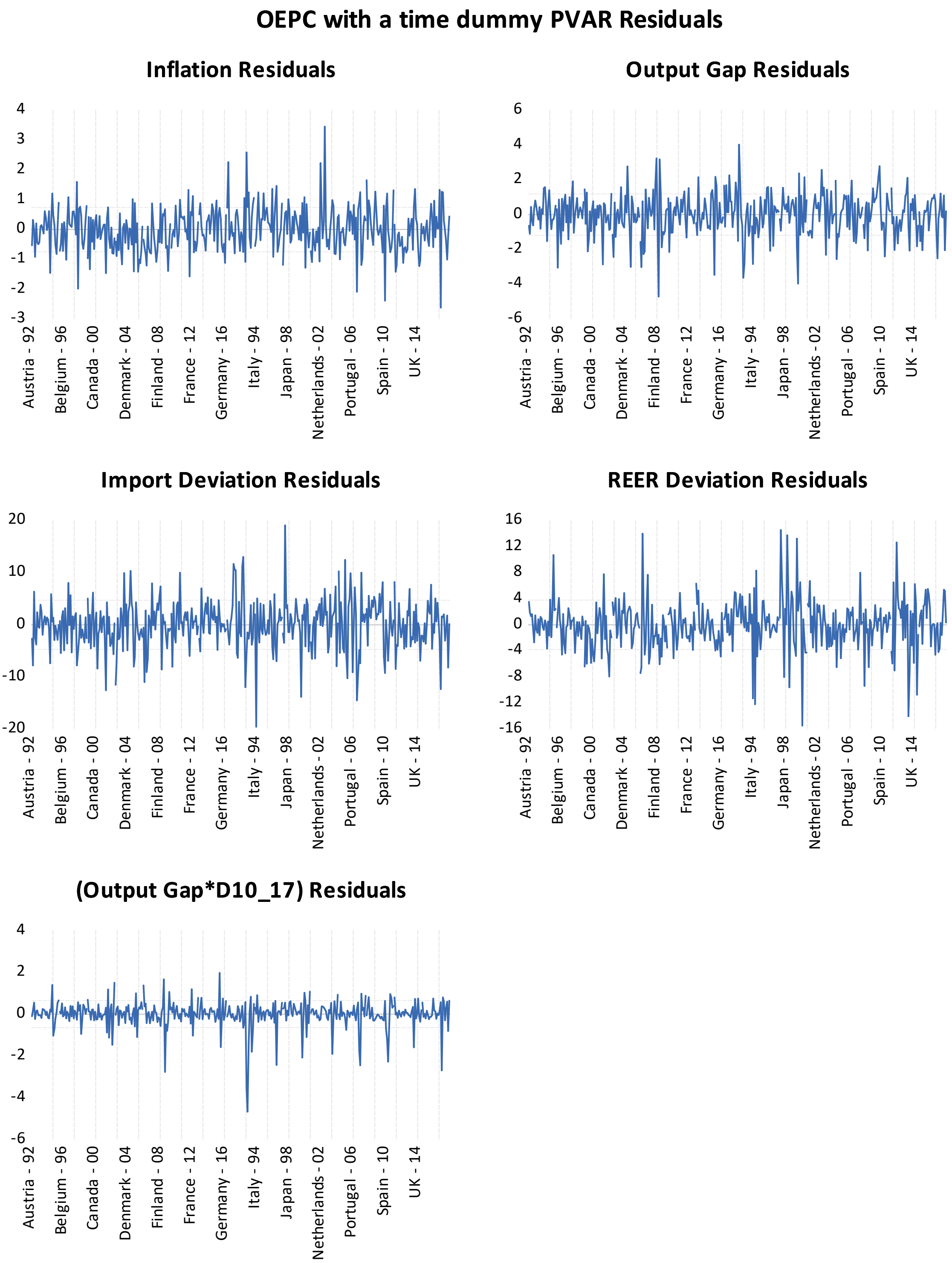
