NOTAS E CONÓMICAS 55

Imprensa da Universidade de Coimbra
Coimbra University Press

Faculdade de Economia da
Universidade de Coimbra

Informações aos autores (Submission guidelines)
https://impactum-journals.uc.pt/notaseconomicas/about/submissions

Publicação resumida e indexada por (Indexing and Abstracting)
EconLit
RePEc
REDIB
latindex

Design
Imprensa da Universidade de Coimbra

Execução gráfica
BOOKPAPER

Tiragem 200 exemplares

Propriedade
Faculdade de Economia
Universidade de Coimbra
Av. Dias da Silva, 165
3004-512 Coimbra

Apoios (Sponsors)
Esta publicação é financiada por fundos nacionais através da
FCT – Fundação para a Ciência e a Tecnologia, I.P.,
no âmbito do projeto UIDB/05037/2020

FCT Fundação para a Ciência e a Tecnologia

Número avulso
Portugal 7,5 €
Outros países 15 €

Condições de assinatura bienal
Portugal: 20 €
Outros países: 40 €

ISSN 0872-4733

ISSN Digital 2183-203X

DOI https://doi.org/10.14195/2183-203X_55

Depósito Legal 64932/93

Contents

Articles

Letters

J. Ignacio Conde-Ruiz
FEDEA (Fundación de Estudios de Economía Aplicada)
and Universidad Complutense de Madrid
nacho.conderuiz@gmail.com
orcid.org/0000-0002-9074-7313
Eduardo L. Giménez
Universidade de Vigo
RGEAF (Research Group in Economic Analysis,
Accounting and Finance) and ECOBAS (Economics and
Business Administration for Society)
egimenez@uvigo.gal
orcid.org/0000-0002-3089-854X

DOI: https://doi.org/10.14195/2183-203X_55_1

The Changing Roles of Young Single Women in Jordan Before the Great Recession: An Explanation Using Economic Theory

A Alteração do Papel das Mulheres Jovens Solteiras na Jordânia Antes da Grande Recessão: Uma Explicação com Base na Teoria Económica

J. Ignacio Conde-Ruiz
Eduardo L. Giménez

Received for publication: February 10, 2022
Revision accepted for publication: April 28, 2022

ABSTRACT
Before the Great Recession (i.e., the 2008 Financial Crises), young single women in Jordan, as in other Middle Eastern and North African countries with a strong Islamic cultural tradition, experienced important changes in social roles. In this paper, we claim that economic theory may help to understand some of these changing patterns. It is argued that the liberalization of the Jordanian economy resulted in important changes in Jordanian social norms regarding gender roles, school enrollment, labor participation, marriage and fertility. In particular, three apparently disconnected contemporaneous developments may be interrelated: increase in the average age of women at marriage, enhanced participation of young single women in the labor market, and higher unemployment rate among young men. This process stopped in the late 2000s, both due to exogenous factors (the Great Recession after 2008 and the Syrian civil war in 2011) and endogenous reasons (existing attitudes towards working women). We argue that economic conditions may play a role as the driving forces for social transformation, and open a window to women's opportunities and empowerment.
Keywords: Young single women; gender discrimination; marriage; Jordanian society; social norms; social economic transformation.

JEL Classification: J12; J16; N35.

Acknowledgement: We are grateful to Mary Kawar for useful comments and suggestions, and to the participants of the Second Mediterranean Social and Political Research Meeting (Firenze), the II Xornadas sobre Xénero e Mercado de Traballo (Vigo), and 17th Conference of the International Association for People-Environment Studies (A Coruña). Financial support from Cátedra Caixanova de Estudios Feministas is acknowledge by both authors, and from Spanish Ministry of Science and Innovation projects PID2019-105499GB-I00 and PID2020-118119GB-I00 are acknowledged by the first and the second authors respectively.

1. Introduction

Before the Great Recession (i.e., the Financial Crises 2008), young single women in Jordan, like those in other Middle Eastern and North African (MENA) countries with a strong conservative social norms, experienced important changes in their social roles. Kawar (2001) examined women's life cycle, their economic opportunities, and the nature of the social norms in Jordan.[1] She reported an ever-growing trend in the 90s of young women joining the labor market, becoming an additional source of income for their families, and also getting married at a later stage and having fewer children than their antecessors. This trend has roughly continued at the beginning of the 21st century, although with some disparities, among MENA countries: both women's female labor force and age at marriage have been rising, while the fertility rate has been falling (see Figures 1, 2 and 3 and Table 1). [2, 3] Some authors view these changes as the dawn of an Islamic women's revolution defying the social contract (e.g., Omar, 2001, p. 16), like that previously witnessed in Western societies.

In this note, we claim that economic theory may help to understand some of these changing patterns. It is argued that the economic developments of the Jordan economy in the 1980s, together with the subsequent liberalization and openness process in the 1990s, resulted in important changes in Jordanian social contract regarding gender roles, school enrollment, labor participation, marriage, and fertility. In particular, three apparently disconnected contemporaneous developments may be interrelated: the increase in women's marriage age, the growth of young single women's participation in the labor market, and the increase in the young male unemployment rate.

Initially, we review the most important features of Jordanian society (Section 2) and the socioeconomic changes taking place from the 1980s to the Great Recession (Section 3), both described in the Kawar paper. Next, we use economic theory to understand the changing roles of young single women in Jordan before the Great Recession in Section 4. We evidence that economic transformations affected the traditional social norms in Jordan.

These changes and trend stopped in the late 2000s because of several reasons, both exogenous (e.g., the Recession of 2008 and the Syrian civil war) and endogenous (e.g., attitudes towards working women). We review the evidence of this broken trend in the concluding Section 5. As a suggested lesson of this work, we argue that economic conditions may play a role as the driving forces for social transformation, and opens a window for women's opportunities and empowerness. In addition, as these economic conditions vanish, social transformation stops, then negatively affected women.

---

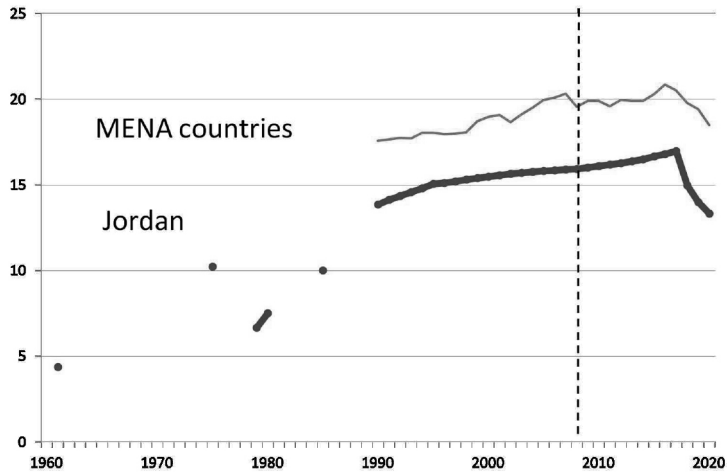
[1] She describes the results of a 1997 survey interviewing 302 households in 14 locations across the city of Amman. The questionnaire explored family relations, income distribution and management, life and work history, social activity, and views on marriage and work. It was administered to single women between 20 and 30. These women were working, unemployed, or non-working, but not enrolled in education.

[2] Sources of all figures can be found in Appendix A.2.

[3] The literature has proposed different explanations for the low female employment rates in Jordan. For instance, Kasoolu et al. (2019) suggest traditional social norms and poor public transportation. Al Khatib (2020) indicates that females are at a greater disadvantage compared to males because of three main reasons: "*the lack of jobs in the private sector, [...] the negative perception within the Jordanian population towards vocational training, [and] the way employers perceive females is one of the obstacles attributing to joblessness among Jordanian women.*" Women are perceived as a liability since they may suddenly leave their job and are 'at the risk of being married at any time'.

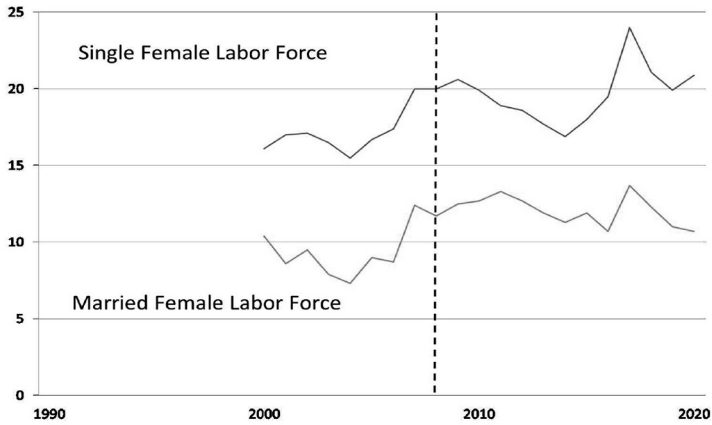
Figure 1: Female labor force in Jordan

(a) Female labor force participation rate, 1960-2020



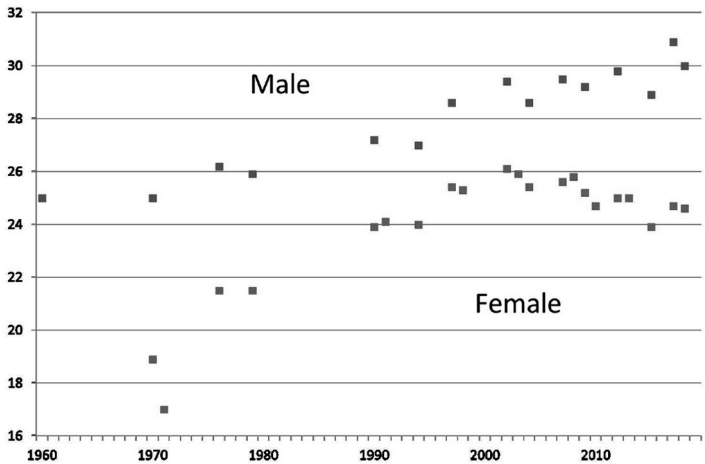
Note: Female Labor Force is given as a percentage of female population over 15 in Jordan and the MENA countries, and Female Labor Force age 14-25 in Jordan.
Source*:* World Bank (2022a,2022b) and Shakhatreh (1995, Table 7.1).

(b) Single and married female labor force, 2000-2020



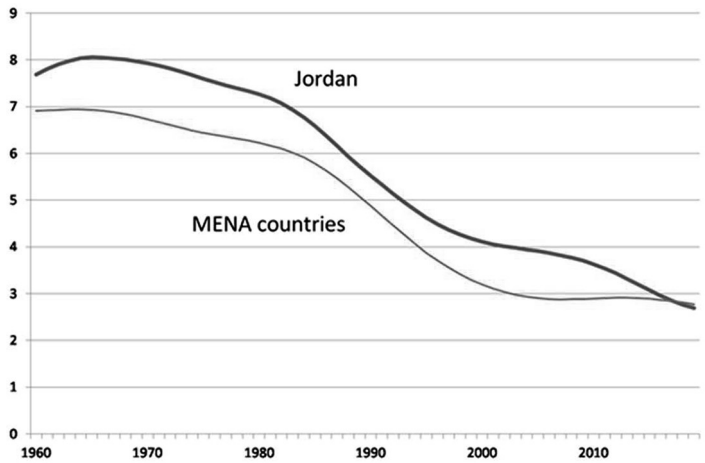
Source*:* Department of Statistics (2022c, Table 5.1, 2022d).

Figure 2: Age of marriage in Jordan, 1960-2018



Source*:* United Nations (2019, Sheet SMAM), Miles (2002, p. 416), Courbage (1999, Table 3) and Department of Statistics (1999).

Figure 3: Fertility rate, 1960-2019



Note: Births per women in Jordan and the MENA countries.
Source*:* World Bank (2022c).

Table 1: Female labor force (% of total labor force), mean age at marriage and Fertility rate in MENA countries

	Female Labor Force				Mean age at marriage						Fertility rate						
	1990	2000	2010	2020	1960s	1970s	1980s	1990s	2000s	2010s	1960-65	1970-75	1980-85	1990-95	2000-05	2010-15	2015-19
Algeria	12,4	14,0	16,9	19,3		21	23,7	25,9	29,5	28,3	7,6	7,5	6,2	4,0	2,4	3,0	3,0
Bahrain	17,7	21,4	21,0	19,4			25,5	26,6	26,3	26,9	7,2	5,9	4,6	3,4	2,6	2,1	2,0
Egypt, Arab Rep.	24,1	22,3	23,5	18,7		21,4	21,4	22,3	22,9	22,3	6,6	6,0	5,4	4,1	3,1	3,4	3,3
Iraq	9,8	11,4	14,4	13,3			22,3	24	25,3	22,7	6,7	7,2	6,3	5,6	4,7	4,2	3,7
Jordan	16,3	18,4	20,1	17,5	18	21,5	21,5	24	25,4	24,6	8,0	7,7	6,9	5,0	4,0	3,3	2,8
Kuwait	26,4	26,7	27,6	24,5	19,6	20,5	21,7	25,2	27,5	25,7	7,3	6,6	4,8	2,7	2,6	2,1	2,1
Lebanon	22,0	23,4	24,2	24,5				27,9	27,8		5,6	4,6	3,7	3,1	2,1	2,1	2,1
Libya	28,4	32,1	34,7	35,8		18,7	23	29,2			7,4	8,1	6,6	4,1	2,6	2,4	2,3
Mauritania	29,6	30,2	30,9	30,8	19,5	19,5	20,5	23	22	21,8	6,8	6,7	6,3	5,7	5,3	4,8	4,6
Morocco	22,9	25,2	26,9	25,7		22,2	24	26,3	26,4	24,4	7,1	6,4	5,3	3,6	2,6	2,6	2,4
Oman	16,0	17,6	15,9	12,3			20,7	21,7	24,8	25,6	7,3	7,5	8,3	6,1	3,2	2,9	2,9
Qatar	14,7	16,7	11,6	13,8			22,7	25,3	25,8		7,0	6,7	5,3	3,7	2,9	2,0	1,9
Saudi Arabia	11,0	13,9	14,8	20,9			21,7	24	24,1	26,6	7,2	7,3	6,9	5,4	3,6	2,7	2,4
Sudan	24,0	28,4	29,3	29,9		21,4	24,1	22,7	24,2	21,9	6,8	6,9	6,6	6,0	5,3	4,7	4,4
Syrian Arab Rep.	18,5	20,4	15,2	18,2	20,7	22,2			25,4		7,5	7,5	6,7	4,8	3,9	3,1	2,8
Tunisia	22,9	25,0	26,9	28,3		22,6	24,3	26,6	28,7	28,2	7,0	6,3	4,8	2,9	2,0	2,2	2,2
United Arab Emirates	11,0	12,1	11,5	16,7		18	23,1	24,4	25,3		6,9	6,4	5,3	3,8	2,3	1,7	1,4
Yemen, Rep.	19,5	22,6	12,9	8,3		18	18,3	20,5	22,2	22,8	8,0	8,5	8,8	8,0	5,8	4,3	3,8
MENA countries	17,9	19,8	20,4	19,6							6,9	6,6	6,0	4,3	3,0	2,9	2,8

Notes: The *Mean age at marriage* for each decade is taken from different surveys found in United Nations (2019) and carried out in particular years, so the data is the closest to the decade. For the *Fertility rate*, we have computed the average value of five-period year.
Sources: World Bank (2022a) for Female Labor Force as % of total labor force; United Nations (2019, Sheet SMAM) for Age of Marriage (except average of Kawer (2001), p. 2, and Courbage (1999), Table 3, for 1960s); World Bank (2022c) for Fertility rate.

2. The Traditional "Social Norms" in Jordan

According to Kawar (2001), the Jordanian tradition treats sons and daughters differently. Tradition assigns sons three main roles. He must marry a woman in exchange for a mahr.[4], [5] Besides, in Jordanian marriages, the groom and his family contributed almost all of the cost of marriage, which includes the jewelry, housing and furniture costs, and celebration costs (see Salem, 2014, Sec.7.8, and Sieverding et al., 2019, Sec. 2.5).

As a second role, a son must also be an income support for his own (new) family, as men have to be "capable of fulfilling their traditional roles as providers [...] for their brides as is the tradition" (Kawar, 2001, p. 7). Finally, as a third role, a son must take care of his elderly parents later in live: "Unlike daughters [...] parents consider their sons as their old-age security." (Kawar, 2001, p. 15). Kawar (2001, p. 16) indicates that the income support role is why parents "cultivate their son's loyalties" both by "expanding [their sons'] economic opportunities [...] not only ensure a better future for sons but also for parents," and by permitting them "more social freedom than daughters" (p.16) and accepting that "they need to spend on recreational activities".

As for daughters, tradition assigns them two roles. First, "daughters are expected to marry and live elsewhere." (Kawar 2001, p. 15) They are expected to be married early, as "[T]he acknowledged stages of Arab women's life cycles excludes youth and single adulthood." (Kawar 2001, p. 21) Second, daughters are expected to remain under patriarchal hierarchy, dependent and under control, as "The persistence of the male breadwinner ideology [means that] women still need to depend on a male guardian throughout the different stages of their lives, be it father, brother, husband or son." (Kawar 2001, p.17)

Observe, therefore, that sons –and not daughters– are also expected to take care of their mothers as their old-age security. Usually, a daughter has her social life restricted by her parents, as "[Y]oung men and women are not supposed to get to know each other outside of the family domain." (Kawar 2001, p. 23) with lacks income control ("[T]raditionally gold jewellery is one of the only form of wealth that women had exclusive ownership rights." Kawar 2001, footnote 5,) and marriage arrangements "[P]arents' attitudes [are that] marriages are arranged and security and reputation rather than love is important." (Kawar, 2001, p. 23). Very often control goes beyond marriage, since marriage arrangements are arrived at with relatives to keep daughters within the family domain. This is why "young women [...] prefer to marry non-relatives so that they will have new lives outside of their communities which they often perceive as less constraining." (Kawar 2001, p. 22).

[4] A *mahr* – or *dower* in English – is the obligation, in the form of money or possessions paid by the groom, to the bride at the time of Islamic marriage (Spies, 1991). This income or wealth is solely received by the bride, so it is different from other social traits concerning marriage, such as the *bride price* (the income or resources paid by the groom or the groom's family to the bride's parents) or the *dowry* (the income or resources brought forth to the marriage by the bride, usually provided by the bride's parents or family).

[5] "[S]ons have to save in order to get married. In Jordanian society a man is expected to provide brideprice as well as housing upon marriage. Therefore, marriage is costly for men and it is customary for parents to facilitate their sons' marriage through financial help. This [...] makes the marriage of a son a costly affair that involves all family members." (Kawar, 2001, p. 16). In many cases, son marriage is arranged, as "Traditionally, parents prefer to arrange their children's marriages whether for sons or daughters." (Kawar, 2001, p. 22).

To summarize, the Jordanian traditional "social norms" assigns the subjection of women, first to her family, then to her husbands, and, later in life, to her sons.

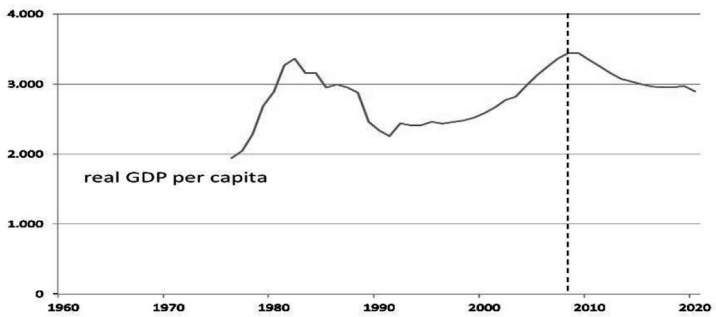
3. Social and Economic Transformation in Jordan Before the Great Recession

In this section, we review the most important features of the socioeconomic changes taking place in Jordan before 2008.

3.1. Economic and social conditions

The economy of Jordan is classified as an emerging market economy. Concerning economic conditions, the Jordanian economy presented two main milestones for the thirty-year spell previous to the Great Recession.[6] The first period encompasses the two decades previous to 1990. Living standards rose strongly in Jordan in the period 1972-1982 (Figure 4). But the decline in foreign aid after the oil crash in 1983 was not matched by substantial budgetary cutbacks. Jordanian GNP stagnated between 1982 and 1987, and the economy ended in an economic and financial crisis in 1988 with an external debt default. This crisis brought with higher prices and falling wages[7] (see Figures 5 and 6). Accordingly, living standards dropped sharply during most of the 1980s (Figure 4).

Figure 4: Real GDP per capita in Jordan (2016 Jordan Dinars)

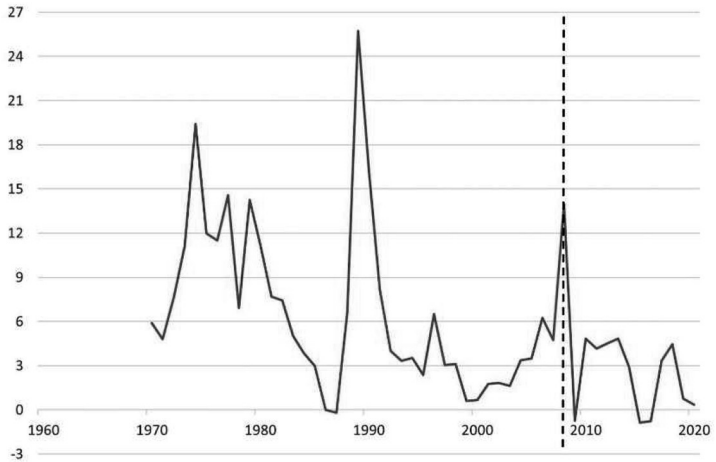


Source: World Bank (2022d).

[6] For a more detailed description of the evolution of Female Labor Force Participation in this period, see Boustati (2020, Sec. 5).

[7] There is no official series of average wages for the Jordan economy. Although there exists a series of compensation of employees from 1976 at the National Accounts, no long series for labor participation and the number of employees are available. In Appendix A.1, we constructed a series for the average real wage per worker in Jordan from 1976 to 2019.

Figure 5: Inflation, consumer prices (annual %)



Source: World Bank (2022d).

Figure 6: Average real wages (2016 Jordan Dinars)

Source*:* Own computations from Department of Statistics (2022a, 2022b) and World Bank (2022d) (see Appendix A.1).

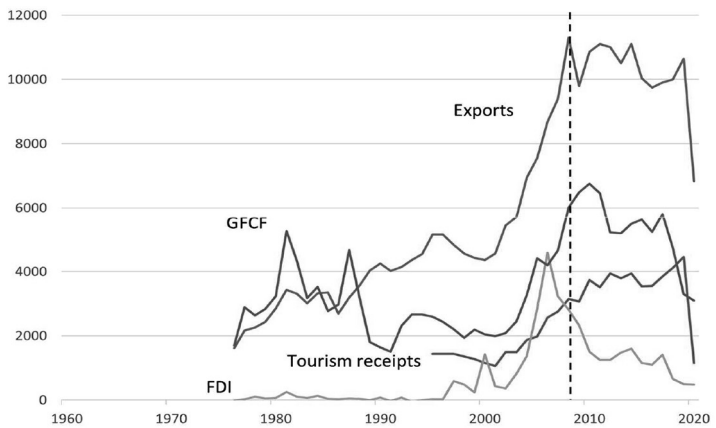
The second period begins after 1990. The Jordanian economy embarked on a route of 'liberalization' and 'global integration' (see Kardoosh, 2019), which attracted both foreign and domestic investment (Figure 7), and created new job opportunities. As a result, there was

a spectacular increase in per capita GDP by 47% from 1990 to 2008. Growth was mainly reported in manufacturing industries and technology-related fields. However, the adjustment of the Jordanian economy to the new open and liberalized environment brought with some detriments; in particular, the unemployment rate was higher for both women, 28,7%, and men, 11,6% in 1995 (Figure 8).

Concerning economic conditions, in the 1990s and 2000s, Jordanian society was amid a demographic transition (Figure 9).[8] The mortality rate declined, as a result of improved health care, while the average number of births per woman in Jordan had been declined from 7,7 in the period 1970-75 to 4 within 2000-2005 (Figure 3 and Table 1). The age structure reveals that 21,6% of the Jordanian population was between 15-24 years old in 1990, and a third of the working population was in that same group (Figures 10 and 11(a)); these numbers were reduced to 19.8% and 29% by 2008, respectively (see World Bank 2022c).

Figure 7: 'Liberalization' and "global integration" in Jordan after 1990s.

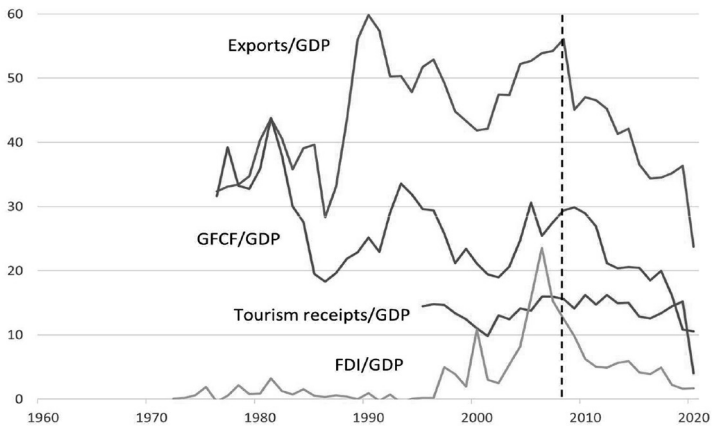
(a) Exports, Gross Fixed Capital Formation, Tourism receipts and Foreign Direct Investment (in 2016 constant millions Jordan Dinars).



Source*:* World Bank (2022d).

[8] See Chesnais (1992) for an excellent theoretical and empirical exploration of the theory of demographic transition.

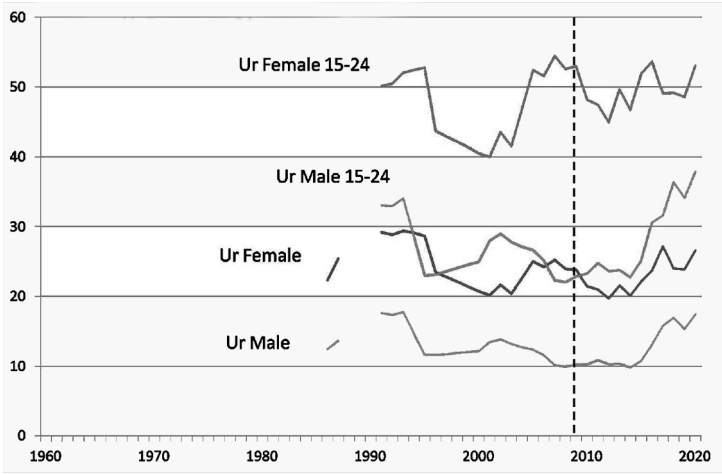
(b) Percentage of Exports, Gross Fixed Capital Formation, Tourism receipts and Foreign Direct Investment with respects of GDP.



Source*:* Own computations from World Bank (2022d).

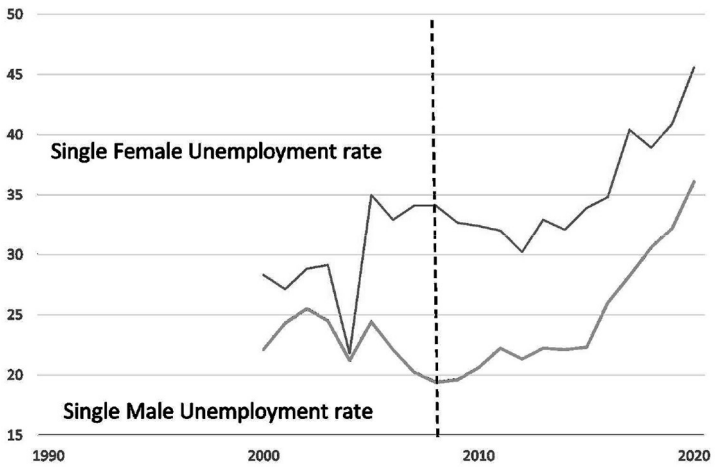
Figure 8: Unemployment rate in Jordan

(a) Unemployment rate in Jordan, 1986-2020 for female and male (total and ages 15-24).



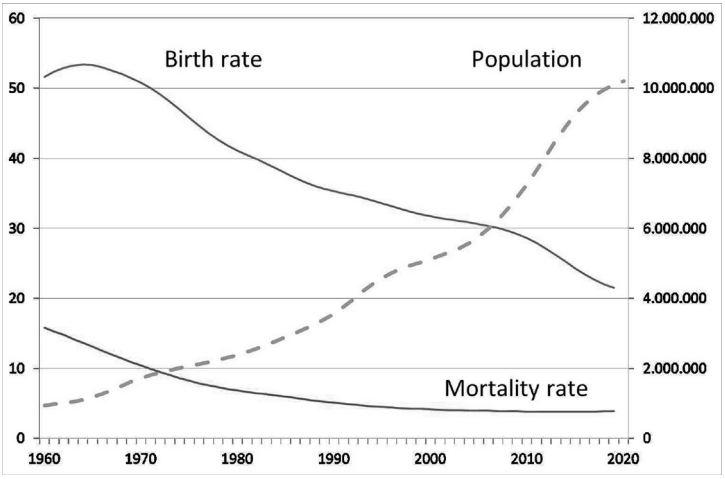
Source*:* World Bank (2022d).

(b) Single Unemployment rate, 2000-2020.



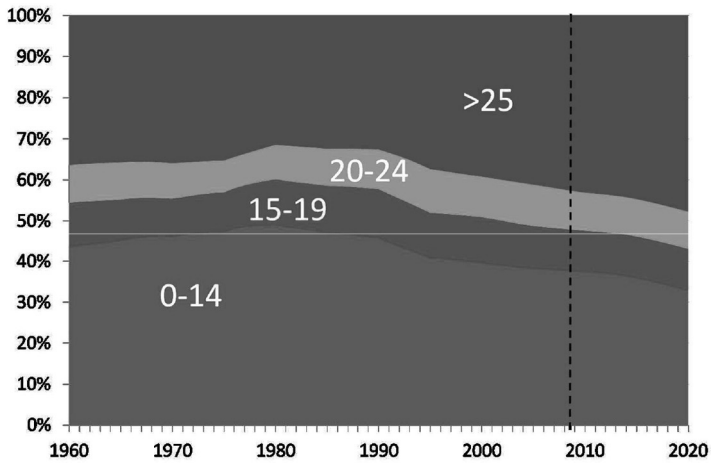
Source*:* Department of Statistics (2022c Table 2.6, 2022d).

Figure 9: Demographic transition in Jordan, 1960-2020



Note: Left scale: Crude birth rate (per 1,000 people) and Death rate, crude (per 1,000 people); Right scale: Population, total.
Source*:* World Bank (2022d).

Figure 10: Age Structure in Jordan, 1960-2020. In 1990, 67,4% of the population in Jordan was below 24 years old, while it was 52.3% in 2020



Source*:* World Bank (2022d).

Figure 11: Jordanian female and male ages 15-24 and the labor market, 1961-2020

(a) Employment (ages 15-24) over Employment (Total) (%) in Jordan, 1990-2020

Source*:* World Bank (2022d).

(b) Female and Male Labor force participation rate for ages 15-24 (%) in Jordan, 1961-2020

Source*:* World Bank (2022d).

3.2. The changing economic environment for women: participation in the labor market

Jordanian women took a more active role in economic activities outside the household in the 1990s and 2000s. There are three features of these women who were incorporated into the labor market (see Kawar 2001, pp. 2-3, 5): they were young, highly educated, and single. First, they were young: women ages 15-24's participation increased from 5.7% in 1961 to about 14% by 2000 (Figure 11(b)); and, among actively working women in 2000, 48.9% were below 30 (Figure 12). Second, they were highly educated: women's illiteracy rate decreased from 48% in 1979 to 10.1% in 2007; and, concerning young females ages 15-24, the illiteracy rate was below 15% from the 1970s and almost non-existent on the 21st century (Figure 13). Perhaps surprisingly, Jordanian women outstrip men in studying secondary and tertiary education since 1990 (Figure 14).[9]

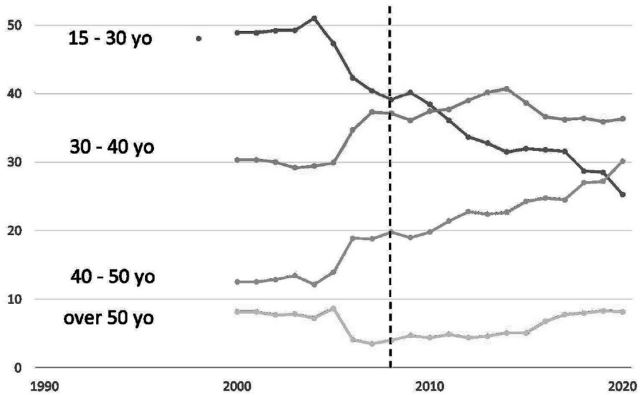
Finally, they were single. Both Jordanian women and men have been delayed marriage: the average age of marriage for women increased from 17 in 1971 to 25.4 in 2004 (see Department of Statistics 1999 – cited by Kawar, 2001, p. 2 – and United Nations 2019, respectively), while the average age for men increased from 25 to 28.6 in the same period (Figure 2). In addition, single women comprised over 50% of economically active women in Jordan before 2008 (Figure 15).[10] These developments have been of crucial interest and led

[9] In the survey carried out by Kawar (1997) in Amman, 82% of daughters have a secondary degree (compared to 68% for sons). In fact, daughters are customarily the most highly educated in their families.

[10] Concerning previous decades, Shakhatreh (1995, p. 138, cited by Omar, 2001, p. 116) found a higher percentage at the beginning of the 1980s: in the 1982-83 Manpower Survey of Households, carried out by the Department of Statistics (Jordan), single women formed 65.2% of economically active women. Tubbeh (1994, Table V) found a

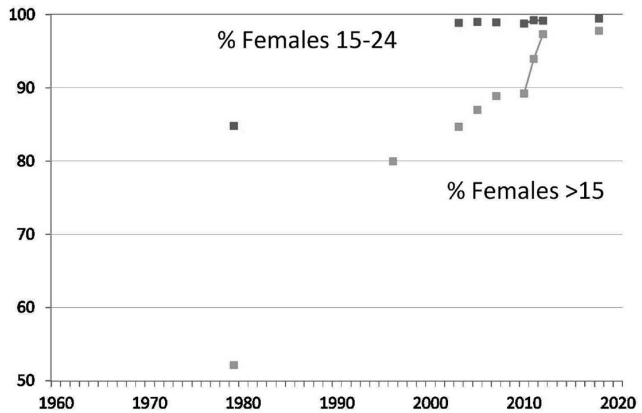
some authors, like Omar (2001, p. 11), to suggest that "*with Islam as the predominant religion, women's choice to delay marriage could be seen as a challenge to the religious status quo*", given that within the Islamic tradition "*marriage holds a primary place from a religious perspective*".

Figure 12: Female Employed Persons by broad Age Groups, 1998-2020, in percentage



Source*:* Department of Statistics (2022c, Tables 4.1 and 5.1) and Kawar (2001, p. 2).

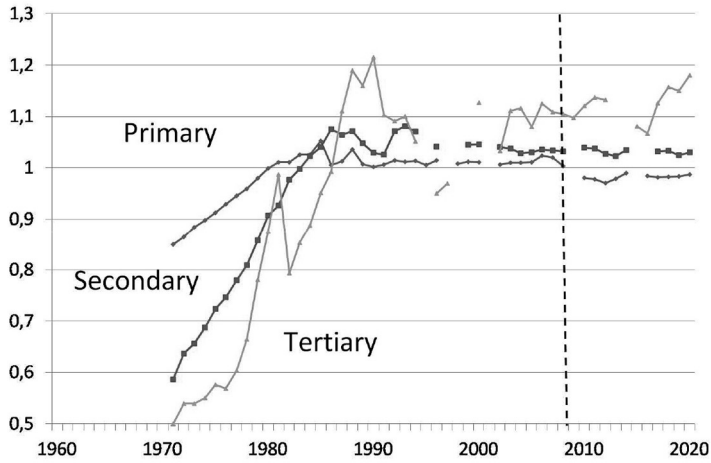
Figure 13: Female Literacy rate in Jordan, 1979-2020



Source*:* World Bank (2022d) and Kawar (2001, p. 2).

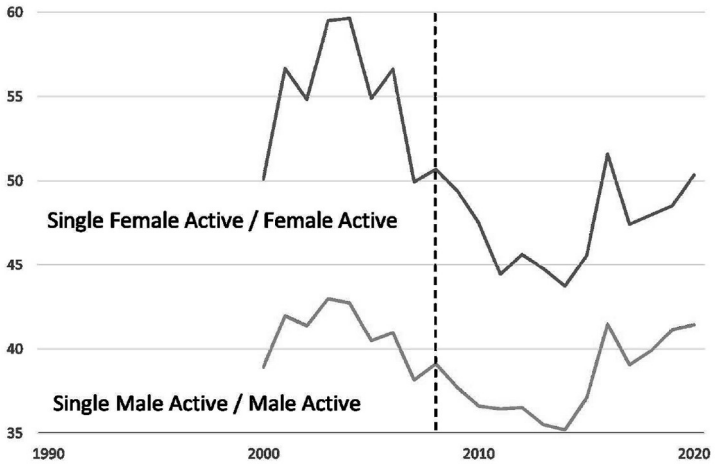
lower percentage at the beginning of the 1990s: in a field survey in 1992, she reported 33.3% active single women, and 42.4% active non-currently marriage female, out of all economically active women.

Figure 14: Gender Parity Index for school enrollment ratio, for primary, secondary and tertiary studies in Jordan, 1971-2020



Notes: Gender parity index for gross enrollment ratio at each education level is the ratio of girls to boys enrolled at secondary level in public and private schools. A number above 1 means that there is more female than male studying such a degree.
Source: World Bank (2022d).

Figure 15: Economically active single Jordanian population over Total economically active Jordanian population by gender, 2000-2020



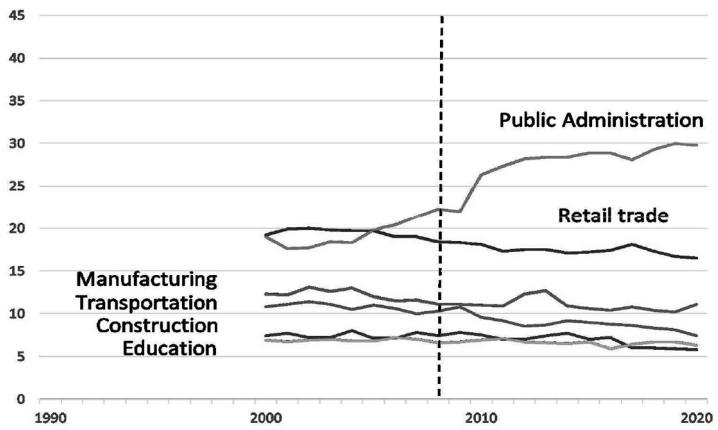
Source*:* Own computations from Department of Statistics (2022c, Table 5.1) and Department of Statistics (2022d).

Kawar (2001, p.4) pointed out several reasons why interviewed young women were entering the labor market: "*Changes in demographic structures and marriage patterns*," which implies that "*young adult men and women live longer with their parents*"; "*the decline of the extended family*"; and, "*the decrease in real wages and rising costs of living and rising unemployment levels*." In fact, the survey reports that "*increase household income*" is the most important reason behind young working women's labor force participation (see Kawar, 2001, Table 1).

However, the increase in women's entry into the labor force is simultaneous with an increase in the unemployment rate. Therefore, it is of great interest to ascertain whether there are specific jobs for women. Both in the survey for young workers (Kawar, 2001, p. 5) and in official data, jobs are surprisingly segmented by gender (Figure 16). Young men work mainly in more labor-intensive sectors and, hence, earn more, while women perform in more capital-intensive jobs with lower wages, although higher skills may be required. Kawar's survey, carried out in 1997, reported for the private sector that 61% of young male employment is related to construction, trade, transportation, finance, and also the emerging manufacturing sector; meanwhile 65% of young female jobs are in the manufacturing sector and technical fields, precisely the most developed sectors as a result of economic growth in the 90s in Jordan. As for the public sector, Kawar's survey reports that jobs are also segmented: 21% of men are in the military since little specialized expertise is required, while 20% of women work in the public sector as teachers, nurses, and medium-level officials.