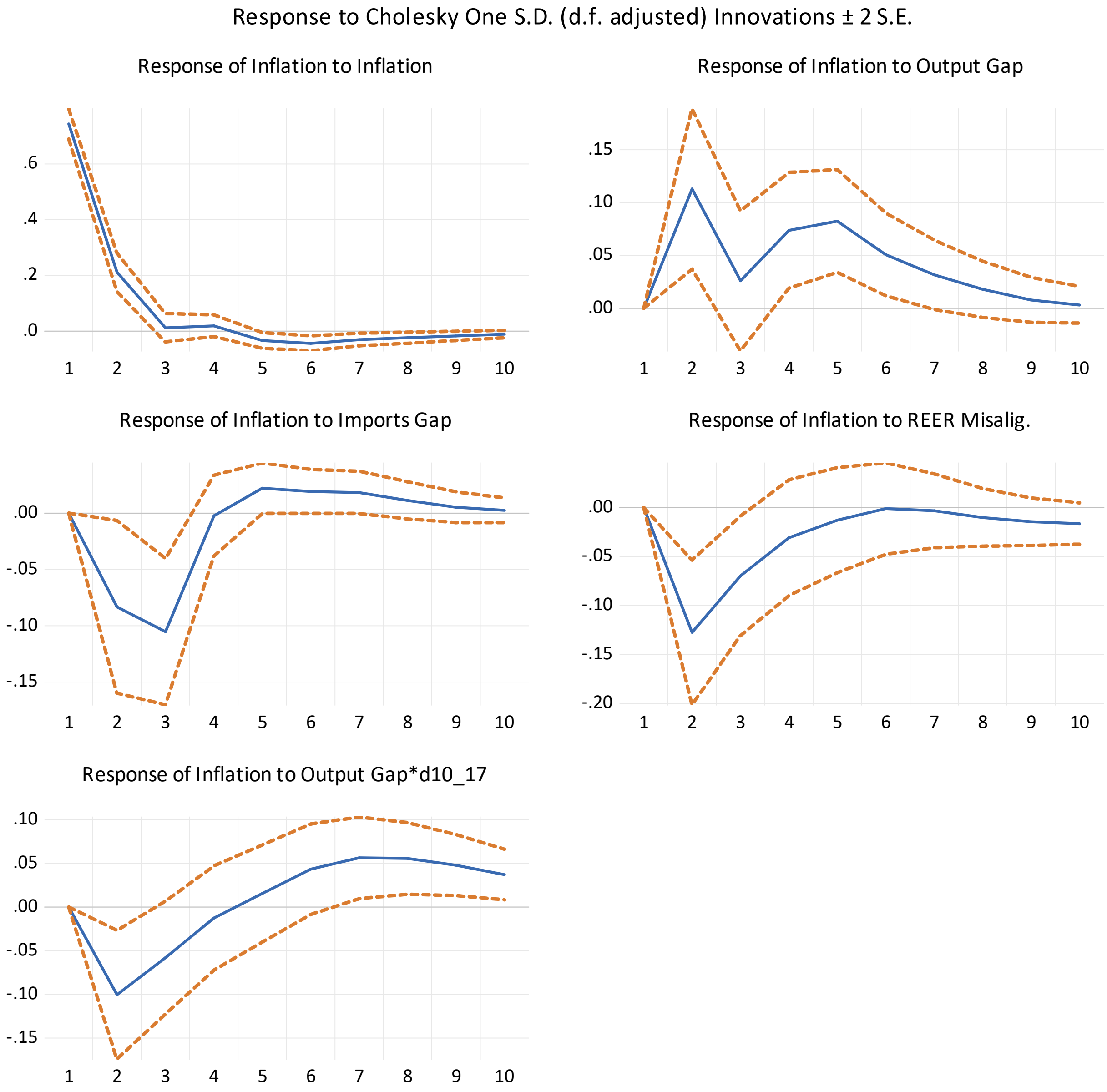