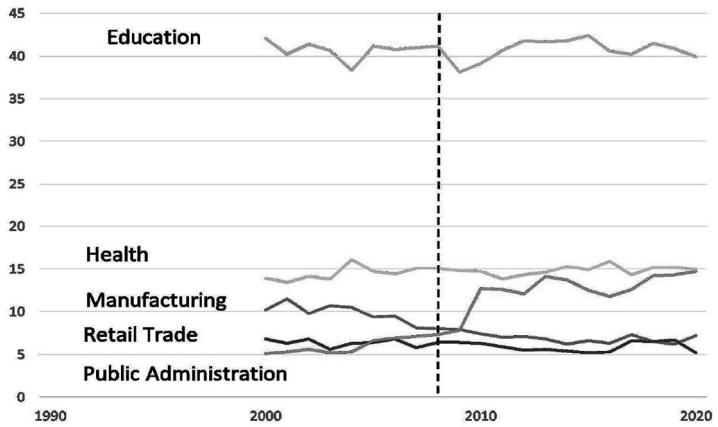
Figure 16: Jordanian employed persons age over 15 years by main current economic activity (percentage distribution)

(a) Male Main Economic Activities (%), 2000-2020



Source: Department of Statistics (2022c, Tables 4.4 (only Jordanian) and 5.18).

(b) Female Main Economic Activities (%), 2000-2020



Source*:* Department of Statistics (2022c, Tables 4.4 (only Jordanian) and 5.18).

It is worth commenting that, although wages are low, Kawar's survey reports that 43% of working women in the survey contribute to household expenditure (57% of which contribute with more than half their earnings). This stresses the relevance of young women's earnings to increasing household income, mainly for lower-income families (see Kawar, 2001, p. 9). In contrast, there are young working women who do not contribute at all, which mainly belong to upper-income households. For these families, daughters' education and occupation become a "*factor in status*" and a "*source of prestige for the male head*" (Kawar, 2001, p. 19).[11] Finally, a question not addressed in the Kawar (2001) paper is why young women are "allowed" to participate in the labor force when the male unemployment rate simultaneously increases.

4. An Explanation Using Economic Theory

In this paper, we claim that economic theory may be helpful to understand the underlying relations among apparently disconnected developments described in the previous Section 3. Economists study decisions and the factors that affect these decisions. Their starting point is the assumption that "agents behave rationally," where 'rationality' must be understood in a very wide sense: the purpose of the agent's behavior is to look for their own welfare. Therefore, parents' altruism towards their children is comprehensible because parents' welfare includes their offspring's welfare; parents are behaving rationally when they buy

[11] This goes in tune with Veblen's (1929) theory of the leisure class and may establish a future trend for middle and lower classes in Jordanian society.

items for their children or educate them, since both decisions make children happier and, therefore, make parents happier.

4.1. Economic theory on fertility and marriage

Concerning fertility, it is observed that parents "bear children". The question is why families have children. Given our assumption of rationality in the broad sense, parents who decide to bear many children must find the gains higher than the costs. Economic theory provides three possible reasons for this (see, for example, Stark, 1981). First, children are demanded as a "consumption good", since they may be a source of pleasure and satisfaction for parents. Something biological, the social contract, or in society's mind makes parents happy to have children and to take care of them. This "consumption good motive" to have children entails the elements beyond any explanation provided by economic theory (and, therefore, other sciences must help to enlighten the issue). Economists formalize this intuition by setting the number of children directly to parents' utility function like any other consumption good. Therefore, the standard consumer demand theory can be applied to explain the evolution of family size (see, for example, Becker, 1961).

Second, children are demanded as an "investment good" for their ability to contribute to the family income by working. This is the "income motive" for childbearing. In rural societies, children are usually a cheap labor input for increasing family income, and later, before they marry, their monetary earnings also increase the family income. Finally, parents also choose to have children as an "investment good for old-age security motive" (see Cigno, 1992). Because in this case offspring are seen as a capital good, they are a hedge for parents' misfortune at the elderly time, with illness and poverty. The social norms in (almost) all cultures is that first parents look after their children and, later, these elderly parents are looked after by their children.[12]

4.2. Economic theory and the traditional social norms in Jordan

In view of the previous arguments, we will next assert that the traditional social norms in Jordanian society establishes that daughters be demanded for the "income motive," while sons are demanded for the "old-age security motive." A son will be an old-age insurance for parents since, as is the tradition, he will both remain at home and be the income earner. The social norms make parents to secure their son's loyalty for old times, and, therefore, to try to brighten their son's future earning prospects. However, daughters will marry, in exchange for a *mahr* (and other marriage revenues, e.g. housing), and leave home. Daughters, then, become a "cost" for families. If parents are altruist with daughters, then parents consider the *mahr* received by daughters as it would be received by parents themselves. Thus, both early age of marriage for women and arrangement of marriages now become comprehensible, since

[12] See Nugent (1985) for an identification of the basic conditions to justify the old-age security hypothesis.

the sooner a daughter is married and the better the financial situation of the fiancé's family, the higher the profit of the ratio "dower received"/"family expenditure on a daughter".

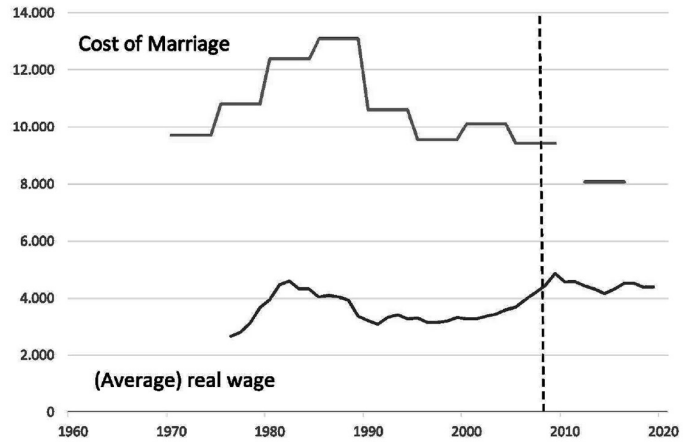
4.3. Understanding the changes in Jordanian society before the great recession

We are now ready to apply economic analysis to understand why young women in Jordan are entering the labor market. The stagnation of the Jordan economy in the 1980s ended up with the economic and financial crises of 1988-89, which brought with high price levels, unemployment, and a decrease in the standards of living (Figures 4, 5, and 6). The conditions of the Jordanian economy after the liberalization and openness process in the 1990s (Figure 7) resulted in Jordanian less competitive sectors declining, thereby further increasing unemployment during the adjustment process, while raising the standard of living. These, in turn, brought about two consequences. First, families needed more income to recover (and achieve a higher) standard of living. Second, a higher number of unemployed males –and, in particular, single young males (Figure 8(a))– gave rise to fewer available young single men who could provide a *mahr* and bear other marriage costs, besides affording family costs if married. The scarcity of financially-sound potential grooms entails that more young women remained single for a long in the 90s, therefore delaying their marriage; hence, the age of marriage increased (Figure 2) and fertility reduced (Figure 3).

The responsibility of a high *mahr* and other marriage costs in delaying marriage, and thus an increase in the age of marriage, is still a subject of controversy (see Singerman, 2007, Salem, 2014, and Sieverding et al., 2019). As already reported by Salem (2014, Sec. 2.5) and Sieverding et al. (2019, Sec. 2.5), the cost of marriage in Jordan (measured in real terms) increased until the late 90s and it has been decreasing thereafter (Figure 17). To get a fair idea of the difficulties to accrue enough monetary resources to afford marriage costs, we can measure the number of years required to save all wage income for an average Jordanian worker. In Figure 18, we report that it was needed 3 years by saving the entire wage income to afford the cost of marriage from the late 1970s to the middle 2000s. Yet, after the financial crises of 1988-89 young male unemployment increased, and the likelihood to find a job (and receive a wage compensation) decreased. So if we consider the wage income that a male young age 15-24 (or, alternatively, a single male) *expects* to receive, then Figure 18 also reports that in 1990 he has to save for 5 years his overall (expected) wage income, and 4 years for the period 1995-2005.[13] Accordingly, these findings suggest that it was the surge of single-young-male unemployment after the financial and economic crises of 1988-89, and not the increase in *mahr* and other marriage costs, what resulted in an increase in the age of marriage in Jordan, both for female and male.

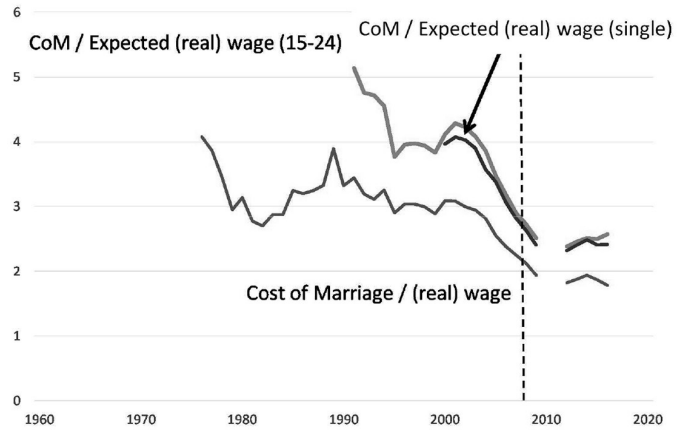
[13] Interestingly, Ajaka (2014) reported that "The average cost of marriage in Jordan is $14,000, while the average salary for a Jordanian hovers around $500 per month," which means 2.3 years saving full wage income. Our computations for 2014 in Figure 18 obtain the following numbers: 1.9 years for the cost of marriage over wages, and 2.5 years for the cost of marriage over expected wages, either for a young male ages 15-24 or a single male.

Figure 17: The Cost of Marriage and the average wage rate in Jordan (in 2010 Jordan Dinars), 1970-2016



Source*:* Salem (2014, Table 7.10) and Sieverding et al. (2018, Table 7), and own computations from Department of Statistics (2022a, 2022b) and World Bank (2022d) (see Appendix A.1).

Figure 18: Number of years required to save all (real) wages income in Jordan, 1976-2019



Notes: The number of years is obtained by dividing the cost of marriage (in 2010 Jordanian Dinars) by annual (real) wages (in 2010 prices). The expected real wage is obtained by multiplying the real wage (in 2010 prices) times the probability of finding a job (i.e., 1 minus the rate of unemployment). The unemployment rate refers to the young male ages 15-24, and the never-married male. We are implicitly assuming that finding a job follows an i.i.d. process. Source*:* Own computations from Salem (2014, Table 7.10), Sieverding et al. (2018, Table 7), Department of Statistics (2022a, 2022b) and World Bank (2022d) (see Appendix A.1).

The consequences of this new social environment turned out to be (perhaps) unexpected. First, as the period of *waithood* –in Singerman (2007)'s terminology– enlarged after the 1990s, single, young women were able to devote more time resources to acquire human capital, hence increasing the enrollment ratio at secondary and tertiary education level (Figure 14).[14] Second, more single women live longer at home, therefore increasing the "cost burden" for their families. Family financial needs to increase (and recover) standard of living, required single daughters to contribute to household income. In the 1990s and 2000s, these single, young, educated women are ready to enter the labor market with the appropriate skills suited for emerging sectors and to earn money (Figure 1). This allows parents to recover part of their losses in the profit rate because of delayed marriage. The parent's expected return on daughters as an "income motive" – which decreased as a consequence of daughters' delayed marriage and higher costs of staying at home – is then partially mitigated by direct daughters' contribution with their labor earnings. These extra earnings can also help to pay for their bother's *mahr* (and other marriage costs) as required by the tradition since the whole family is involved in this duty.

Yet, there might exist an alternative explanation to developments described in the previous Section 3. The growth of the Jordanian economy has created new jobs in particular sectors, such as the tourism sector that demands more female-oriented jobs. Given gender segmentation of the labor market, it may be the case that these jobs are not socially acceptable for men. Hence, due to changes in the economic conditions, parents prefer for their daughters to work at these jobs and appropriate their income, delaying their marriage. And, to improve their daughter's employability they are more willing to invest in their human capital. However, Kawar (2001, p. 23) reports in the survey that *"The households where parents objected to daughters marriage in order to retain their income were minimal in number"*. So we think that this alternative explanation is not valid for the Jordanian case and that tradition has greater weight.[15]

In conclusion, it seems that there is a reproduction of the traditional gender roles already existed when women married earlier. One might consider that nothing has changed. With this respect, *"[H]ouseholds maximise the use of daughters wages and expand benefits and advantages for sons [...] because there are high expectations from sons and no expectations for daughters in the future."* Kawar (2001, p. 17). However, become money earners opened new opportunities for single women and transformed daughters' social position, improving their reputation within the

[14] Accordingly, high young-male unemployment might be also the reason for other regularities observed concerning the overall improvement of the general education level of the labor force over the time in Jordan (see Al-Kahldi, 2006): i) the increasing demand for education in Jordan; ii) the higher ratio of educated male to female at various levels of education; iii) the higher proportion of educated labor force to the total labor force; and, iv) the spectacular increase in the proportion of the labor force with professional educational attainment. This suggests that the opportunity cost of unemployed young-male's and single young-female's time is very high, and thus they devote their temporal resources to education to improve their future economic prospects (which, according to Salem, 2014, Figure 21, also increases their *mahr*, and thus their requirements concerning any potential husband).

[15] Wolf (1990) reports two polar cases that might play a role in explaining the decision-making process in households concerning young women's involvement in employment: Javanese daughters seek employment against their parents' wishes, while Taiwanese daughters may be obliged to submit to parental decisions and work to contribute to household income. Our explanation argues that Jordanian daughters' circumstances are analogous to those of Javanese daughters.

family, and to allow them to receive more affection and more respect, and to become more involved in family decisions (see Kawar, 2001, pp. 12-18).

5. Discussion and Lessons for the Future

We have presented an economic theory explanation for understanding the changes in the female roles in Jordanian society before the Great Recession. This paper suggests that economic developments in the Jordanian economy, initially in the 80s and subsequently after the liberalization process in the 90s, resulted in important changes in the Jordanian social norms concerning gender roles, school enrollment, labor participation, marriage, and fertility.

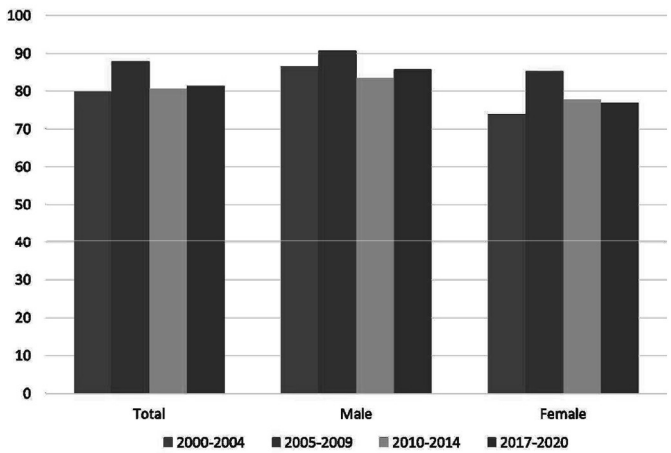
We can summarize our argument as follows. The stagnation of the Jordanian economy in the 1980s brought with high price levels, unemployment, and decrease in the standards of living. The subsequent economic liberalization in the 90s (helped by the favorable environment created after the signature of the Peace Treaty with Israel in 1993), restructured the Jordan economy, increasing the unemployment in less productive sectors while increasing the employment opportunities in the tech and manufacturing sectors. In this environment, a young single male did not earn enough to afford *mahr* (and other marriage costs) and to sustain the expenditures of his (potentially) new family. In consequence, young males, and thus young women, delayed marriage. In addition, families found themselves at home with more young single women –who devoted their *waithood* spell improving their educational level–, ready to participate in the labor market because of higher qualified employment opportunities; thus, young females became an additional income source to families. Accordingly, the age of marriage increased, the fertility rate dropped, female education level and young female labor participation both rose. The higher educated females were, the higher *mahr* was required (see, e.g., Salem, 2014, Figure 21), then resulting in a feedback on this dynamics. In this regard, we disagree with Omar (2001, p. 16)'s views on women's challenging the Islamic tradition. Instead, we support the view that economic motivations, shared by all human communities, allow us to understand these apparently challenging social phenomena before the Great Recession.

Social improvements of Jordanian women, however, stopped after the Great Recession and the Syrian war, and the social change dynamic mechanism above mentioned broke. The economic activity deteriorated after 2008 (Figure 4). FDI, Exports, Investment and the tourism sector slumped (Figure 7). Labor opportunities for young people worsened dramatically, especially for single female Jordanians (Figure 8). This break in women's advancement might be exacerbated by the Jordan society's social attitude towards women's right to work, namely the conception that women become competitors in men's labor opportunities. This phenomenon, known as "*lump of labor fallacy*,"[16] might generate rejection towards working

[16] This phenomenon is generated by the misconception that there is a fixed amount of work and the erroneous perception that if a job is occupied by a woman, then it cannot be occupied by a man. This fallacy is often related to the competition in the labor market between immigrant and native workers, between young and old workers, and it has also been argued at the time women were incorporated into the labor market in developed countries. Empirically it was found incorrect: the more immigrants, the older workers, and the more women participate in the labor market, the higher is the GDP growth and the lower is the unemployment rate.

women and might amplify the negative effects of the economic downturn after the Great Recession and the Syrian war. Indeed, this negative attitude has not progressed and has remained virtually stagnant since the early 2000s (Figure 19).[17] Finally, it was evidenced an interruption of the rise in the age of marriage for both men and women (Figure 2), although the age of marriage did not decrease. Moreover, highly educated young females (Figures 13 and14), together with a steady decreasing fertility – already envisaged by Roudi (2001) – (Figure 3), are trends in the Jordan society that remained despite the Great Recession.

Figure 19: Negative Attitudes toward Women's Right to Work in Jordan, 2000-2020



Note: The figure reports the percentage of *strongly agree* and *agree* answers with the statement "Men should have more right to a job than women").
Source*:* Own computation from Inglehart et al. (2022).

It is always difficult to carry out a counterfactual analysis of Jordanian women's improvement if its course would not be interrupted by the events followed by the Great Recession and the Syrian war. Yet, the economic theory that allowed us to uncover social-change dynamic mechanisms in Jordanian society can also be useful to devise the social developments should no economic and war strongly hit the Jordanian economy. Under this radically different scenario, Jordan might have been taking the similar social and economic path as other industrialized countries did in the past. Our economic analysis allows us to assert several counterfactual statements on Jordanian society. First, there would have been changes in the marriage institution. Although conservative social norms limits freedom of choice for

[17] Boustati (2020, Table 1) reports that a majority of the Jordanian population holds egalitarian views: 71,2% of women and 86.1% of men in 2016 reports an *agree* answer with the statement Women should be allowed to work. Yet, this support has decreased since 2010, when 90,4% of women support this statement.

daughters to obey their parents' commandments, daughters' earnings could increase their own bargaining power in choosing a partner, in particular one outside the family linkage. Second, as indeed happened, there would have been a decrease in fertility rates in Jordan, as the delay of marriage age will further decrease fertility, since fecundity ages would be also reduced. In addition, the (eventual) introduction of a more developed welfare state in Jordan would diminish the old-age security motive to have children.[18] Third, there would have been changes in women's role in Jordanian society. Young women's attitudes towards the future reported in 1997 indicated that young working women favor the idea of working after marriage (see Kawar, 2001, p. 24). Although they would like to keep working until their first child, and then assume the 'natural' role as mothers, we somewhat doubt that this could be carried out if the husband's earnings are not enough to achieve a desired standard of living. Judging from the experience of other countries, women would have kept working even after their children were born, although some would have left the labor market.

Should all these changes have been accomplished, Jordanian women would have been more integrated in the labor market (with full rights and responsibilities) and, thus, more income-independent. This might have resulted in changes in the Jordanian social contract based on male guardianship, not without conflicts;[19]and, also, in changes of daughters' status for parents, weakening the "income motive" while strengthening the "old-age security motive" for fertility, (eventually) replacing sons. Hence, women may achieve equality with men first in the labor market, and then inside families.

In our view, two lessons for the future can be drawn from the Jordanian experience. Firstly, in middle income countries –such as Jordan–, it is essential that the process of women's empowerment be accompanied by an economic bonanza. As soon as the economic situation worsens, women are the first to suffer the consequences. Alon et al. (2020a, 2020b) report that the worsening of working women's opportunities also takes place in developed countries. The "shecession (she-recession)" – a term coined by these authors for the case of the US – might be even more exacerbated in poor countries. Secondly, to achieve continued progress in the advancement of women, and to prevent it from being interrupted by economic cycles –as seen in the case of Jordan–, it is necessary a strong State that consolidates all progress accomplished in favor of women's well-being and independence. The state potentially has very effective tools for this task by deploying spending programs to support women or implementing legislation that empowers women and gives women freedom and independence.

[18] See Olmsted (2001) for a description of some MENA welfare states and Yousef (2001) for a claim of a redefinition of the role of the state in MENA countries. For a reinterpretation of the welfare state, see Becker et al. (1988), Boldrin et al. (2005), and Conde-Ruiz et al. (2010, Sec. 5).

[19] Income earning raises daughter status, threatening fathers' positions as household head, who may. become more authoritative See Kawar (2001, p. 19).

References

Ajaka, N. (2014) Waiting longer to marry in Jordan. AlJazeera, May 2nd. Retrieved from https://www.aljazeera.com/news/2014/5/2/waiting-longer-to-marry-in-jordan

Al-Kahldi, M. D. (2006) Educational Attainment of Jordan's Population and Labor Force. *Journal of Social Sciences* 21, 1-6.

Al Khatib, M. (2020) Facilitating female employment in Jordan, YEM Blogs and Thinkpieces. Retrived from https://unevoc.unesco.org/yem/Female+unemployment+in+Jordan+YEM+Blog&context=

Alon, T.; Doepke, M.; Olmstead-Rumsey, J.; Tertilt. M. (2020a) The Impact of COVID-19 on Gender Equality. *Covid Economics: Vetted and RealTime Papers* 4, 62-85.

Alon, T.; Doepke, M.; Olmstead-Rumsey, J.; Tertilt, M. (2020b) This Time It's Different: The Role of Women's Employment in a Pandemic Recession, CEPR Discussion Paper 15149.

Becker, G. S. (1961) An Economic Analysis of Fertility. In NBER, *Demographic and Economic Change in Developed Countries*, Princeton: Princeton University Press.

Becker, G. S.; Murphy, K. (1988) The family and the state. *Journal of Law and Economics*, 31, 1-18.

Boldrin, M. and Montes, A. (2005) The intergenerational state education and pensions. *Review of Economic Studies 72*(3), 651-664.

Boustati, A. (2020) The Evolution of Female Labour Force Participation in Jordan SOAS Department of Economics Working Paper.236, London: SOAS University of London.

Chesnais, J.-C. (1992) The Demographic Transition. Stages, Patterns and Economic Implications. New York, Clarendon Press Oxford.

Cigno, A. (1992) Children and pensions. *Journal of Population Economics,* 5, 175-83.

Conde-Ruiz, J.I., Giménez, E. L.; Pérez-Nievas, M. (2010) Millian eficiency with endogenous fertility. *Review of Economic Studies*, 77(1), 154-187.

Courbage, Y. (1999) Economic and political issues of fertility transition in the Arab world: Answers and open questions. *Population and Environment*, 20(4), 353-80.

Department of Statistics (1998) *Employment and Unemployment Survey 1998*. Hashemite Kingdom of Jordan.

Department of Statistics (1999) *Men and Women in Jordan: A Statistical Portrait.* Hashemite Kingdom of Jordan.

Department of Statistics (2022a) Table 2. National Disposable Income and its Appropriations at Current Prices, 1976-2009 Hashemite Kingdom of Jordan. Retrieved from http://www.dos.gov.jo/dos_home_e/main/economic/nat_account/sel2/nat_1/curr_2.pdf

Department of Statistics (2022b) Table 10: Gross Domestic Product by Income Approach at Current Prices, 2008-2016, Hashemite Kingdom of Jordan. Retrieved from https://jorinfo.dos.gov.jo/Databank/pxweb/en/NationalAccount/NationalAccount_Yearly_Isic4/Table10.px

Department of Statistics (2022c) Employment and Unemployment, Yearly (Percentage), Hashemite Kingdom of Jordan. Retrieved from http://www.dos.gov.jo/dos_home_e/main/linked-html/Emp&Un.htm

Department of Statistics (2022d) Number of Jordanian Age 15+ Years by Some of Characteristics Selected 2017 - 2021, Hashemite Kingdom of Jordan. Retrived from https://jorinfo.dos.gov.jo/Databank/pxweb/en/DOS_Database/START_12/EMPALL/

Inglehart, R.; Haerpfer, C.; Moreno, A.; Welzel, C.; Kizilova, K; Diez-Medrano, J., Lagos, M.; Norris, P., Ponarin, E. Puranen, B. (eds.) (2022) *World Values Survey: All Rounds - Country-Pooled Datafile.* Madrid (Spain) and Vienna (Austria): JD Systems Institute & WVSA Secretariat. Dataset Version 3.0.0.

Kardoosh, M., A. (2019) *Trade Liberalization in Jordan and Economic Diplomacy: A Story of Qualified Success.* Konrad-Adenauer-Stiftung.

Kasoolu, S.l; Hausmann, R.; O'Brien, T.; Santos, A. M. (2019) Female Labor in Jordan: A Systematic Approach to the Exclusion Puzzle, Center for International Development Faculty, Working Papers.365, Harvard University.

Kawar, M. (2001) *Women's Changing Life Cycles, Expanding Economic Opportunities and the Social Contract in Jordan.* Paper presented at the Second Mediterranean Social and Political Research Meeting, Florence.

Kawar, M. (1997) Gender, Employment and the Life Course: The Case of Working Daughters in Amman, Jordan. Ph.D Thesis Development Studies, London School of Economics.

Miles, R. (2002) Employment and unemployment in Jordan: The importance of the gender system. *World Development*, 30(3), 413-427.

Nugent, J.B. (1985) The old-age security motive for fertility. *Population and Development Review*, 11(1),75-97.

Olmsted, J. (2001) Gendered Social Safety Nets in a Period of Demographic Transition: A Focus on the MENA Region. Paper presented at the Second Mediterranean Social and Political Research Meeting, Florence.

Omar, M. (2001) The Marriage Mystery: Exploring Late Married in MENA. *Al-Raida, XVIII-XIX* (93-94), 12-19.

Roudi, F. (2001) Fertility Policies in the Middle East and North Africa. Paper presented at the Second Mediterranean Social and Political Research Meeting, Florence.

Salem, R. (2014) Trends and differentials in Jordanian marriage Behavior: Marriage timing, spousal characteristics, household structure and matrimonial expenditures. In Ragui Assaad (Ed.), *The Jordanian Labour Market in the New Millennium*. Oxford, Oxford University Press, 189-217.

Shakhatreh, H. (1995) Determinant of female labor-force in Jordan. In Nabil F. Khoury and Valentine M. Moghadam (Eds.), *Gender and Development in the Arab World: Women's Economic Participation*. London, Zed Books,125-147.

Sieverding, M.; Berri, N.; Abdulrahim, S. (2019) Marriage and fertility patterns among Jordanians and Syrian refugees in Jordan. In Caroline Krafft and Ragui Assaad (Eds.) *The Jordanian Labor Market: Between Fragility and Resilience*. Oxford Scholarship Online, ch.10.

Singerman, D. (2007) The Economic Imperatives of Marriage: Emerging Practices and Identities among Youth in the Middle East. Wolfensohn Center for Development and Dubai School of Government, Middle East Youth Initiative Working Paper, No. 6

Spies, O. (1991) Mahr. In C.E. Bosworth, E. van Donzel, B. Lewis, and C. Pellat (Eds.). *Encyclopaedia of Islam (2nd ed.)*, Vol.6. Leiden, E.J. Brill, 78-79.

Stark, O. (1984) Bargaining, altruism, and demographic phenomena. *Population and Development Review*, 10(4), 679-692.

Tubbeh, T. K. (1994) The Determinants of Women's Work: A Case Study from Three Urban Low-income Communities in Aman, Jordan. Ph.D. dissertation, Portland State University.

United Nations (2019) *World Marriage Data,* Department of Economic and Social Affairs, Population Division. Retrieved from https://www.un.org/development/desa/pd/data/world-marriage-data

Veblen, T. (1929) *The Theory of the Leisure Class*. New York, Vanguard Press.

Wolf, D. (1990) Daughters, decisions and domination: An empirical and conceptual critique of households strategies. *Development and Change*, 21, 34-74.

World Bank (2022a) *Labor force participation rate, female (% of female population ages 15+) (national estimate)* World Bank database. Retrived from https://data.worldbank.org/indicator/SL.TLF.CACT.FE.NE.ZS

World Bank (2022b) *Labor force participation rate, female (% of female population ages 15+) (modeled ILO estimate*, World Bank database. Retrieved from https://data.worldbank.org/indicator/SL.TLF.CACT.FE.ZS

World Bank (2022c) Fertility rate, total (births per woman), World Bank database. Retrieved from https://data.worldbank.org/indicator/SP.DYN.TFRT.IN?locations=JO

World Bank (2022d) Jordan, World Bank database. Retrieved from https://data.worldbank.org/country/JO

World Economic Forum (2021) *Global Gender Gap Report 2021: Insight Report.* Geneva, March 2021.

Yousef, T. M. (2001) *Demography, Inequality and Intergenerational Generations in the Middle East and North Africa.* Paper presented at the Second Mediterranean Social and Political Research Meeting, Florence.

Appendix

Series of average (real) wages per worker for Jordan

Consider the following series:

Compensation of employees (current LCU) Millions: Department of Statistics (2022a, Table 2 and 2022b), range: 1976-2016.

Compensation of employees (current LCU): World Bank (2022d, series GC.XPN.COMP.CN), range: 1990-2019.

Employment to population ratio, 15+, total (%) (modeled ILO estimate): World Bank (2022d, series SL.EMP.TOTL.SP.ZS), range: 1991-2020.

Population, total: World Bank (2022d, series SP.POP.TOTL), range: 1960-2020.

Population ages 0-14, total: World Bank (2022d, series SP.POP.0014.TO), range: 1960-2020.

Consumer price index (2010 = 100): World Bank (2022d, Series FP.CPI.TOTL), range: 1969-2020.

GDP per capita (constant 2016 LCU): World Bank (2022d, Series NY.GDP.PCAP.KN), range: 19762020.

Initially, we complete the series Compensation of employees (1) for the years 2017-2019. Let us denote the growth rate of series (2) for the period t as

$$g_{t+1}^{(2)} = \frac{(2)_{t+1}}{(2)_t}, \text{ for } t = 2016, 2017, 2018.$$

We can then enlarge forward recursively the series (1) for 2017, 2018 and 2019, to obtain the new series Compensation of employees (1^e) with a range 1976 to 2019. That is,

$$(1^e)_{t+1} = (1^e)_t \cdot g_{t+1}^{(2)}, \text{ for } t = 2016, 2017, 2018,$$

and given the initial value $(1^e)_{t=2016} = (1)_{t=2016}$.

The number of employees (N) for each period t is found by multiplying

$N_t = (3)_t \cdot \{(4)_t - (5)_t\}$, for $t = 1991,...2019$.

Then, the average (nominal) wage per worker at current prices (w) for each period t is obtained as

$$w_t = \frac{(1^e)_t}{N_t} = \frac{(1^e)_t}{(3)_t \cdot \{(4)_t - (5)_t\}}, \text{ for } t = 1991, ..., 2019.$$

To obtain the average (real) wage per worker at 2010 Jordanian Dinar constant prices ($wreal_{(2010)}$) for each period t, we divide the nominal average wage by the consumer price index at 2010 prices

$$wreal_{t(2010)} = \frac{w_t}{(6)_{t(2010)}}, \text{ for } t = 1991, ..., 2019.$$

This series ranges from 1991 to 2019.

Interestingly, the series *GDP per capita* is very similar to the *average wage per worker*: instead of considering the overall final output and the overall population, the average wage per worker is considering the share of GDP to compensate the labor factor (series (1^e)) and only those members of the population who works (series $\mathcal{N}$). Accordingly, if both series have the same profile, we can use the growth rates of the *real GDP per capita* to enlarge backwards the series of average real wage per worker.

Initially, observe that both series display a different base year. The series *real GDP per capita* in (7) is 2016, while the base period for the series average real wage per worker $wreal_{(2010)}$ is 2010. So we can find the average wage per worker at 2016 Jordanian Dinar constant prices ($wreal_{(2016)}$), by dividing

$$wreal_{t(2016)} = \frac{w_t}{(6)_{t(2010)} \cdot \frac{100}{(6)_{2016(2010)}}}, \text{ for } t = 1991,...2019.$$

If we draw the series *real GDP per capita* and the average wage per worker at 2016 Jordanian Dinar constant prices and their growth rate, we find that both shows a similar pattern (see Figure A.1(b)). Let us denote the growth rate of the GDP per capita for the period t as

$$g_{t+1}^{GDPpc} = \frac{(7)_{t+1(2016)}}{(7)_{t(2016)}}, \text{ for } t = 1976, ...,1991.$$

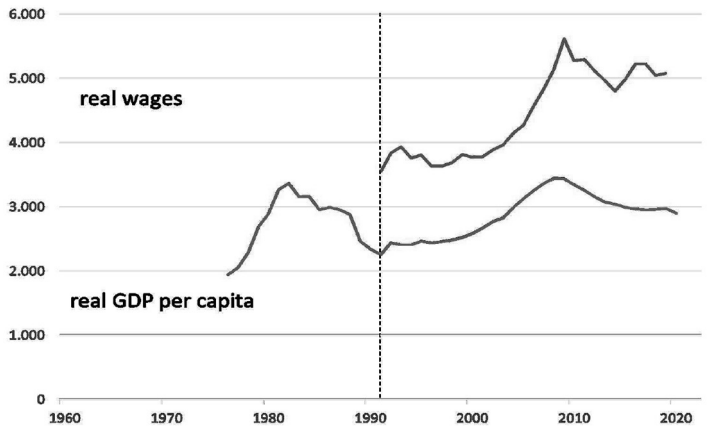
Then, we can enlarge backwards the series of wages starting from 1990, recursively, to 1976. That is,

$$wreal_{t-1(2016)} = \frac{wreal_{t(2016)}}{g_t^{GDPpc}}$$

for $t = 1991, ..., 1977$, and given the initial value $wreal_{1991(2016)}$.

Figure A.1: Real GDP per capita and (average) real wages in Jordan, and their growth rates, 1976-2020

(a) Original series



(b) Growth rates

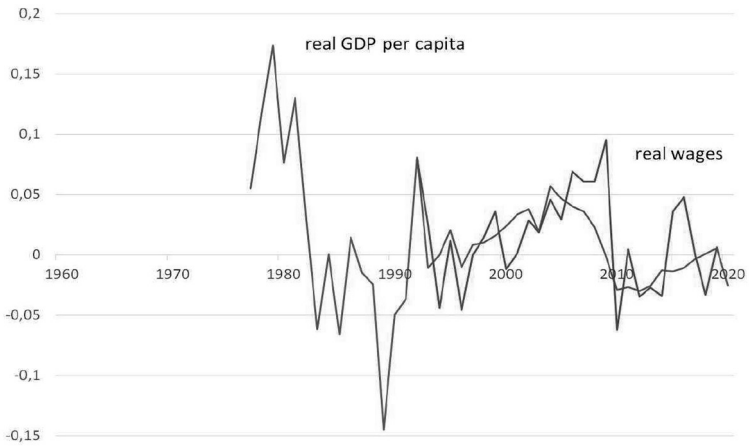


Table A.1: Average real wages (in 2016 Jordanian Dinar) in Jordan, 1976-2019

	Total wages	N/Pop	Pop	Pop	Employees	CPI	wreal	GDPpc	GDPpc(2016)	wreal
	millions DJ	> 15	Total	< 14		2010=100	2016=100	2016=100	growth rate	2016=100
	(1[e])	(3)	(4)	(5)	N	(6)	original	(7)	gGDPpc	enlarged
1976			2.123.180	1.022.364		15,2		1942,2		3062,1
1977			2.179.361	1.059.639		17,4		2049,1	0,1	3230,7
1978			2.237.936	1.092.914		18,6		2288,4	0,1	3608,0
1979			2.303.116	1.126.856		21,2		2686,3	0,2	4235,2
1980			2.377.997	1.164.721		23,6		2892,7	0,1	4560,6
1981			2.464.870	1.196.983		25,4		3270,1	0,1	5155,7
1982			2.56 3.525	1.236.671		27,3		3365,2	0,0	5305,6
1983			2.671.413	1.280.745		28,7		3157,6	-0,1	4978,3
1984			2.784.457	1.324.678		29,8		3159,4	0,0	4981,2
1985			2.900.055	1.366.702		30,7		2951,4	-0,1	4653,2
1986			3.015.294	1.415.924		30,7		2994,8	0,0	4721,7
1987			3.131.800	1.460.894		30,6		2950,4	0,0	4651,7
1988			3.256.552	1.507.490		32,6		2878,9	0,0	4538,9
1989			3.399.333	1.563.486		41,0		2462,0	-0,1	3881,7
1990	994,6		3.565.888	1.632.100		47,7		2340,6	0,0	3690,2
1991	1.074,4	32,5	3.760.493	1.678.129	677.018,21	51,5	3555,5	2255,1	0,0	3555,5
1992	1.287,7	32,3	3.977.667	1.736.406	723.210,13	53,6	3835,9	2438,0	0,1	3835,9
1993	1.462,6	32,2	4.201.559	1.796.418	775.273,18	55,4	3933,9	2411,6	0,0	3933,9
1994	1.598,3	33,4	4.410.357	1.844.258	855.947,96	57,3	3761,4	2411,7	0,0	3761,4
1995	1.808,0	34,4	4.588.842	1.872.302	935.168,87	58,7	3804,9	2461,6	0,0	3804,9
1996	1.921,8	34,8	4.732.848	1.925.886	978.085,94	62,5	3630,9	2436,5	0,0	3630,9
1997	2.036,5	34,8	4.848.536	1.961.993	1.005.729,28	64,4	3631,5	2457,0	0,0	3631,5
1998	2.181,7	34,8	4.943.975	1.985.953	1.030.190,31	66,4	3684,2	2482,2	0,0	3684,2

	Total wages	N/Pop	Pop	Pop	Employees	CPI	wreal	GDPpc	GDPpc(2016)	wreal
	millions DJ	> 15	Total	< 14		2010=100	2016=100	2016=100	growth rate	2016=100
	(1[e])	(3)	(4)	(5)	N	(6)	original	(7)	gGDPpc	enlarged
1999	2.323,1	34,8	5.031.754	2.006.447	1.052.595,04	66,8	3816,3	2521,6	0,0	3816,3
2000	2.358,5	34,7	5.122.495	2.029.215	1.074.172,47	67,2	3771,5	2582,1	0,0	3771,5
2001	2.425,5	34,2	5.217.328	2.050.674	1.083.629,04	68,4	3777,8	2668,7	0,0	3777,8
2002	2.574,5	33,9	5.317.514	2.074.380	1.097.995,41	69,7	3886,2	2769,9	0,0	3886,2
2003	2.759,2	34,1	5.434.036	2.104.290	1.136.342,38	70,8	3959,9	2823,3	0,0	3959,9
2004	3.055,0	33,9	5.580.241	2.145.881	1.163.767,28	73,2	4141,9	2984,9	0,1	4141,9
2005	3.348,2	33,6	5.765.639	2.204.965	1.197.276,63	75,8	4263,4	3124,2	0,0	4263,4
2006	3.980,8	33,8	5.991.547	2.282.747	1.252.943,94	80,5	4558,7	3249,7	0,0	4558,7
2007	4.660,0	34,0	6.255.290	2.372.917	1.319.890,41	84,3	4836,4	3367,2	0,0	4836,4
2008	5.933,0	34,1	6.556.473	2.476.614	1.389.967,17	96,1	5130,3	3444,9	0,0	5130,3
2009	6.784,0	34,0	6.893.258	2.593.462	1.461.672,63	95,4	5620,0	3441,2	0,0	5620,0
2010	7.109,0	34,3	7.261.541	2.721.450	1.557.296,55	100,0	5272,1	3342,3	0,0	5272,1
2011	7.867,0	34,3	7.662.858	2.859.831	1.646.958,00	104,2	5296,2	3253,9	0,0	5296,2
2012	8.515,0	34,7	8.089.963	3.001.705	1.766.592,39	108,9	5113,4	3157,0	0,0	5113,4
2013	9.181,0	34,7	8.518.992	3.137.427	1.867.456,88	114,1	4975,5	3076,3	0,0	4975,5
2014	9.717,0	35,1	8.918.822	3.252.332	1.988.484,62	117,4	4806,1	3037,8	0,0	4806,1
2015	10.345,0	34,7	9.266.573	3.333.810	2.061.338,44	116,4	4979,5	2996,8	0,0	4979,5
2016	10.935,0	34,0	9.554.286	3.388.133	2.094.642,25	115,5	5220,5	2964,5	0,0	5220,5
2017	11.308,1	32,9	9.785.840	3.413.910	2.096.365,07	119,3	5220,6	2954,8	0,0	5220,6
2018	11.424,4	32,0	9.965.322	3.412.673	2.097.175,38	124,7	5047,1	2957,7	0,0	5047,1
2019	12.106,1	32,6	10.101.697	3.390.356	2.190.850,22	125,6	5080,9	2974,8	0,0	5080,9

Sources of Figures 1 through 19

Figure 1(a)

- Labor force participation rate, female (% of female population ages 15+): World Bank (2022a, series SL.TLF.CACT.FE.ZS) for 1961, 1975 and 1979, Shakhatreh (1995, Table 7.1) for 1979 and 1985, and World Bank (2022b, series SL.TLF.CACT.FE.ZS) for 1990-2020.
- Labor force participation rate, female ages 15-24 (% of female population ages 15-24): *Labor force participation rate for ages 15-24, female (%)* World Bank (2022d), series SL.TLF.ACTI.1524.FE.ZS) for 1961, 1975 and 1979, and World Bank (2022b, series SSL.TLF.ACTI.1524.FE.ZS) for 1990-2020.