OEPC with a time dummy PVAR Residuals
Inflation Residuals
Output Gap Residuals
Import Deviation Residuals
REER Deviation Residuals
(Output Gap*D10_17) Residuals
Austria - 92
Belgium - 96
Canada - 00
Denmark - 04
Finland - 08
France - 12
Germany - 16
Italy - 94
Japan - 98
Netherlands - 02
Portugal - 06
Spain - 10
UK - 14

Figure 4: Impulse-response analysis



Solid lines represent impulse responses and dashed lines are standard error bands created by Monte Carlo simulations with 10,000 repetitions.

We perform an impulse response analysis repeating the previous procedure applied to the newly estimated PVAR, focusing again on inflation's response. Results, in Figure 4, show that the responses are very similar to the ones in Figure 2, and again consistent with both our theoretical approach and with the previous results. In regard of the output gap dummy for 2010-2017, the impulse analysis shows a negative effect for each period until the 4th one. Afterwards, the effects become slightly positive, reversing partially, but in coincidence when the output gap effects are also decreasing, which suggests that the global effects of the output gap after 2010 are smaller but could last longer than before. All in all, this impulse analysis shows that the effects of the output gap on inflation are smaller since 2010, and thus the slope of the Phillips curve is smaller. The output we obtain from this PVAR estimation can be considered a robustness proof of the Phillips curve for an open economy proposed in this chapter, since it reinforces the regression findings obtained in Section 3.2.2.

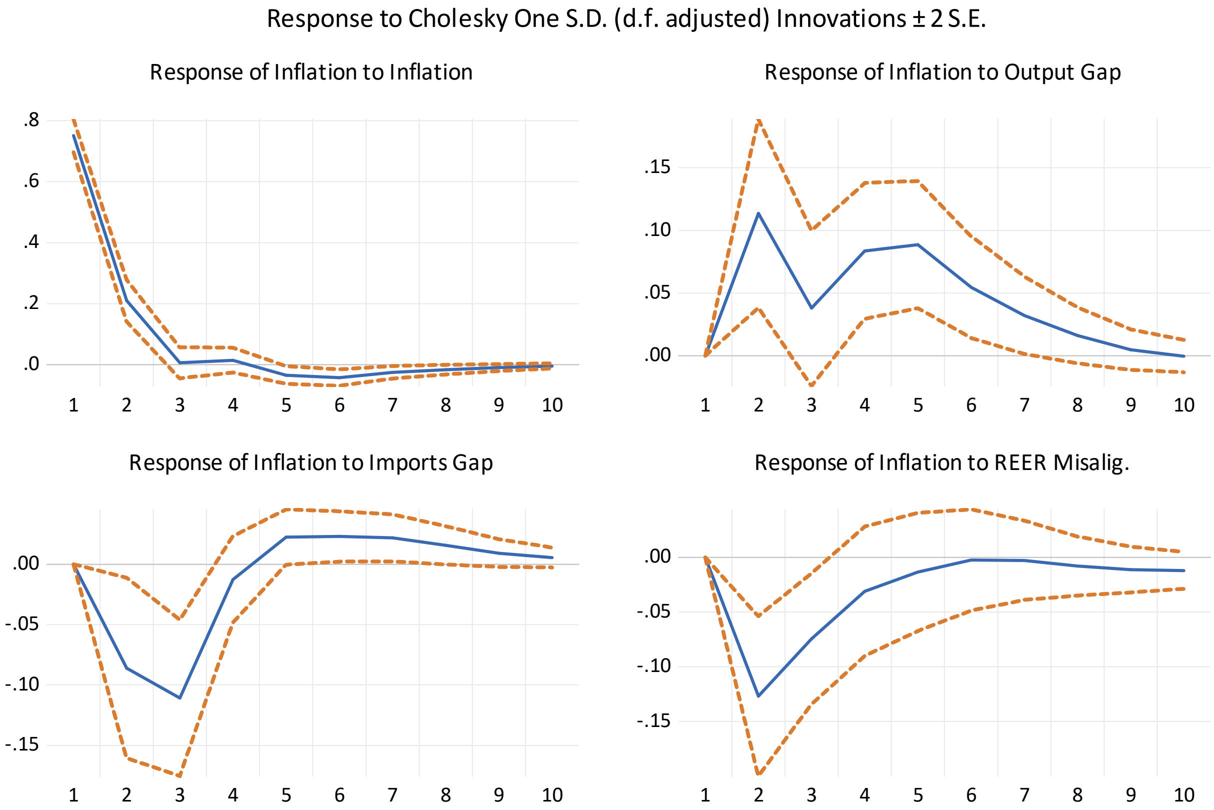
At this stage, some considerations regarding trade openness are in order. Since the economies of our sample have different degrees of *total* trade openness -even though they are relatively homogeneous in many other aspects– we find justified to check whether not considering explicitly total trade openness in our estimations has affected our results. For this purpose, we repeat the PVAR estimations presented in Table VIII including trade openness as an exogenous variable. Data on trade openness comes from the World Bank (details in Table I). As can be seen in Table XI, the new estimation maintains the sign and significance of the variables as in Table VIII, with no relevant change in the value of the estimated parameters and, most important, the degree of trade openness is not significant. In addition, the Impulse response analysis based on this VAR estimation (which follows the same methodology presented in the previous impulse response analysis in this chapter and which is available in Figure 5), is very similar to the one represented in Figure 2.