Figure 1(b)

- Single Female Labor Force (%) and Married Female Labor Force (%): Department of Statistics (2022c, Table 5.1) from 2000-2016, and Department of Statistics (2022d) from 2017-2020.

Figure 2

- Age of Marriage: United Nations (2019, Sheet SMAM) for years 1976-2018, Miles (2002, p.416) for male in 1960 and 1970, Courbage (1999, T.3) for female in 1970, and Department of Statistics (1999) for female in 1971 (cited by Kawar 2001, p. 2).

Figure 3

- Fertility rate: World Bank (2022c, series SSP.DYN.TFRT.IN).

Figure 4

- Real GDP per capita: World Bank (2022d, series NY.GDP.PCAP.KN).

Figure 5

- Inflation, consumer prices (annual %): World Bank (2022d, series FP.CPI.TOTL.ZG).

Figure 6

- Average real wages: Own computations from Department of Statistics (2022a, 2022b) and World Bank (2022d) (see Appendix A.1).

Figure 7(a)

- Exports: World Bank (2022d, series NE.EXP.GNFS.KN).
- Gross Fixed Capital Formation: World Bank (2022d, series NE.GDI.FTOT.KN).
- Tourism receipts: Own computation from World Bank (2022d) by multiplying *International tourism, receipts (% of total exports)* (series ST.INT.RCPT.XP.ZS) times *Exports of goods and services (constant LCU)* (series NE.EXP.GNFS.KN); and,

- Foreign Direct Investment, Own computation from World Bank (2022d) by multiplying *Foreign direct investment, net inflows (% of GDP)* (series BX.KLT.DINV.WD.GD.ZS) times *GDP (constant LCU)* (series NY.GDP.MKTP.KN).

Figure 7(b)

- Gross Fixed Capital Formation/GDP: World Bank (2022d, series NE.GDI.FTOT.ZS);
- Foreign Direct Investment/GDP: World Bank (2022d, series BX.KLT.DINV.WD.GD.ZS);
- Exports/GDP: Own computations from World Bank (2022d) by dividing *Exports of goods and services (current LCU)* (series NE.EXP.GNFS.CN) by *GDP (current LCU)* (series NY.GDP.MKTP.KN);
- Tourism receipts/GDP Own computations from World Bank (2022d) by multiplying Exports/GDP times *International tourism, receipts (% of total exports)* (series T.INT.RCPT.XP.ZS).

Figure 8(a)

- Ur Female 15-24: Unemployment, youth female (% of female labor force ages 15-24) (modeled ILO estimate) World Bank (2022d, series SL.UEM.1524.FE.ZS), range 1991-2020;
- Ur Male 15-24: Unemployment, youth male (% of male labor force ages 15-24) (modeled ILO estimate) World Bank (2022d, series SL.UEM.1524.MA.ZS), range 1991-2020;
- Ur Female: *Unemployment female (% of female labor force)* World Bank (2022d, series SL.UEM.TOTL.FE.ZS) for 1991-2020, except for 1983, 1986 and 1987 taken from World Bank (2022d, series SL.UEM.TOTL.FE.NE.ZS);
- Ur Male: *Unemployment male (% of male labor force)* World Bank (2022d, series SL.UEM.TOTL.MA.ZS) for 1991-2020, except for 1983, 1986 and 1987 taken from World Bank (2022d, series SL.UEM.TOTL.MA.NE.ZS).

Figure 8(b)

- Single Female Unemployment rate (%) and Single Male Unemployment rate (%) Department of Statistics (2022c, Table 2.6) from 2000-2016, and Department of Statistics (2022d) from 2017-2020.

Figure 9

- Birth rate: *Birth rate, crude (per 1,000 people)* World Bank (2022d, series SP.DYN.CBRT.IN), range 1960-2019;
- Mortality rate: *Death rate, crude (per 1,000 people)* World Bank (2022d, series SP.DYN.CDRT.IN), range 1960-2019;
- Population: *Population, total* World Bank (2022d, series SP.POP.TOTL), range 1960-2020.

Figure 10. Age Structure in Jordan

(1) *Population ages 0-14, male (% of male population)*: World Bank (2022d, series SP.POP.0014.MA.ZS), range 1960-2020;

(2) *Population ages 15-19, male (% of male population)*: World Bank (2022d, series SP.POP.1519.MA.5Y), range 1960-2020;
(3) *Population ages 20-24, male (% of male population)*: World Bank (2022d, series SP.POP.2024.MA.5Y), range 1960-2020;
(4) *Population ages 15-64, male (% of male population)*: World Bank (2022d, series SP.POP.1564.MA.ZS), range 1960-2020;
(5) *Population ages 65 and above, male (% of male population)*: World Bank (2022d, series SP.POP.65UP.MA.ZS), range 1960-2020;
(6) *Population ages 0-14, female (% of female population)*: World Bank (2022d, series SP.POP.0014.FE.ZS), range 1960-2020;
(7) *Population ages 15-19, female (% of female population)*: World Bank (2022d, series SP.POP.1519.FE.5Y), range 1960-2020;
(8) *Population ages 20-24, female (% of female population)*: World Bank (2022d, series SP.POP.2024.FE.5Y), range 1960-2020;
(9) *Population ages 15-64, female (% of female population)*: World Bank (2022d, series SP.POP.1564.FE.ZS), range 1960-2020;
(10) *Population ages 65 and above, female (% of female population)*: World Bank (2022d, series SP.POP.65UP.FE.ZS), range 1960-2020;
(11) *Population, male*: World Bank (2022d, series SP.POP.TOTL.MA.IN), range 1960-2020;
(12) *Population, female*: World Bank (2022d, series SP.POP.TOTL.FE.IN), range 1960-2020;
(13) *Population, total*: World Bank (2022d, series SP.POP.TOTL), range 1960-2020.

Variables:

- Population ages 0-14, total (% of population)= (1)*(11)/(13)+(6)*(12)/(13).
- Population ages 15-19, total (% of population)= (2)*(11)/(13)+(7)*(12)/(13).
- Population ages 20-24, total (% of population)= (3)*(11)/(13)+(8)*(12)/(13).
- Population ages above 25, total (% of population)= [(4)-(2)-(3)+(5)]*(11)/(13)+[(9)-(6)-(7)+(10)]*(12)/(13).

Figure 11(a)

(1) Employment to population ratio, 15+, total (%) (modeled ILO estimate): World Bank (2022d, series SL.EMP.1524.SP.ZS);
(2) Employment to population ratio, ages 15-24, total (%) (modeled ILO estimate): World Bank (2022d, series SL.EMP.TOTL.SP.ZS).

Variables:

- Employment, ages 15-24, to Total Employment, total (%)= (1)/(2).

Figure 11(b)

- Female Labor force participation rate for ages 15-24: *Labor force participation rate for ages 15-24, female (%) (modeled ILO estimate)* World Bank (2022d, series SL.TLF.ACTI.1524.FE.ZS), range 1990-2020 except for 1961, 1970 and 1979 taken from World Bank (2022d, series SL.TLF.ACTI.1524.FE.NE.ZS).;

- Male Labor force participation rate for ages 15-24: *Labor force participation rate for ages 15-24, male (%) (modeled ILO estimate)* World Bank (2022d, series SL.TLF.ACTI.1524.MA.ZS), range 1990-2020 except for 1961, 1970 and 1979 taken from World Bank (2022d, series SL.TLF.ACTI.1524.MA.NE.ZS).

Figure 12

- Female Employed Persons by broad Age Groups (percentage) Department of Statistics (2022c), Table 5.1 from 2000-2016, Table 4.1 (only Jordanian) from 2017-2020, except Kawar 2001, p.2) for 1998. For shorter range of years, a proportional distribution among years have been assigned.

Figure 13

- % Females 15-24: *Literacy rate, youth female (% of females ages 15-24)* World Bank (2022d, series SE.ADT.1524.LT.FE.ZS);
- % Females ¿15: *Literacy rate, adult female (% of females ages 15 and above)* World Bank (2022d, series SE.ADT.LITR.FE.ZS) all years except Kawar 2001, p.2) for 1996.

Figure 14

- Primary: School enrollment, primary (gross), gender parity index (GPI) World Bank (2022d, series SE.ENR.PRIM.FM.ZS);
- Secondary: School enrollment, secondary (gross), gender parity index (GPI) World Bank (2022d, series SE.ENR.SECO.FM.ZS);
- Tertiary: School enrollment, tertiary (gross), gender parity index (GPI) World Bank (2022d, series SE.ENR.TERT.FM.ZS).

Figure 15

- Single Female Active over Female Active (%) and Single Male Active over Male Active (%) Own computations from Department of Statistics (2022c, Table 5.1) from 2000-2016, and Department of Statistics (2022d) from 2017-2020.

Figure 16

- Male Main Current Economic Activity (percentage) and Female Main Current Economic Activity (percentage): Department of Statistics (2022c, Table 5.18) from 2000-2016, and Department of Statistics (2022c, Table 4.4 (only Jordanian)) from 2017-2020.

Figure 17

- The Cost of Marriage in Jordan (in 2010 Jordan Dinars): Salem (2014, Table 7.10) from 1970-2010. For period 2012-2016 we have taken data from Sieverding et al. (2018, Table 7) and multiplied the (real) growth rate of the cost of marriage between the periods 2005-2009 and 2012-2016.
- Average real wage (in 2010 Jordan Dinars): Own computations from Department of Statistics (2022a, 2022b) and World Bank (2022d) (see Appendix A.1). To obtain the

series of average real wage in 2010 Jordan Dinars, we have multiplied the series of the real wage by the CPI of 2016 (column (6) in Table A.1) and divided the result by 100.

Figure 18

- The Cost of Marriage over (real) wages: Own computations dividing The Cost of Marriage in Jordan (in 2010 Jordan Dinars) from Figure 17, by the *real wage (in 2010 Jordan Dinars)* computed in Section A.1, range 1976-2019.
- The Cost of Marriage over expected (real) wages, age 15-24: Own computations dividing The Cost of Marriage in Jordan (in 2010 Jordan Dinars) from Figure 17 by the expected real wage (in 2010 Jordan Dinars). *Expected real wage (in 2010 Jordan Dinars)* is computed by multiplying the *real wage (in 2010 Jordan Dinars)*, computed in Section A.1, times the probability a young male ages 15-24 finds a job. The probability a young male ages 15-24 finds a job is 1 minus the young-male-age-15-24, unemployment rate, i.e. the *Unemployment, youth male (% of male labor force ages 15-24) (modeled ILO estimate)* World Bank (2022d, series SL.UEM.1524.MA.ZS), range 1976-2019. Thus, we are implicitly assuming that finding a job follows an independent and identically distributed process.
- The Cost of Marriage over expected (real) wages, single male: Own computations dividing The Cost of Marriage in Jordan (in 2010 Jordan Dinars) from Figure 17 by the expected real wage (in 2010 Jordan Dinars). *Expected real wage (in 2010 Jordan Dinars)* is computed by multiplying the *real wage (in 2010 Jordan Dinars)*, computed in Section A.1, times the probability a single male finds a job. The probability a single male age finds a job is 1 minus the single-male, unemployment rate, i.e. the Single Male Unemployment rate (%) Department of Statistics (2022c), Table 5.1 from 2000-2016, and Department of Statistics (2022d) from 2017-2020, range 2000-2019. Thus, we are implicitly assuming that finding a job follows an independent and identically distributed process.

Figure 19

- Agree: the percentage of *strongly agree* and *agree* answers with the statement *Men should have more right to a job than women*, Own computation from the World Values Survey, Inglehart et al. (2022).

Daniel Gomes Fernandes
Nova School of Business and Economics
daniel.gomes.fernandes@outlook.com
DOI: https://doi.org/10.14195/2183-203X_55_2

Business Cycle Accounting for the COVID-19 Recession

Contabilidade de Ciclos Económicos na Recessão Covid-19

Daniel Gomes Fernandes

Received for publication: January 14, 2022
Revision accepted for publication: April 15, 2022

ABSTRACT
We apply the Business Cycle Accounting framework to the COVID-19 recession in the Euro Area and the United States of America. We conclude that the efficiency wedge had the most important role in the Euro Area, followed by the labor and investment wedges. In the United States, the labor wedge was most crucial, with the investment wedge coming in second. We present hypotheses, supported by our theoretical framework, for the dichotomy of the role of the efficiency wedge between the studied regions.
Keywords: COVID-19; business cycle accounting; macroeconomics; financial crises; financial frictions; wedges.

JEL Classification: E32; E44

Acknowledgements: I am grateful for funding provided by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, LISBOA 01 0145 FEDER 022209), POR Lisboa (LISBOA 01 0145 FEDER 007722, LISBOA 01 0145 FEDER 022209), POR Norte (LISBOA 01 0145 FEDER 022209) and CEECIND/02747/2018. A special thanks is also due to Prof. Pedro Brinca.

1. Introduction

The COVID-19 pandemic has objectively left a heavy mark on the world: as of December 2021, 272 million people have been infected by it, and more than 5 million people have deceased due to it, worldwide. However, the consequences of this pandemic were not only health-related as global supply chains were also dismantled, record high uncertainty stroke financial markets, and, to control the spread of the virus and its consequential loss of life, countries all over the world implemented social distancing norms. Most countries, during the initial and most severe phases of the pandemic, set restrictions to non-essential economic activities, thus disrupting consumption channels and labor markets.

Given the unconventional nature of this recession, and the difficulty of comparing its corresponding shocks with past studied events, researchers have struggled to decide which kinds of market frictions to add, when structuring their models. This creates space in covid-related literature to Business Cycle Accounting (BCA) exercises. BCA has its theoretical background on the neoclassical growth model, an area of economics pioneered by Abramovitz (1956) and Solow (1957). More specifically, it builds on Real Business Cycle modeling, introduced by Kydland and Prescott (1982), by deviating from the modelling of perfectly competitive markets with its introduction of wedges, which are representations of distortions of the equilibrium decisions of economic agents.

BCA, first introduced by Chari et al. (2002), is a method to infer which frictions are the most relevant in explaining macroeconomic fluctuations. It consists in two stages: 1) using a prototype economy to calculate wedges, and inputting them back in it, individually or in groups, to conclude which have the most quantitative relevance for economic observables; 2) implementing equivalence theorems, which are equivalence links between detailed economies/models and the prototype economy.

This paper applies this type of exercise to the economies of the Euro Area and United States, on the aftermath of the inception of the COVID-19 pandemic (2019:Q4-2021:Q2, in the case of the Euro Area, 2019:Q4-2021:Q3, in the case of the United States). We estimate four wedges: the efficiency wedge, the labor wedge, the investment wedge, and the government wedge. Since the literature for this most recent pandemic is still developing, there are no models to prove the equivalence results. Therefore, the focus of this paper is not the investigation of the origins of the economic shock caused by the pandemic, but to infer how each economy absorbed the shocks. This paper not only adds to the literature by directing interested researchers to the mechanisms most useful to understand fluctuations of economic indicators, but also hypothesizes how these mechanisms played out during the COVID-19 recession and its consequent recovery.

The rest of this paper is structured as follows: first, we summarize the research developments made in the area of BCA; second, we present the theoretical framework behind the used model; subsequently, we delineate the methods and sources used to come to the variables we describe in the theoretical framework; third, we present the results and analyze which wedges perform the best; and, finally, the conclusion summarizes the discussion.

2. Literature Review

Chari et al. (2002) introduces the first Business Cycle Accounting (BCA) exercise as an approach to model macroeconomic fluctuations using market distortions which were discussed in the literature as useful and realistic additions to the neoclassical growth model. Chari et al. (2005) adds to the BCA literature by introducing a government wedge. Chari et al. (2007a) consolidates previous BCA literature and builds on its theoretical framework.

Christiano and Davis (2006) criticizes the BCA exercise presented in Chari et al. (2007a) on two fronts: 1) some spillovers may be left out, since the model only identifies the transmission mechanisms of shocks, not the source of shocks; 2) the investment wedge's involvement, due to its specification, seems to be hindered by environmental changes (sometimes shifting the manifestation of financial shocks to other wedges, for example), with the authors suggesting a new distortion, the capital wedge. Chari et al. (2007b) responds to these criticisms with three arguments: 1) they prove that changing between the investment and capital wedges does not change equilibrium allocations; 2) they justify how their theoretical framework has a stronger footing in the literature; 3) using variance decomposition of forecast errors, they prove that the investment wedge does, in fact, absorb a moderate share of a financial shock.

Since Chari et al. (2007a), BCA has been applied to a wide range of periods, countries, and regions.[1] In addition, several alternative BCA methods were introduced, namely: Open-Economy BCA, which introduces distortions related to the international flows of debt, and was pioneered by He et al. (2009) and Otsu (2010b); International BCA, which adds frictions related to international prices and international trade, thus separating net exports from government spending, and was introduced by Otsu (2010a) and Hirata & Otsu (2011); and Monetary BCA, which includes disturbances associated with asset holdings and monetary policy, first applied by Sustek (2011) and Brinca (2013). Brinca et al. (2020) summarizes the theoretical background of these alternative methods, while providing an extensive review of the BCA literature.

3. Methodology

The BCA exercise proposed by Chari et al. (2007a) can be segmented in two different procedures: the accounting procedure and the equivalence result.

The accounting procedure comprises two different processes. The first, focuses in identifying four wedges: the efficiency wedge, the labor wedge, the investment wedge, and the government wedge. They were named this way, because at face-value they could be interpreted as productivity, labor income taxes, investment taxes and government consumption, respectively. Researchers should, nonetheless, be wary of interpreting the fluctuations of wedges as being caused by the variables referenced in their face-value names, since, for example, Mendoza (2010) shows that input-financing frictions are manifested through the efficiency, labor, and investment wedges, and not only through the investment wedge. The wedges should not thus be interpreted as identifiers of the origin of a given shock, but rather as a

[1] See Brinca (2014) and Dooyeon and Doblas-Madrid (2012) for two examples.

transmission mechanism, a channel through which the economy absorbs the shock. Wedges are calculated using a prototype economy. Given the origins of this accounting exercise being so closely linked to the neoclassical growth model, we assume that, inside the boundaries of our theoretical framework, agents are rational and that their resource-allocation decision in each period is based on the history of past realizations of said wedges in the economy.

The second process involves inputting the wedges back into the prototype economy, either one at a time, or by group. Since, by construction, the four wedges account for the entirety of macroeconomic fluctuations, feeding them all back would result in the replication of the observed data. The goal of this section is to understand which wedges (or group of wedges) can be the better predictors of some of the main economic indicators: output, labor, investment, and private consumption.

The equivalence result consists on the possibility of mapping a detailed economy with frictions into a prototype model with wedges. These mappings ensure that equilibrium allocations in both economies are the same, making the models observationally equivalent. The usefulness of the procedure is that by understanding which wedge is quantitatively more relevant, the appropriate equivalence theorems (for example between a detailed economy with sticky prices and the prototype economy with a labor wedge) can guide researchers into introducing additional mechanisms in the proper derivates of a standard Business Cycle Model. Chari et al. (2007a) and Brinca et al. (2016) present the theoretical proof of the equivalence result between the prototype economy and several detailed economies.

3.1. The prototype economy

Much like Chari et al. (2007) and Brinca et al. (2016), the model I use to represent the prototype economy is a stochastic growth model, where in each period t the economy will be impacted by a finite number of different events, s_t. The historical of all events in the economy up to moment t is denoted by $S^t = (s_0, \ldots, s_t)$. The economic historical, S^t, determines current values of economic variables and is considered by the economic agents when predicting future values. The consumer population will maximize their expected lifetime utility, that is:

$$\sum_{t=0}^{\infty} \sum_{s^t} \pi_t(S^t) \beta^t U(c_t(S^t), l_t(S^t)) N_t, \tag{1}$$

where $\pi_t(S^t)$ is the probability of S^t, β is the discounting factor, $U(.)$ is the utility function of a representative consumer, $c_t(S^t)$ is consumption per capita, $l_t(S^t)$ is labor supplied per capita, and N_t is the population size. The utility function is represented by:

$$U(c_t(S^t), l_t(S^t)) = \ln[c_t(S^t)] + \psi \ln[1 - l_t(S^t)], \tag{2}$$

where ψ is the time allocation parameter. Each representative consumer's utility will be limited by the following budget constraint:

$$c_t(S^t) + (1 + \tau_{x,t}(S^t))\, x_t(S^t) = (1 - \tau_{l,t}(S^t))\, w_t(S^t) l_t(S^t) + r_t(S^t) k_t(S^t) + T_t(S^t), \tag{3}$$

where $1/(1+\tau_{tx})$ is the investment wedge, x_t is investment per capita, $(1-\tau_{lx})$ is the labor wedge, w_t is the real wage rate, r_t is the real rate of return of capital, k_t is capital holdings per capita and T_t are lump-sum subsidies from the government per capita. In this model, the law of capital accumulation follows the following equation:

$$(1-\gamma_N)k_{t+1}(S^t) = (1-\delta)k_t(S^t) + x_t(S^t) + \Phi\left(\frac{x_t(S^t)}{k_{t-1}(S^t)}\right), \tag{4}$$

where δ is the depreciation rate and $\Phi\left(\frac{x_t(S^t)}{k_{t-1}(S^t)}\right)$ is the adjustment cost of capital, given by (Brinca et al., 2020):

$$\phi\left(\frac{x_t(S^t)}{k_{t-1}(S^t)}\right) = \frac{a}{2}\left(\frac{x_t(S^t)}{k_{t-1}(S^t)} - \delta - \gamma - \gamma_N\right)^2, \tag{5}$$

where a determines the marginal capital adjustment costs, γ is the growth rate of the technical ability of labor and γ_N is the population growth rate. In this economy, there are also firms, which produce according to the following equation:

$$\gamma_t(S^t) = A_t(S^t)F(k_t(S^{t-1}), (1+\gamma)^t l_t(S^t)), \tag{6}$$

where $A_t(S^t)$ is the efficiency wedge and $F(.)$ is the production function, represented by:

$$F(k_t(S^{t-1}), (1+\gamma)^t l_t(S^t)) = k_t(S^{t-1})^a[(1+\gamma)^t l_t(S^t)]^{1-a}, \tag{7}$$

where α is the share of capital.

Finally, the firms' profit function is:

$$\Pi_t(S^t) = \gamma_t(S^t) - w_t(S^t)l_t(S^t) - r_t(S^t)k_t(S^{t-1}). \tag{8}$$

The equilibrium of the prototype economy can then be found with four equations: the production function (6); the national resource constraint:

$$y_t(S^t) = c_t(S^t) + g_t(S^t) + x_t(S^t), \tag{9}$$

where $g_t(S^t)$ is the government wedge; the function that captures the intra-temporal decision between labor and leisure:

$$-\frac{U_{l,t}(S^t)}{U_{c,t}(S^t)} = (1-\tau_{lt}(S^t))A_t(S^t)(1+\gamma)F_{l,t}, \tag{10}$$

where $U_{l,t}$ is the first-order derivative of the utility function with respect to labor, $U_{c,t}$ is the first-order derivative of the utility function with respect to consumption and $F_{l,t}$ is the first-order derivative of the production function with respect to labor; and the function that captures the inter-temporal decision between consumption and savings:

$$U_{c,t}(S^t)(1+\tau_{xt}(S^t)) = \beta\sum_{S^t}\pi_t(S^{t+1}\mid S^t)\left[U_{c,t}(S^t)(A_{t+1}(S^{t+1})F_{k,t} + (1-\delta)(1+\tau_{x,t+1}(S^{t+1})) + \phi_{k,t+1}\right], \tag{11}$$

where $\pi_t(S^{t+1}|S^t)$ is the conditional probability of S^{t+1} given S^t and can also be represented by $\pi_t(S^{t+1})/\pi_t(S^t)$, and $\Phi_{k,t+1}$is the first order derivate of the capital adjustment cost function with respect to capital. Equations(10) and (11) are respectively obtained by the utility and profit maximizing decisions of consumers and firms. Solving each equation for a wedge, we have:

$$A_t(S^t) = \frac{F\left(k_t(S^{t-1}),(1+\gamma)^t l_t(S^t)\right)}{y_t(S^t)}, \tag{12}$$

$$g_t(S^t) = y_t(S^t) - c_t(S^t) - x_t(S^t), \tag{13}$$

$$\left(1-\tau_{l,t}(S^t)\right) = -\frac{U_{l,t}(S^t)}{U_{c,t}(S^t)A_t(S^t)(1+\gamma)F_{l,t}}, \tag{14}$$

$$\frac{1}{\left(1+\tau_{x,t}(S^t)\right)} = \frac{U_{c,t}(S^t)}{\beta\Sigma S^t \pi_t(S^{t+1}|S^t)\left[U_{c,t}(S^t)\left(A_{t+1}(S^{t+1})F_{k,t}+(1-\delta)\left(1+\tau_{x,t+1}(S^{t+1})\right)\right)+\phi_{k,t+1}\right]} \tag{15}$$

To get the equilibrium of the prototype economy, we need to do some assumptions. First, we assume:

$$k_0 = x_0, \tag{16}$$

to be able to get a value for capital for period 0. I will also assume values for parameters in the following chapter. With data on l_t, x_t, y_t, g_t and c_t, we can solve equations (12), (13) and (14), but not (15), since it holds an expectation term, $\pi_t(S^{t+1}|S^t)$. Just as Chari et al. (2007a) and Brinca et al. (2016), we will assume that expectations follow a first-order Markov process:

$$\pi_t(s_t|S^{t-1}) = \pi_t(s_t|s_{t-1}), \tag{17}$$

meaning that the conditional probability of S^t is the same whether we are taking in account all the historical events prior to the current period, S^{t-1}, or only the events of the previous period S_{t-1}. Hence, expectations for period $t+1$ can be estimated with only S_t. If we also assume that the events S_t are mapped one-to-one to the wedges:

$$s_t = \left[A_t, 1-\tau_{l,t}, \frac{1}{(1+\tau_{x,t})}, g_t\right], \tag{18}$$

we can create a first-order autoregressive process for S_{t+1}:

$$s_{t+1} = P_0 + Ps_t + \varepsilon_{t+1}, \tag{19}$$

where P_0 is a vector of constants, P is a 4x4 matrix of coefficients, and ε_{t+1} is a zero mean, independent and identically distributed, error term vector, which represents randomized exogenous shocks to the economy. The previously referenced stochastic character of the prototype economy has its root in this autoregressive process. ε_{t+1} 's covariance matrix, V, is semi-definite positive by construct. This way, there will be spillover effects between the wedges, not only due to the coefficient matrix, P, but also due to the error term's covariance

matrix, V. This autoregressive process will be solved by applying a standard maximum likelihood procedure using the log-linear versions of the previously presented decision rules and six final variables which we describe in the next chapter.

4. Data and Application Details

We use quarterly data between 1995:Q1-2021:Q2, for the Euro Area, and 1965:Q1-2021:Q3, for the United States. The estimated periods were solely determined by the intersection of the periods with available data between the used data sources. The fifteen countries included to compute the aggregate values for the Euro Area were also determined by the intersection of the countries with available data, and are available in Annex I. Even though the USA states are much more synchronized in terms of business cycles than the Euro Area countries, the latter also shows a considerable degree of synchronization,[2] especially in core countries, which motivates this comparative exercise.

To be able to simulate the *prototype economy* and estimate the wedges, we use data for the United States and the Euro Area, of the following variables, with the following sources: gross capital formation (investment), GDP (output), private final consumption, government final consumption, exports of goods and services, imports of goods and services, hours worked, total employment and the GDP deflator, from the *OECD Economics Outlook* database, with the exception of exports and imports of goods and services for the Euro Area, which are from the *IMF Data* database; size of population aged between 15-64 from the *OECD.Stat* database; consumption of durable goods from the *OECD National Account Statistics* database; and average tax rate on goods and services from *OECD Data* database. The *IMF Data* database was used to calculate exports and imports out of and to the Euro Area, because it has a feature which discriminates the exports (imports) to (from) the country chosen by the user. This way, we can subtract the goods and services that the Euro Area exports and imports to and from itself from the aggregate values, as well as adjust for the exclusion of some of the Euro Area countries.

Hours worked and total employment will be used to calculate total labor. Net exports will be combined with government expenditure and be considered as one variable, g_t. Therefore, the *government wedge* will also capture fluctuations of the participation of the *prototype economy* in the international market of goods and services. For equivalence result purposes, an open economy model can be mapped into a closed economy in which net exports are added with government consumption, as proven in Chari et al. (2005). This also allows the study of international transmission of shocks.[3] The GDP deflator will be used as the price level, to obtain the real values of the economic variables.

To approach the economic decisions that most resemble the ones described in the last sub-chapter, we will need to do several adjustments to our variables. We will consider the consumption of durable goods as investment, needing thus to subtract the consumption of durable goods from total consumption and add it to investment. Assuming a depreciation

[2] See Aguiar-Conraria et al. (2017).

[3] See Brinca and Costa-Filho (2021a).

rate, δ_D, and a return rate, r_D, for the stock of consumption durables, we will also add back the depreciation and return values to consumption and, to maintain the resource constraint [equation (9)], to output too. We will also subtract the taxes of goods and services regarding the consumption of durables from investment and will subtract the rest from private consumption. To maintain the resource constraint [equation (9)], total taxes on consumption of goods and services will also be subtracted from output. Finally, the population size aged between 15-64 will be used to obtain the per capita version of the economic variables and population growth rate, γ_N, instead of total population size.

After all initial computations, we remain with five final variables which will be used to solve the maximum likelihood procedure described in the last section: output per capita; investment per capita; hours worked per capita; government consumption per capita; and private consumption per capita. These variables are logged and from them is removed their country/region-specific trend.

Looking at the fluctuation of the final variables during our period of study, during the first half of 2020, we can see a similar pattern in both studied regions: government consumption slightly increases, while the rest of the variables plummet. In spite of this, the recovery of these four indicators in each economy is contrasting: In the Euro Area, after a quick recovery, the most affected indicators either stagnate or fluctuate back downwards and upward; In the United States, the recovery process is much more successful, with hours worked being the only variable that couldn't retain its 2019:Q4 value. The initial drop in indicators in both regions, and subsequent drop of private consumption in the Euro Area coincides with the first and third wave of the pandemic, which indicate restrictions of economic activities as its main cause. The hike of U.S. investment can be partially explained by the 30% increase of consumption of durables, but more on that later.

Another interesting differentiation is the initial impact of hours worked, which, out of the initially affected variables, was the one with the smallest drop in the Euro Area, albeit being the most affected in the United States. This may be due to two reasons: 1) the more effective job retention schemes which European countries implemented, which alleviated the impact of the pandemic on the labor market and household income; 2) differentiation in unemployment accounting, as in the U.S., workers in lay-off are considered unemployed, while in the Euro Area, they are not (Anderton et. al 2020). Finally, the United States experienced a major decline of government consumption. This can be explained by net exports since it decreased almost 70% during the studied period.

Table 1: Model parameters

Region/Country	γ_N	γ	a	β	ψ	δ	α	δ_D	r_D
Euro Area	0.0003	0.0026	16.025	0.9937	2.5	0.0127	0.3333	0.0574	0.01
United States	0.0027	0.0045	12.563						

Notes: Parameters are rounded to the fourth decimal place; γ_N, γ are endogenous to the model.

The exogenous values of the model parameters, given in Table 1, were taken from Brinca et al. (2016) and chosen such that the annualized discounting factor, β, is 0.975; the annualized depreciation rate δ, is around 5%; the annualized depreciation rate of durables, δ_D, is 25%; and the annualized return rate of durables, r_D, is close to 4%. Following Bernanke et al. (1999) the parameter which determines the marginal capital adjustment costs, a, is such that the elasticity, $\eta = a(\delta + \gamma + \gamma_N)$, of the price of capital in regard to the investment-capital ratio, $\rho = \dfrac{1}{1 - \phi(.)}$, equals 0.25.

5. **Results**

In Table 2 we display the parameters' matrixes regarding equation (19), which are estimated using a maximum likelihood process. The coefficient matrix of the Euro Area presents higher spillover effects between the variables, in comparison with the coefficient matrix of the United States.[4]

The rest of this chapter will be divided in three sub-chapters, the first two analyze the results for each region, and the third discusses the results. The wedges and economic variables presented in this section are all detrended and indexed with the peak quarter as its base, which as reported by the National Bureau of Economic Research, is the fourth quarter of 2019.

Table 2: Parameters of the stochastic AR(1) process, estimated using maximum likelihood

Coefficient Matrix, P					Standard Deviation Matrix, Q ($V = QQ'$)			
Euro Area (1995:Q1-2021:Q2)								
0.867	0.280	0.027	0.007		0.016	-0.007	0.011	0.002
0.072	0.956	0.133	-0.003		-0.007	0.005	-0.009	0.001
-0.145	0.0157	0.666	-0.013		0.011	-0.009	-0.004	-0.002
0	-0.167	-0.194	0.976		0.002	0.001	-0.002	0.007
Mean of States, $\bar{s}_t$ = [1.088, 0.512, -0.221, 0.182]					P_0 = [-0.1139, 0.0409, -0.0920, 0.0014]			
United States (1965:Q1-2021:Q3)								
0.937	0.042	0.045	-0.017		0.010	0.001	0.002	0
-0.033	1	0.054	-0.006		0.001	0.011	-0.004	0.001
0.063	-0.031	0.941	0.015		0.002	-0.004	0.013	0.016
0.090	-0.045	-0.022	1.012		0	0.001	0.016	-0.014
Mean of States, $\bar{s}_t$ = [1.144, 0.348, 0.090, 0.165]					P_0 = [-0.0411, -0.0113, 0.0340, 0.0280]			

Notes: Parameters are rounded to the third decimal place. Mean of States are given in absolute values.

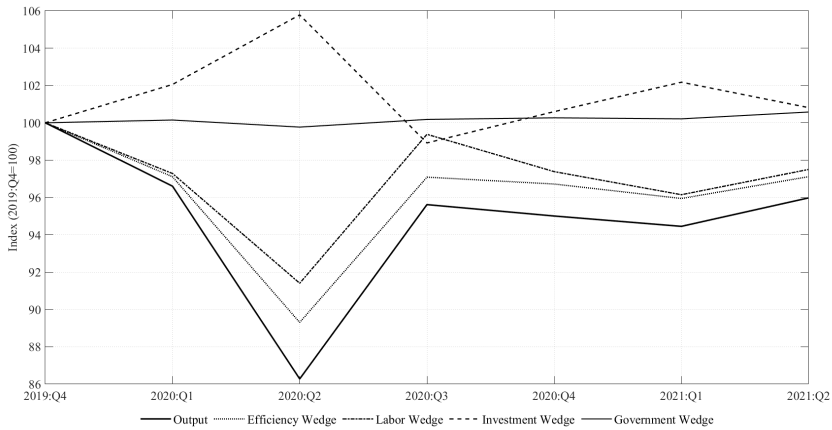
[4] For parameter identification issues, see Brinca et al. (2022).

5.1. Euro area

The investment wedge, contradicting its historical record, has a strong negative correlation with output, seemingly oppositely mirroring its movements. The government wedge holds absolutely no correlation with output, although historically it presents a modest negative correlation with output from the two preceding quarters, hinting at a lag of fiscal policy. The efficiency wedge is the one which most correlates with output, although its standard deviation is much smaller. The labor wedge's movement mimics that of output the most, due to its strong correlation and close standard deviation with output.

This, however, does not mean that the labor wedge is the best predictor of outcome, something that is best exemplified in Figure 1, which portrays output and the prototype economy's prediction of output when only inputting a wedge at a time. Actual output was worse than any wedge's prediction. The contribution of the efficiency wedge, as in last recessions, seems to be the strongest. Its predicted values of output are the closest to the actual values in all studied periods. Additionally, they virtually perfectly correlate with actual values, and their standard deviation is the closest to that of actual output. If the disturbance mechanism behind it was the only one in the economy, until 2020:Q2 output's decrease would have been 3% lower.

Figure 1: Output and modeled output with one wedge (Indexed, Euro Area, 2019:Q4-2021:Q2)



The labor wedge also seems to be a good predictor of output as well, as the correlation of its model values with output is 0.95. This, along with the 33% lower standard deviation, is an indication that, if it was the only wedge in the economy, output wouldn't have decreased has much during the first wave of the pandemic, by about 5%.

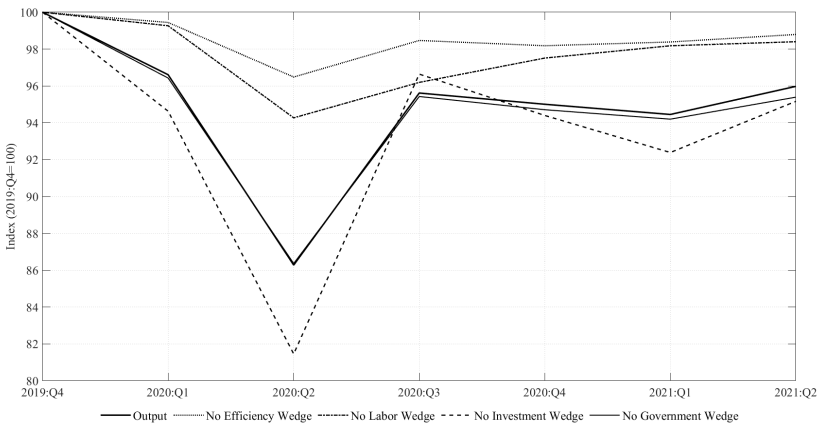
The government wedge's predicted values present the weakest correlation with and the farthest standard deviation of that of actual output, which is a signal that it does not capture

any disruption mechanism that is essential to understand to study the economy of the Euro Area during the COVID-19 Recession. Historically, its contribution is negligible as well.

The investment wedge's predicted values differ the most from the real ones, with the correlation between them being -0.84. They also fluctuated significantly less than output, by about 47%. Historically, its correlation with output is mediocre, although its correlation with the prediction values of the labor wedge is a very strong -0.91, which can be a sign of a mechanism of decreased savings in bonanzas and increased savings in periods of higher labor uncertainty, or of compensation between labor and capital, when there are market disruptions.