Table XI: PVAR Estimates
Open Economy Phillips Curve (OEPC) with trade openness

	domestic inflation	output gap	imports gap	REER misalig.
domestic inflation(-1)	0.274118	-0.773976	-2.753631	0.807969
	(0.04274)	(0.06987)	(0.27706)	(0.21461)
	[6.41298]	[-11.0775]	[-9.93886]	[3.76474]
domestic inflation(-2)	0.026834	0.189806	1.172634	-0.324800
	(0.03875)	(0.06335)	(0.25119)	(0.19458)
	[0.69242]	[2.99632]	[4.66827]	[-1.66924]
output gap(-1)	0.149874	0.933415	-0.604053	0.423497
	(0.03894)	(0.06366)	(0.25242)	(0.19553)
	[3.84853]	[14.6635]	[-2.39305]	[2.16589]
output gap(-2)	-0.074472	-0.152120	0.160837	-0.403313
	(0.03859)	(0.06308)	(0.25012)	(0.19375)
	[-1.92990]	[-2.41167]	[0.64303]	[-2.08161]
imports gap(-1)	-0.021394	0.032596	0.208448	-0.082099
	(0.00987)	(0.01613)	(0.06394)	(0.04953)
	[-2.16863]	[2.02142]	[3.25992]	[-1.65751]
imports gap(-2)	-0.026127	0.010346	-0.056813	-0.082063
	(0.00690)	(0.01128)	(0.04473)	(0.03465)
	[-3.78558]	[0.91709]	[-1.26999]	[-2.36816]
reer misalig.(-1)	-0.033697	0.006194	0.033651	1.110784
	(0.00950)	(0.01554)	(0.06161)	(0.04772)
	[-3.54533]	[0.39869]	[0.54622]	[23.2761]
reer misalig.(-2)	0.026678	-0.029396	-0.073895	-0.302138
	(0.00957)	(0.01564)	(0.06202)	(0.04804)
	[2.78803]	[-1.87941]	[-1.19141]	[-6.28870]
c	0.035704	-0.740775	0.613087	1.820975
	(0.12877)	(0.21048)	(0.83465)	(0.64654)
	[0.27727]	[-3.51938]	[0.73454]	[2.81649]
expected inflation	0.749963	0.806463	2.398563	-0.813864
	(0.05552)	(0.09076)	(0.35988)	(0.27877)
	[13.5073]	[8.88600]	[6.66481]	[-2.91943]
trade openness	0.000331	0.001724	-0.002884	-0.009553
	(0.00121)	(0.00199)	(0.00787)	(0.00610)
	[0.27208]	[0.86823]	[-0.36622]	[-1.56610]
R-squared	0.820719	0.787510	0.307643	0.774074
Adj. R-squared	0.815988	0.781904	0.289375	0.768113
F-statistic	173.4994	140.4615	16.84056	129.8542
Akaike AIC	2.292141	3.274918	6.030121	5.519364
Akaike information criterion		16.55820		
Schwarz criterion		17.00567		

Sample (adjusted): 1992 2017. Included observations: 390. Number of coefficients: 44. Standard errors in ( ) and t-statistics in [ ].

Figure 5: Impulse-response analysis



Solid lines represent impulse responses and dashed lines are standard error bands created by Monte Carlo simulations with 10,000 repetitions.