This relation between the investment wedge's predictions and actual output should not lead to any conclusions that disruptions in the investment market are not an important component of output. In Figure 2, we display the prototype economy's predicted values of output when we input all but one of the wedges. As we can see, even though when we exclude the investment wedge, the model's predictions are the second best, it seems that its inclusion somewhat offsets the excessive negative impact that the combination of the efficiency and labor wedges have on output. When we exclude it, predicted output falls 4.2% more than actual output during the first half of 2020. The investment wedge's positive impact on outcome seem to coincide with the periods associated with the strongest restrictions to economic activity, during the first and third wave of the pandemic. Note also that financial frictions must not necessarily be mapped onto the investment wedge. The financial system has two main functions: channel resources to their most efficient uses and transfer resources across time and states of the world. Obstacles to the latter will show up as distortions to equation (11), and thus, the investment wedge. Nonetheless, the former is essentially a misallocation issue, and as such, it will be captured by the efficiency wedge.[5]

Figure 2: Output and modeled output with all but one wedge (Indexed, Euro Area, 2019:Q4-2021:Q2)



[5] For an example of a model with financial frictions that show up in the efficiency wedge, see Brinca and Costa-Filho (2021b).

The model's predictions when excluding the other wedges were much more predictable: when excluding the government wedge, the prototype economy nearly perfectly predicts actual values of output, diverging slightly during the last two studied quarters; when excluding the labor and efficiency wedges, the model's predictions are much more positive, which is a further indication of the negative impact these disruptions had on output during the analyzed period.

To conclude our inference on which wedges most influence output, we present each model prediction's θ statistic, as in Brinca et al. (2016):

$$\theta_i^Y = \frac{1/\Sigma_t \left(Y_t - Y_{t,i}\right)^2}{\Sigma_j 1/\Sigma_t \left(Y_t - Y_{t,j}\right)^2}$$

where Y_t is detrended output and $Y_{t,i}$ is the prototype economy's prediction of output using wedge i (or all wedges with the exception of wedge i). The better the output prediction is, the smaller $(Y_t - Y_{t,i})$ will be, and hence, the closer the θ statistic will be from 1.

In Table 3 we display the θ statistics for the Euro Area. Taking in account one wedge economies, the efficiency wedge displays the biggest contribution to output, with the labor wedge taking a distant second place. Taking in account all but one wedge economies, however, only the government wedge appears to have an unimportant contribution to output. Considering our previous explanation of the dichotomy between the seemingly unimportance of the investment wedge in the one wedge economies and the modest contribution in the all but one wedge economies, it takes us to infer that only the government wedge had an insignificant effect on output, with the efficiency wedge taking center stage.

Table 3: The contribution of each wedge in the variation of output (Euro Area, 2019:Q4-2021:Q2)

θ_e^Y	θ_l^Y	θ_x^Y	θ_g^Y
One Wedge Economies			
69%	24%	2%	4%
All But One Wedge Economies			
86%	78%	36%	---- (Excluded from the calculation)

Notes: The reported values are rounded to the second decimal place. For better interpretation, the All But One Wedge Economies present $(1 - \theta)$, instead of θ. The predictive power of the model without this government wedge was too strong, distorting the θ statistic of other wedges, making them appear to contribute more than they actually do. Table with complete statistics can be found in Annex II.

In terms of other economic variables, the labor wedge, unsurprisingly, is the best predictor of detrended hours worked in one wedge economies. Its predicted values have a correlation of 0.90 with hours worked, only surpassed by the efficiency wedge's, which is 0.99. Nevertheless, the low standard deviation of the predicted values by the efficiency wedge, 54% lower than that of hours worked, hints at a weaker impact in the labor market, in comparison with the labor wedge.

Table 4: The contribution of each wedge in the variation of economic variables (Euro Area, 2019:Q4-2021:Q2)

θ_e^H	θ_l^H	θ_x^H	θ_g^H	θ_e^X	θ_l^X	θ_x^X	θ_g^X	θ_e^C	θ_l^C	θ_x^C	θ_g^C
One wedge economies											
36%	50%	4%	11%	62%	27%	2%	9%	29%	36%	50%	4%
All but one wedge economies											
26%	94%	81%	*----	79%	54%	68%	----	95%	96%	83%	26%

Notes: Parameters are rounded to the second decimal place. For better interpretation, the All but one wedge economies present $(1 - \theta)$, instead of θ; The predictive power of the model without the government wedge was too strong, distorting the θ statistic of other wedges, making them appear to contribute more than they actually do. The table with complete calculation can be found in Annex II.

In all but one wedge economies, a similar scenario as in output's modelling happens: the government wedge is the only disturbance whose impact is irrelevant, but this time the labor wedge takes center stage, with the investment wedge on a close second.

The investment wedge has the same offsetting effect as in output, as detrended hours worked would have decreased 7.5% more than the actual 9% if its fluctuation had been null.

Investment's modelling follows a similar layout as output: in one wedge economies, the efficiency wedge's prediction values are the best, followed by the labor wedge, at a far second, while the investment wedge looks inconsequential; in all but one wedge economies, only the government wedge's effect is negligible, while the θ statistic indicates that the investment wedge contributes more than the labor wedge.

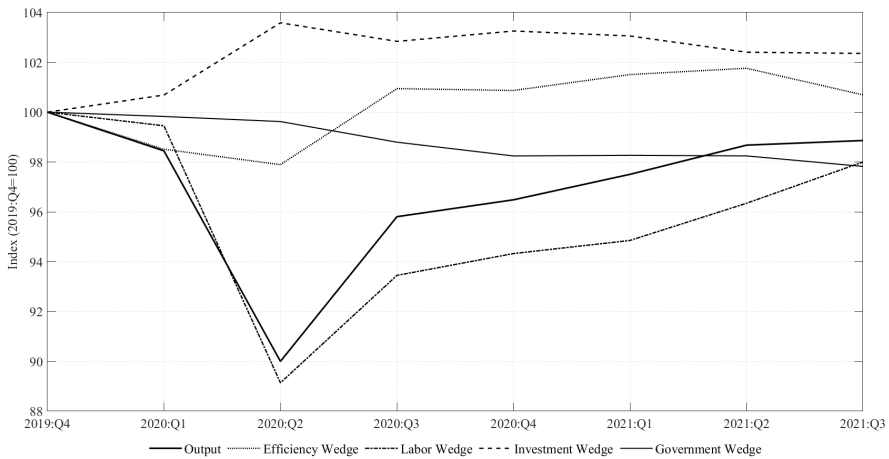
Private consumption's modelling has a varying feature in comparison with the other variables, which is a strong positive correlation between the investment wedge's predictions and actual values, of 0.96, so there is no offsetting mechanism. This, along with the closest standard deviation to actual consumption, makes it the best predictor in one wedge economies, although the contribution of the labor and efficiency wedges is much more evenly allocated, since their forecasts are the most correlated with actual values. In all but one wedge economies, and considering all wedges, the prototype economy manifests its most accurate predictions, although the government wedge still has the least vital contribution.

5.2. United States

Generally, we can say that the United States wedges are more heterogeneous than the Euro Area ones. Their relative fluctuation is higher too, with average standard deviation being 30% higher than that of its output, while in the Euro Area it is 16% lower. This is due to a more stable output. The investment wedge, as in the Euro Area, seems to be oppositely mirroring output, although historically, except during the Great Recession, it has

no correlation with it. The government wedge has the weakest correlation with output and the standard deviation furthest away from that of output, being 101% higher. The efficiency wedge, despite having a moderate correlation with output, barely fluctuates. The labor wedge seems to be the one whose motion most closely imitates output, having the highest correlation with it. Historically, it also seems to be the most important wedge.

Figure 3: Output and modeled output with one wedge (Indexed, United States, 2019:Q4-2021:Q3)



The argument for the importance of the labor wedge continues in Figure 3, which presents output along with the one wedge economies' prediction of output. Not only the labor wedge's forecast values correlation of 0.93 with output is high, but its standard deviation only surpasses output's by 14%. If the labor market's disturbance mechanisms were the only in the economy, output would have decreased only 0.9% more than in reality, albeit it persisted below actual values between 2.3% and 2.6% of the base value, during the proceeding years. This apparent intense contribution to output variation may be due to the record high unemployment, whose rate increased from 4.4% to 14.8%, between March and April 2020.[6] Historically, it fluctuates along real values, having a correlation of 0.77 with them, despite diverging away from them only five years before the base period.

The government wedge seems to have a very negligible role in setting up output, as its predicted values decreased very gradually along the entire studied period, stagnating for three quarters, between the end of 2020 and middle of 2021. This is best exemplified by its standard deviation and correlation with output, both the lowest and weakest among the wedges' forecasts, being 73% lower than that of output and -0.18, respectively. Historically, it has a somewhat stronger negative correlation with output, with the 1990s and initial period of the Great Recession showcasing this relation the best.

[6] See Annex IV.

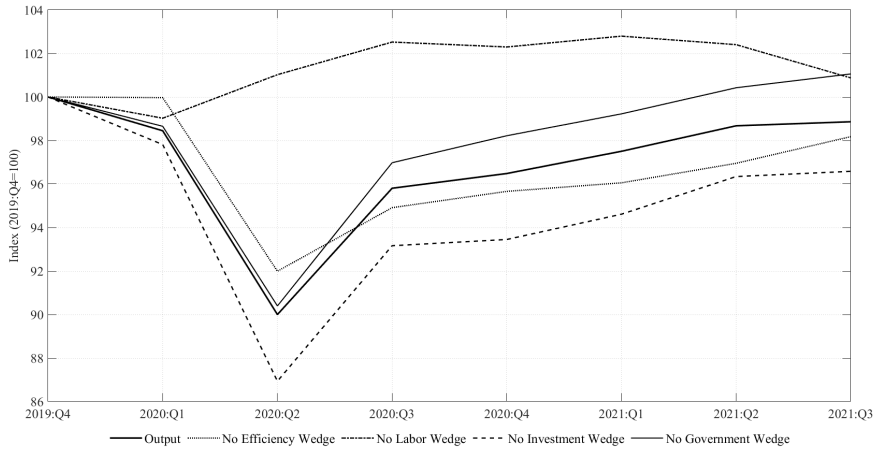
The investment wedge also seems to be a poor sole predictor of output: when only imputing it back in the prototype economy, it estimates output fluctuations which oppositely mirror actual output, increasing 3.6% until 2020:Q2 and then consistently and slowly decreasing until reaching a value 2.4% higher than the base value. Its negative correlation with output is moderately strong, although its standard deviation is 59% lower than that of output. Historically, it has a negligible correlation with output, although it fluctuated along it during the Great Recession and the preceding years.

The efficiency wedge's contribution to output in the United States contrasts with that of the Euro Area, as it has a much lower correlation with its output and a much lower relative standard deviation, 54.5% lower than that of output. Nonetheless, with the exception of the last studied quarter, it fluctuates similarly as output, although it surpasses and endures above its base value during and after 2020:Q3. Historically, it has the weakest correlation with output, in spite of having the standard deviation most similar to that of output. Just like the efficiency wedge its fluctuation matches that of output until the middle of the 1980s decade.

For further examination, we display the estimations of output of all but one wedge economies in Figure 4. Excluding the labor wedge results in the biggest discrepancy in predictions, in comparison with the actual values. Had it not been for labor market disruptions, detrended output would actually increase 1% over the first half of 2020, reaching its maximum point of 2.8% above its base value, in the first quarter of 2021, before converging back near its 2019:Q4 reference point until the end of the sample. This is an indication that the labor wedge is a crucial mechanism to study to be able to understand the COVID-19 Recession in the United States. Historically the labor wedge seems unimportant from the 1990s up to the pre-Great Recession period, but the most relevant wedge from the beginning of the sample up the end to of the 1980s, and from the Great Recession until 2017.

Just like in the Euro Area, the investment wedge has an offsetting effect on output. In the absence of investment market disturbances, output would have decreased 13.1% until 2020:Q2, 3.1% more than in reality. This divergence from real values continues until the end of the sample. Estimated output does, however, fluctuate similarly as actual output. This can be justified with the hike in credit deferral during the first wave of the pandemic and the subsequent persistence of a reasonable percentage of deferrals. Historically the absence of the investment wedge seems to affect output the least out of all wedges.

Figure 4: Output and modeled output with all but one wedge (Indexed, United States, 2019:Q4-2021:Q3)



On the opposite side, the government and efficiency wedges have the slightest influence on output: with the absence of government disruptions, output would have barely changed through the first couple quarters of the pandemic, although it overestimates it by a margin of 1.2% to 2.2% until the last quarter of our studied period; with the absence of efficiency disturbances, output would have only decreased 8% until 2020:Q2, although its weaker relative recuperation means it would fall behind actual output by 0.7% and 1.7% until the end of the sample. The government wedge's negative effect on output on the aftermath of the initial economic shock can easily be explained by the strong decrease of net exports depicted in the last chapter.

Table 5: The contribution of each wedge in the variation of output (United States, 2019:Q4-2021:Q3)

θ_e^Y	θ_l^Y	θ_x^Y	θ_g^Y
One Wedge Economies			
12%	67%	5%	16%
All But One Wedge Economies			
55%	98%	87%	61%

Note: The reported values are rounded to the second decimal place. For better interpretation, the All But One Wedge Economies present $(1 - \theta)$, instead of θ.

Looking at the θ statistics for one wedge and all but one wedge economies, shown in Table 5, we can support our argument that, in the U.S., the labor wedge overwhelmingly provides the biggest contribution in explaining fluctuations in output. At a far second place, we would place the investment wedge, whose low θ statistic in one wedge economies can

be excused, given the formula's averse character in dealing with values which contrast real output. In reality, the investment wedge's offsetting feature provides strong complementary predictive value to the labor wedge. The government and efficiency wedges, however, seem to have an ineffective conduct during this last recession. Interestingly enough, the efficiency wedge, which is found to be the one with least explanatory power, is the wedge which is found to be most important in past literature.[7] This further adds to the unconventional nature of the economic shock caused by the COVID-19 pandemic.

Table 6: The contribution of each wedge in the variation of other economic variables (United States, 2019:Q4-2021:Q3)

θ_e^H	θ_l^H	θ_x^H	θ_g^H	θ_e^X	θ_l^X	θ_x^X	θ_g^X	θ_e^C	θ_l^C	θ_x^C	θ_g^C
One Wedge Economies											
8%	76%	3%	13%	73%	5%	3%	20%	6%	57%	31%	5%
All But One Wedge Economies											
----	96%	75%	29%	55%	98.2%	98.1%	49%	50%	95%	94%	62%

Notes: The reported values are rounded to the second decimal place, for values below 98%, and rounded to the third decimal place, for values above 98%. For better interpretation, the All But One Wedge Economies present $(1 - \theta)$, instead of θ. The predictive power of the economy without the efficiency wedge was too strong this wedge was too strong, distorting the θ statistic of other wedges, making them appear to contribute more than they actually do. Table with complete calculation can be found in Annex III.

In terms of estimating other variables, the labor and investment wedges clearly hold the main predictive power for hours worked, with their forecast values having the biggest correlations with it, of 0.92 and -0.52 respectively, and the standard deviations closest to that of it, being 38% higher and 12.1% lower, respectively. The labor wedge seems to be a better estimator though, with the investment wedge taking a moderately distant second place. The efficiency wedge's role here is absolutely null, while the government wedge seems to have a very slight negative effect as net exports plummeted.

In predicting investment values, an interesting anomaly arises: the efficiency and government wedges, which look to be the disturbances with the biggest predictive power in one wedge economies, turn out to be the disturbances with the weakest forecasting power in all but one wedge economies. This happens for two reasons: 1) the labor and investment wedges have very strong contributions of nearly even power, but with much different effects, with labor and investment market disruptions respectively pushing investment downwards and upwards, which results in investment fluctuating around its base value; 2) the forecasts of the efficiency and government wedges hold low standard deviations, respectively 53% and 81% lower than that of investment, which retains them near their base values, thus resulting in a low $(Y_t - Y_{t,i})^2$, and consequently, a high θ statistic. Interestingly enough, the efficiency wedge's estimation values also hold by far the biggest correlation with investment, of 0.91, although that does not seem to translate into predictive power.

[7] See Brinca et al. (2020).

The labor and investment wedges also seem to be the best predictors of private consumption, with their forecasts holding the highest correlations and the standard deviations closest to actual values. Just as with hours worked, the labor wedge hold the strongest predictive power, while the efficiency and government wedges' contribution is unimportant.

5.3. Discussion

Comparing the shock-absorption mechanisms of the studied regions, we can start to paint the bigger picture. The pandemic rose unemployment to record levels in recent history[8], not only due to temporary and permanent closures of businesses, as a consequence of restrictions to economic activity, but also due to older laborers leaving the workforce, to avoid the risk of contagion (Coibion et al., 2020). This decrease of labor was heterogeneous between the U.S. and the Euro Area: in the former, from January 2020 until its peak, seasonally adjusted unemployment surged from 3.5% to 14.8%, while in the latter it only grew from 7.1% to 8.7%[8]. This is due to two reasons: 1) the more effective job retention programs implemented in Europe, since in April, an estimated 32 million workers, which is three times the number of unemployed, were part of these schemes; 2) the different accounting methods between both regions, as, in the U.S., workers in temporary lay-off are considered unemployed, while in the Euro Area, they are not (Anderton et al., 2020). Despite this second point, hours worked decreased 12% in the U.S. (the highest among the main economic variables), in comparison with the 9% of the Euro Area (the lowest among the main economic variables, excluding government consumption). So, although the U.S. also had several job retention schemes, they seem to not have been as effective.

Another important point for the relevance of the *labor wedge* in the U.S. is that two thirds of the of the fall in the growth rate of hours worked, between March and April of 2020, can be attributed to labor supply. The reasoning behind this, as hinted before, may be workers wanting to avoid risk of contagion, since sectors with a smaller share of employees working from home experienced the highest labor supply decreases (Brinca et al. 2021).

This is crucial to understand the mechanism behind our wedges. Assuming a production function as in Equation 6, faced with a negative shock demand, output, Y_t, decreases. If we also assume sticky wages and rental rates, firms' optimal choice would be to decrease the quantity of its inputs, k_t and l_t. This was what happened in the United States, as detrended investment and labor respectively decreased 11.9% and 12% during the first half of 2020, in comparison with output's 10%. Our prototype economy then majorly composes the shock through the labor and investment wedges. In the Euro Area, however, since such a substantial decrease of labor was prevented with job retention programs, for equation (6) to hold, capital, k_t, and/or the efficiency wedge, A_t, had to compensate.

The investment wedge, however, had a positive impact on output of both regions, meaning that, to decrease the capital stock to the firm's optimal level, investment should have dropped even further. The interpretation for this phenomenon may be supported by on one and/or three lines of thinking: 1) given the temporary nature of the recession, firms maintained a

[8] See online appendix, Annex IV.

higher percentage of their capital stock to be prepared for the reopening of the economy; 2) credit deferral and moratorium programs, which contributed to distort the intertemporal decision between consumption and savings (equations (11) and (3)) historically low interest rates, which decreased not only due to the recession, as a consequence of the combination of a decrease in aggregate demand and increase in savings (Jordà et al., 2020), but also due to central banking intervention, as the monetary aggregates were largely increased. The extraordinary increase of the savings rate may be attributed to the consumption channels being blocked due to restrictions to economic activity, but its persistence to remain above pre-pandemic levels, even in periods of economic reopening may be due to record high levels of uncertainty (Baker et al., 2020). In view of investment's reaction, the *efficiency wedge* was forced downwards in the Euro Area.

6. **Conclusion**

This paper intends to provide value added to the BCA literature by guiding researchers to which kinds of disturbances and market frictions they should try to model in order to better examine the economic shock caused by the COVID-19 pandemic, both in the Euro Area and the United States.

Using a prototype economy similar as that displayed in Chari et al. (2007a), we estimated wedges which represent disruptions associated with government consumption, labor markets, investment markets and efficiency. We found that in the Euro Area, the efficiency wedge had a crucial role, while the labor wedge was substantial and the investment wedge was relevant, albeit having a relatively smaller influence. In the United States, however, the labor wedge was the most important disruption, with the investment wedge taking a moderate second place.

In particular, we found that: the differences of the effect the efficiency wedge in each region seems to be originated in the higher effectiveness of European job retention schemes; the labor wedge's fluctuations were largely influenced by restrictions to economic activity which accompanied the pandemic; and the investment wedge's upwards effect on output seems to be rooted by a higher-than-expected capital retention rate, possibly moved by expectations of quick liftings of the restrictions to economic activity, moratorium and credit deferral program, and/or also possibly moved by low interest rates.