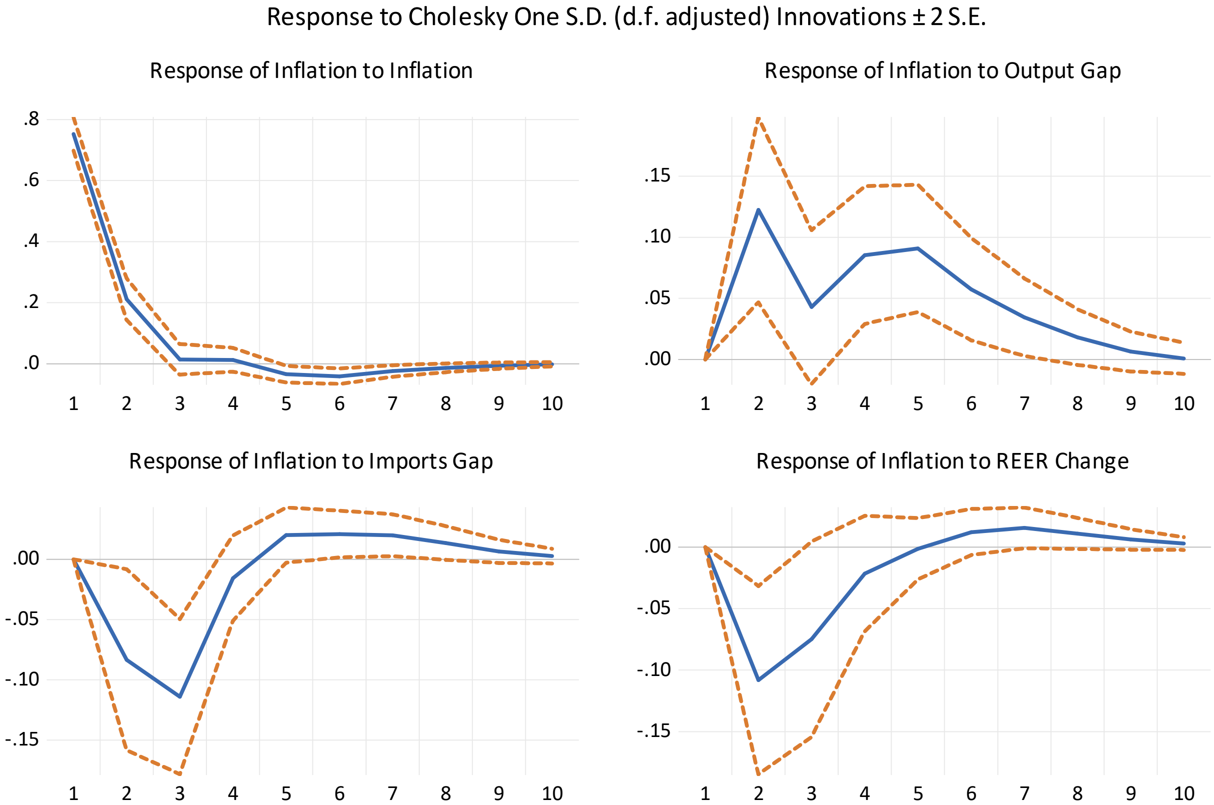
Finally, in order to gain additional robustness for our results, we have performed an alternative estimation using REER variations instead of REER misalignment, as considered in more traditional Phillips curves for open economies. Interannual REER changes were obtained from the World Bank database, details provided in Table I. As can be verified in Table XII and the impulse-response analysis in Figure 6, results are very similar to ones in Table VIII and Figure 2, including signs and statistical significance levels, which implies that most of the REER changes of the sample correspond to real exchange rate misalignment. The rest of the variables maintain their explanatory power, providing consistence to the Phillips curve estimated in this chapter.

Table XII: PVAR Estimates
Open Economy Phillips Curve (OEPC) with REER change

	domestic inflation	output gap	imports gap	REER change
domestic inflation(-1)	0.269535	-0.761039	-2.651384	0.634735
	(0.04333)	(0.07136)	(0.27951)	(0.23262)
	[6.22004]	[-10.6651]	[-9.48581]	[2.72858]
domestic inflation(-2)	0.034070	0.193525	1.116167	0.007438
	(0.03948)	(0.06501)	(0.25465)	(0.21194)
	[0.86299]	[2.97676]	[4.38309]	[0.03509]
output gap(-1)	0.160067	0.959965	-0.575126	0.605022
	(0.03864)	(0.06364)	(0.24926)	(0.20745)
	[4.14215]	[15.0855]	[-2.30734]	[2.91650]
output gap(-2)	-0.078756	-0.173443	0.104637	-0.442352
	(0.03852)	(0.06343)	(0.24847)	(0.20679)
	[-2.04449]	[-2.73425]	[0.42113]	[-2.13913]
imports gap(-1)	-0.021911	0.028823	0.195289	-0.049948
	(0.00991)	(0.01633)	(0.06395)	(0.05323)
	[-2.20993]	[1.76539]	[3.05365]	[-0.93843]
imports gap(-2)	-0.026134	0.009609	-0.052194	-0.094206
	(0.00693)	(0.01141)	(0.04467)	(0.03718)
	[-3.77331]	[0.84253]	[-1.16831]	[-2.53375]
REER change(-1)	-0.026850	0.017767	0.065303	0.241069
	(0.00922)	(0.01518)	(0.05948)	(0.04950)
	[-2.91172]	[1.17002]	[1.09792]	[4.86987]
REER change(-2)	-0.006283	-0.006198	0.063683	-0.144582
	(0.00930)	(0.01531)	(0.05998)	(0.04992)
	[-0.67565]	[-0.40476]	[1.06166]	[-2.89615]
C	0.036907	-0.672062	0.325076	0.388919
	(0.08465)	(0.13940)	(0.54603)	(0.45444)
	[0.43598]	[-4.82115]	[0.59535]	[0.85583]
expected inflation	0.753487	0.816046	2.410846	-0.774062
	(0.05576)	(0.09181)	(0.35964)	(0.29931)
	[13.5141]	[8.88800]	[6.70354]	[-2.58614]
R-squared	0.819302	0.782638	0.308940	0.138083
Adj. R-squared	0.815023	0.777490	0.292573	0.117669
F-statistic	191.4399	152.0262	18.87558	6.764170
Akaike AIC	2.294882	3.292459	6.023117	5.655894
Akaike information criterion		16.70235		
Schwarz criterion		17.10914		

Sample (adjusted): 1992 2017. Included observations: 390. Number of coefficients: 40. Standard errors in ( ) and t-statistics in [ ].

Figure 6: Impulse-response analysis



Solid lines represent impulse responses and dashed lines are standard error bands created by Monte Carlo simulations with 10,000 repetitions.

3.3. Main conclusions and policy implications

The main task in this chapter has been to derive a Phillips curve for a small open economy in which, in addition to the traditional output gap and inflation expectations, two external variables play an important role: the gap between current and long-term imports growth, which we call the imports gap, and misalignment of the real exchange rate, the REER misalignment. The two econometric methodologies applied in the frame of 15 industrialized countries, panel regressions and PVAR estimations accompanied by impulse response analysis, coincide to show that the degree of imports opening and international relative prices have been key in making inflation quiescent in advanced countries over the last three decades. They also indicate that the sensitivity of inflation to domestic slack has decreased after the Great Recession, thus flattening the Phillips curve during this period, probably as a result of the globalization's drive in recent years.

Flat Phillips curves have important implications for the design and implementation of monetary and fiscal policies. In principle, as inflation is less sensitive to output, it is less likely to spiral out of control when output deviations occur. But, by the same token, raising inflation to bring it closer to the central bank's target would require very large changes in cyclical output and employment. These outcomes point to the desirability of extra flexibility in the inflation targeting framework in the sense of granting additional weight to output stabilization. Finally, the influence of external factors on the Phillips curve also highlights the relevance of a careful design of trade policy, which takes into consideration not only sectorial effects, but also the structural impact on price formation and other macroeconomic outcomes.

Additional policy implications emerge when, as seen in advanced countries in the post crisis period, flat Phillips curves are coupled with interest rates that are at, or near to, the zero lower bound (ZLB). In that situation, the central banks' ability to fight recession with conventional monetary weapons – i.e. cutting the interest rate – is seriously curtailed. Moreover, if the inflation target is maintained, flatter Phillips curves make it very difficult for central banks to meet their inflation objectives since monetary policy alone cannot lift inflation by boosting economic activity. These features warrant raising the inflation target and/or, as suggested by Rogoff (2020), finding ways to strengthen the effectiveness of monetary policy in a low interest-rate environment, including using negative rates more fairly and effectively.

On the other hand, recent works show that the government spending multiplier increases significantly as the Phillips curve flattens and when interest rates are at, or near, the ZLB. In that case, fiscal policy is particularly effective in shifting the aggregate demand[7]. In addition, the effectiveness and usefulness of a decidedly expansionary fiscal policy has gained even more strength in all advanced countries after the recessionary impact created by the coronavirus pandemic.

[7] Using a panel with many countries for a large temporary sample, Klein and Winkler (2018) demonstrate that the public spending multiplier is approximately 1.5 when interest rates remain at, or near, the zero-lower bound, and fall below 1 when economies are out of that context. Miyamoto, Lan Nguyen and Sergeyev (2018) get very similar results for Japan.

Main conclusions

Main conclusions

The objective of this thesis is to shed light on the interaction between external and internal macroeconomic variables and external sector stability. This topic is crucial since international economic integration is transforming our economies, affecting macroeconomic policies and outcomes. Therefore, it is key to have a deep understanding of such interactions in order to design sound economic policies that foster strong and stable economies.

The estimations in this thesis provide a series of observations about the consequences of international economic integration and the interaction between domestic and external imbalances. Specifically, results in the first chapter expose that world economies registered a higher number of breaks during the XXI century than at the end of the XX century, with a peak around the years of the Great Recession. These breaks are relatively evenly distributed between the four different positive/negative breaks in slope/level combinations. An interesting finding is that the average change in both slope and mean doubles when they change in opposite directions (positive/negative or negative/positive) in comparison with a change in the same direction (positive/positive or negative/negative). Only 27% of breaks occurred when the economy was in a surplus period and, in this case, breaks reduce the current account mean significantly, by -4.41% of GDP on average. Thus, 73% of breaks happened when economies registered a structural current-account deficit, suggesting that structural current account deficits present higher break risks.

Regarding the 341 stability spells identified, half of them lasted 10 years or less and their volatility tends to increase when the current account diverges from its equilibrium. An analysis of the spells shows that they have different characteristics depending on countries' income levels and location. High-income countries have an average structural current-account surplus in their spells of 0.69% of GDP, while low-income countries have a major average structural deficit of -5.95% of GDP. Additionally, Asia & Pacific registers a moderate surplus in their spells, Sub-Saharan Africa presents a major average deficit, -7.01% of GDP, while Europe, North America and Latin America & Caribbean show moderate average deficits and lower volatility. Results thus confirm the idea that advanced economies present more balanced and stable current-account figures while, on the other extreme, Sub-Saharan Africa registers high current account deficits and high volatility.

The analysis of the determinants of the breaks indicates that an increase in growth levels, higher real interest rates, larger foreign reserves and currency depreciation reduce break risks, while lower income levels increase these risks. Furthermore, income per capita, FDI net inflows, real interest rates and the level of foreign reserves have a positive impact on the level change after a break.

The empirical estimations in the second chapter show that current accounts and domestic output gaps present an inverse relationship with bilateral causality links. Additionally, shocks on REER misalignments have the opposite effect on current accounts and output gaps, while a positive shock in the current account depreciates the REER and stimulates economic growth. Another key finding is that higher growth levels in an economy result in real exchange-rate appreciations, supporting the Balassa-Samuelson hypothesis.

Finally, results in the third chapter of this thesis indicate that the Phillips curve has flattened after the Great Recession, reinforcing the idea of a reduction in inflation's sensitivity to domestic slack. They also reveal that foreign competitive pressures, considered through the level of imports opening and real exchange rates, have helped to curb inflation in advanced economies over the last three decades since they reduce the pricing power of domestic firms.

Regarding policy considerations, results in the first chapter indicate the following policy implications: First, promoting growth and increasing foreign reserves are especially effective to reduce break risks. Indeed, a sustainable economic boost through structural reforms could be particularly successful to enhance external stability. Second, low-income countries should pay especial attention to external stability since they are particularly exposed to break risks. Lastly, contractive monetary policy can reduce breaks risks, however it requires a careful design and application since, if this measure also causes a currency appreciation, it could be ineffective, or even counterproductive.

Results in the second chapter indicate that policies that promote REER undervaluation help to curb current account deficits and increase cyclical economic growth, with the opposite also being true. Furthermore, implementing measures to boost the output gap can reduce current account figures, facilitating higher deficits. Likewise, policies that increase the current account balance, such as successful export promotion or import substitution policies, could have a relevant positive impact on both potential output and economic growth.

Finally, the findings in the third chapter show that macroeconomic policies need to be more ambitious in order to have impact on inflation due to the flattening of the Phillips curve. Results also reinforce the idea that policymakers should consider the impact of external variables in the design of macroeconomic measures since, among other effects presented in this thesis, relevant foreign competitive pressures reduce the risks of output deviations causing inflation spiraling out of control.

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