References

Abramovitz, M. (1956) Resource and output trends in the United States since 1870. *American Economic Review*, 46(2), 5-23.

Aguiar-Conraria, L. F.; Brinca, P. M.; Guðjónsson, H. V.; Soares, M. J. (2017) Business cycle synchronization across US states. *The BE Journal of Macroeconomics*, *17*(1).

Anderton, R.; Botelho, V.; Consolo da Silva, A. D.; Foroni, C.; Mohr, M.; Vivian, L. (2020) The Impact of the COVID-19 Pandemic on the Euro Area Labor Market. ECB Economic Bulletin 8/2020.

Baker, S. R.; Bloom, N.; Davis, S. J.; Terry, S. J. (2020) COVID-Induced Economic Uncertainty. National Bureau of Economic Research. NBER Working Paper 26983.

Bernanke, B. S.; Gertler, M.; Gilchrist, S. (1999) The Financial Accelerator in a Quantitative Business Cycle Framework. In J. B. Taylor and Michael Woodford (Eds.), *Handbook of Macroeconomics*, Vol. 1. Amsterdam, Elsevier, 1341-1393.

Brinca, P. M. (2013) Monetary business cycle accounting for Sweden. *The BE Journal of Macroeconomics*, *13*(1), 1085-1119.

Brinca, P. M. (2014). Distortions in the neoclassical growth model: A cross-country analysis. *Journal of Economic Dynamics and Control*, 47, 1-19.

Brinca, P. M.; Costa-Filho, J. (2021) Output Falls and the International Transmission of Crises. Retrieved from https://mpra.ub.uni-muenchen.de/107297/. Accessed on 07-12-2021.

Brinca, P. M., and Costa-Filho, J. (2021b) Economic depression in Brazil: the 2014-2016 Fall. Retrieved from https://mpra.ub.uni-muenchen.de/107298/. Accessed on 07-12-2021.

Brinca, P. M.; Iskrev, N.; Loria, F. (2022) On identification issues in business cycle accounting models. In J. J. Dolado, L. Gambetti, and C. Matthes (eds.), *Essays in Honor of Fabio Canova*, Vol. 44A. Bingley, Emerald, 55-138.

Brinca, P. M.; Chari, V. V.; Kehoe, P. J.; McGrattan, E. R. (2016) Accounting for business cycles. In J. B. Taylor and Harald Uhlig (Eds.), *Handbook of Macroeconomics*, Vol. 2. Amsterdam, Elsevier, 1013-1063.

Brinca, P. M.; Costa-Filho, J.; Loria, F. (2020) Business Cycle Accounting: What Have We Learned So Far? Retrieved from https://mpra.ub.uni-muenchen.de/100180/. Accessed on 07-12-2021.

Brinca, P. M.; Duarte, J. B., Castro, M. F. (2021) Measuring labor supply and demand shocks during COVID-19. *European Economic Review*, *139*, 103901.

Chari, V. V.; Kehoe, P. J.; McGrattan, E. R. (2007a) Business cycle accounting. *Econometrica*, *75*(3), 781-836.

Chari, V. V.; Kehoe, P. J.; McGrattan, E. R. (2007b) Comparing Alternative Representations and Alternative Methodologies in Business Cycle Accounting. Federal Reserve Bank of Minneapolis. Research Department Staff Report 384.

Chari, V. V.; Kehoe, P. J.; McGrattan, E. R. (2002) Accounting for the Great Depression. *American Economic Review*, *92*(2): 22-27.

Chari, V. V.; Kehoe, P. J.; McGrattan, E. R. (2005) Sudden stops and output drops. *American Economic Review*, *92*(2), 381-387.

Coibion, O.; Gorodnichenko, Y.; Weber, M. (2020) Labor Markets During the COVID-19 Crisis: A Preliminary View. National Bureau of Economic Research. NBER Working Paper 27017.

Direction of Trade Statistics: Exports and Imports by Areas and Countries. IMF Data. Retrieved from https://data.imf.org. Accessed 07-12-2021.

Dooyen, C.; Doblas-Madrid, A. (2013) Business cycle accounting East and West: Asian finance and the investment wedge. *Review of Economic Dynamics*, *16*(4), 724-744.

He, Q.; Chong Tai-Leung, T.; Shi, K. (2009) What accounts for Chinese business cycle? *China Economic Review*, *20*(4), 650-661.

Hirata, H.; Otsu, K. (2011) Accounting for the Economic Relationship Between Japan and the Asian Tigers. University of Kent, School of Economics. Studies in Economics: 1120.

Jordà, Ò.; Singh, S. R.; Taylor, A. M. (2020) Longer-Run Economic Consequences of Pandemics. National Bureau of Economic Research. NBER Working Paper 26934.

Kydland, F. E.; Prescott, E. C. (1982) Time to build and aggregate fluctuations. *Econometrica*, *50*, 1345-1370.

Lawrence, J. C.; Davis, J. M. (2006) Two Flaws in the Business Cycle Accounting. Federal Reserve Bank of Chicago. Working Paper Series WP-06-10.

Mendoza, E. G. (2010) Sudden stops, financial crises, and leverage. *American Economic Review*, *100*(5), 1941-1966.

National Bureau of Economic Research. US Business Cycle Expansions and Contractions. Retrieved from https://www.nber.org/research/data/us-business-cycle-expansions-and-contractions. Accessed on 07-12-2021.

OECD Data: Tax on Goods and Services. Organisation for Economic Co-operation and Development. doi: 10.1787/40b85101-en. Accessed on 07-12-2021.

OECD Economic Outlook Nº (Edition 2021/2). OECD iLibrary. https://doi.org/10.1787/eo-data-en. Accessed on 07-12-2021

OECD National Accounts Statistics: Quarterly National Accounts. OECD iLibrary. https://doi.org/10.1787/na-data-en. Accessed on 07-12-2021

OECD.Stat. OECD iLibrary. https://doi.org/10.1787/data-00285-en. Accessed on 07-12-2021.

Otsu, K. (2010a). International Business Cycle Accounting. University of Kent, School of Economics Discussion Papers: 44635.

Otsu, K. (2010b) A neoclassical analysis of the Asian crisis: Business cycle accounting for a small open economy. *The BE Journal of Macroeconomics*, *10*(1).

Solow, R. M. (1957) Technical change and the aggregate production function. *Review of Economics and Statistics*, *39*(3), 312-320.

Sustek, R. (2011). Monetary business cycle accounting. *Review of Economic Dynamics*, *14*(4), 592-612.

Annex

Annexes I, II, III, and IV are available from the author upon request.

Manuel Correia de Pinho
Porto, Portugal
m.correia.pinho@sapo.pt
Maria Manuel Pinho
Universidade do Porto, CEFUP, Faculdade de Economia
mpinho@fep.up.pt
orcid.org/0000-0001-5887-637X

DOI: https://doi.org/10.14195/2183-203X_55_3

The 2011-2014 Economic Adjustment Programme for Portugal: A Plausible Counterfactual Scenario

O Programa de Ajustamento Económico para Portugal, 2011-2014: Um Cenário Contrafactual Plausível

Manuel Correia de Pinho
Maria Manuel Pinho

Received for publication: July 25, 2022
Revision accepted for publication: October 14, 2022

ABSTRACT
The 2007 global financial crisis triggered a severe sovereign debt crisis in Portugal, which led to the need to comply with an Economic Adjustment Programme (EAP) based on fiscal consolidation, among other pillars. According to our literature review, the economic environment in which the adjustment takes place matters. Also, the composition of the adjustment seems to be relevant to its effectiveness, with expenditure-based plans being less contractionary (or even expansionary) than tax-based plans. Our purpose is to understand, through a VAR model, which path the Portuguese economy would have followed without the EAP. Our results suggest that the austerity programme may have been harmful to economic activity in the short run, but in a longer horizon it produced a better outcome than if the EAP had not been implemented. In the absence of the EAP, the tax to GDP ratio would have been below the current ratio, with the inverse happening for the primary public expenditure ratio and for the public debt interest rate. Overall, our results support the likelihood of less disciplined fiscal accounts in the absence of the EAP.
Keywords: adjustment programme, fiscal consolidation, vector autoregressive, counterfactual

JEL Classification: C32; E62; H30

1. Introduction

The 2007 global financial crisis triggered a severe sovereign debt crisis in some European Union (EU) member states, including Portugal. In May 2011, Portugal formalized a request for financial assistance from the EU and the International Monetary Fund (IMF), which provided a loan of €78 billion. The granting of the loan required compliance with an Economic Adjustment Programme (EAP), agreed with the European Commission (EC), the European Central Bank (ECB) and the IMF, based, among other pillars, on fiscal consolidation.[1] The implementation of this programme ended on June 30, 2014. As for fiscal consolidation, the EAP entailed the adoption of a set of tax and public expenditure measures that constituted a case for austerity.[2]

The evolution of GDP, inflation, unemployment, public debt and household savings in the 2000-2007 (before the financial crisis), 2008-2010 (before the EAP regime), 2011-2015 (during the lifetime of the EAP regime[3]) and 2016-2019 (after the EAP regime) periods is presented in Table 1.

Table 1: The economic situation in Portugal, 2000-2019

	2000-2007	2008-2010	2011-2015	2016-2019
Real GDP growth rate	1.5	-0.4	-0.8	2.8
Inflation rate	3.0	1.1	1.4	0.9
Unemployment rate	6.3	9.4	14.4	8.5
Gross public debt as a % of GDP	65.2	87.9	127.8	123.9
Households savings rate	11.0	9.3	8.3	6.9

Notes: Figures displayed refer to annual averages of each indicator (in percent). The households savings rate includes non-profit institutions serving households.
Source: Eurostat database.

The observation of these figures reveals that, during the period of application of the EAP regime, the performance of the Portuguese economy deteriorated, worsening the recessive situation already evidenced during the international financial crisis. It is possible, however, to conclude for some recovery in the period that followed the implementation of the financial assistance programme.

[1] At a press conference held on July 14, 2011, the Portuguese Minister of Finance stated that the EAP was based on three pillars: first, fiscal consolidation aimed at establishing the balance of public accounts; second, actions aimed at maintaining financial stability; and, third, a comprehensive set of structural measures aimed at improving competitiveness and growth potential.

[2] The term austerity is used here to mean an economic policy pattern, composed of public spending cuts and/or tax increases, aiming a fiscal adjustment.

[3] Although formally the implementation of this programme ended on June 30, 2014, the corresponding economic regime is assumed to have lasted until November 25, 2015, when, following parliamentary elections, a new, left-wing, government took office.

Our work intends to contribute to a reflection on the consequences of the application of the EAP regime through a model that, assuming an appropriate representation of the Portuguese economy, allows for the estimation of the results of a counterfactual situation that corresponds to the hypothesis of such economic regime have not been adopted. Our research will hopefully contribute to shed some light on the circumstances that shape the effectiveness of fiscal consolidation plans.

This work is organized in four main sections. Section 2 reviews the relevant economic literature on the effects of fiscal consolidation measures in terms of the economic activity, with the composition of fiscal adjustments deserving a special attention. Section 3 addresses the case of economic adjustment programmes within international assistance requests, providing the link to the Portuguese specific 2011-2014 situation. In section 4, a counterfactual scenario is modelled based on an appropriate representation of the Portuguese economy with the purpose of estimating a plausible scenario that could have taken place had the Portuguese government not called for international assistance. Lastly, in section 5, the main conclusions and possible lines of development are presented.

2. The Literature on the Effects of Fiscal Consolidation

Before proceeding to the analysis of the Portuguese situation, we review the relevant literature on the effects of fiscal consolidation measures in terms of the economic activity, with the composition of fiscal adjustments deserving a special attention.

2.1. Can austerity be expansionary?

In the early nineties of the last century, Giavazzi and Pagano (1990) raised the following question: "Can severe fiscal contractions be expansionary?". This research was the beginning of the production of a vast economic literature on what has been generically labelled expansionary austerity and that has lasted to this day. Giavazzi and Pagano (1990) studied fiscal consolidation processes based on wide cuts in public spending in Ireland and Denmark in the 1980s, considered to be a period of strong expansion of private consumption in those economies. To explain the apparent non-Keynesian effects of the public spending cuts then produced, the authors advanced the hypothesis that direct (Keynesian) effects are more than offset by the change in consumer expectations (hope of a tax reduction in the future) with an impact on private consumption and investment – this became known as the wealth effect. But it should be noted that these authors did not rule out the possibility of growth being boosted by the monetary and exchange rate policies adopted at the time.

Subsequent research focused on the central question of whether austerity could, in the short run and against the Keynesian teaching, lead to the economic growth and on the investigation of some adjacent issues, namely whether: (i) the composition of the adjustment, in terms of expenditure cuts or tax increases, is relevant, (ii) the impact of the adjustment is permanent or transitory, (iii) the impact of the adjustment depends on the state of the economy (a recession or an expansion), and (iv) the level of indebtedness of the economy is

significant. In addition, the literature discusses issues related to the research methodology adopted, the political impacts of the adjustments, the role played by the economic policies adopted in the course of the adjustment processes, or the mechanisms – the wealth effect mentioned by Giavazzi and Pagano (1990) and other mechanisms like the supply side ones – that can theoretically explain the impacts of these processes.

Our literature review is focused on the plausibility of the expansionary austerity hypothesis and on the relevance of the composition of fiscal adjustments.

The literature reveals the existence of two lines of answer to the central question. One line of research concludes for the evidence that austerity can, even in the short term, bring growth to the economy (or, at least, not harm the economic activity); these conclusions were drawn by Afonso (2010), Afonso and Jalles (2014), Afonso et al. (2022), Alesina and Ardagna (1998 and 2010), Alesina and Perotti (1995 and 1996), Alesina et al. (1998), Alesina (2010), and Giavazzi and Pagano (1990); and, for the Portuguese case, Afonso and Sousa (2011). The main argument is a demand side one: the positive effect on private demand more that compensates for the decrease in public demand. Other works denying the evidence of such possibility were carried out by Baker (2010), Bhattacharya and Mukherjee (2013), and Guajardo et al. (2011). This latter trend includes the remarkable study by the IMF "Will it hurt? Macroeconomics effects of fiscal consolidation" (IMF, 2010).

In a speech to the Ecofin meeting in Madrid on April 15, 2010, Alesina (2010, p. 3) stated that evidence accumulated in the literature reveals that "not all fiscal adjustments cause recessions. Many even sharp reductions of budget deficits have been accompanied and immediately followed by sustained growth rather than recessions even in the very short run." Alesina and Ardagna (1998, p. 3) concluded that "several fiscal adjustments have been associated with expansions even in the short run" and also that "fiscal adjustments are expansionary when they occur following a fiscal crisis" (Alesina and Ardagna, 1998, p. 4). Alesina and Perotti (1995, p. 24)'s work led to the conclusion that "major fiscal adjustments do not cause recessions". In an extension of this study, Alesina and Perotti (1996, p. 40) concluded that "a fair amount of evidence suggests that, in some cases, fiscal contractions can be expansionary". Alesina et al. (1998) revisited and updated the work reported in Alesina and Perotti (1995, 1996) and found evidence that "fiscal adjustments are not always associated with reduced growth, or with a deterioration in the macroeconomic environment in general" (Alesina et al. 1998, p. 200). On the contrary and in line with Alesina and Ardagna (1998), the authors concluded that "fiscal consolidations prompted by a fiscal crisis and achieved by trimming government spending often have expansionary effects" (Alesina et al., 1998, p. 241). Alesina and Ardagna (2010, p. 37) "uncover several episodes in which spending cuts adopted to reduce deficits have been associated with economic expansions rather than recessions.". However, Jayadev and Konczal (2010, p. 1) verified that the majority of the episodes used by Alesina and Ardagna (2010) did not see a deficit reduction in the middle of a slump. Where they did, it often resulted in a decline in the subsequent growth rate or an increase in the debt-to-GDP ratio.

As previously mentioned, in 2010, the IMF published a study, which is part of the second line of answer to the central question stated above, concluding that there is no evidence that austerity is expansionary in the short term. This study was carried out from the identification of episodes of fiscal adjustment in advanced economies and obtained as relevant

results that "undertaking fiscal consolidation is likely to have more negative short-term effects if (…) interest rates are near zero and central banks are constrained in their ability to provide monetary stimulus", and that "fiscal consolidation is likely to be beneficial over the long term" (IMF, 2010, p. 113). This is line with Afonso and Martins (2016)'s findings that when fiscal consolidations are not matched by a monetary expansion the non-Keynesian effects disappear.

Baker (2010) has reviewed the arguments that support the hypothesis of expansionary austerity to gauge the suitability of its application to the United States having concluded that "the differences [in the economic environment] between the United States in 2010 and the countries that have successfully gone the route of fiscal austerity to boost growth are large and are very central to the adjustment process" (Baker, 2010, p. 12). Afonso and Leal (2019) found that stringent fiscal consolidations may not be the best strategy to boost economic growth, as the response is expected to be recessive in highly indebted countries that faced recession. Bhattacharya and Mukherjee (2013, p. 4128) also concluded that "fiscal austerity is unlikely to trigger faster growth in the short term, as argued forcefully in IMF (2010). However, the article suggests that the contractionary impact of fiscal consolidation in heavily indebted advanced economies may be offset, at least in part, by higher private consumption."

Guajardo et al. (2011) suggest that the methods used by other studies to identify fiscal consolidation episodes may bias the analysis towards the expansionary austerity hypothesis. By using an alternative method based on the identification of fiscal policy variables directly from historical documents, the authors concluded that there is "little support for the expansionary hypothesis" and that its "main finding that fiscal consolidation is contractionary holds up in cases where one would most expect fiscal consolidation to raise private domestic demand" (Guajardo et al., 2011, p. 29).

Overall, the evidence on the feasibility of expansionary austerity is mixed and the contributions for the output reaction mechanisms are diverse. A complementary explanation is suggested by Alesina et al. (2017a), Alesina et al. (2019) and Jayadev and Konczal (2010), with the argument that the outcome in terms of economic output of fiscal consolidations depends on the state of the business cycle. This is the "when" issue raised in Alesina et al. (2017a) and in Alesina et al. (2019). As reviewed, the economic environment in which the adjustment process takes place matters: not only the economic cycle, but also the conduction of monetary and exchange rate policies as well as the degree of fiscal stress influence the economic outcome of fiscal consolidations.

Besides the analysis of the impact of fiscal consolidations in terms of economic growth, one relevant issue is: why austerity? The answer of Alesina et al. (2019, pp. 1-2) to this question is that governments resort to austerity because countries accumulate debt in excess and experience various crises. The former occurs when the governments do not compensate for deficits produced in recessionary times with surpluses in boom times. Moreover, austerity may also be a consequence of rising public spending in the aftermath of crises triggered by a war, a natural disaster, a pandemic or an external financial or economic crisis, among others. "The bottom line is that austerity measures sometimes are required because of past policy mistakes, or a combination of policy mistakes and unexpected negative shocks. The latter are fortunately relatively rare, so that austerity is almost always the result of poor foresight and overspending relative to tax revenues" (Alesina et al., 2019, p. 2).

2.2. Does the composition of fiscal adjustments matter?

An issue widely discussed in the literature is the relevance of the composition of the fiscal adjustments both on the effectiveness in achieving fiscal consolidation and on the impact on economic activity. According to our literature review, there is a large consensus that expenditure-based adjustments are less contractionary than tax-based adjustments.

Alesina (2010) expressed, during the aforementioned Ecofin meeting, the view that spending cuts are more effective than tax increases in stabilizing debt and avoiding economic downturns. Guajardo et al. (2011) concluded that "spending-based adjustments are less contractionary than tax-based adjustments, particularly after the first year" (Guajardo et al., 2011, p. 25). Alesina et al. (2015b, p. 386) concluded "that fiscal adjustments based on cuts in spending are much less costly, in terms of output losses, than those based on tax increases".

Some studies go further in detailing the most suited components of expenditure to cut in order to guarantee less or non-contractionary effects. Alesina and Perotti (1995, p. 19) concluded that "within expenditure, successful adjustments are characterized by large cuts in transfers and in wage government consumption". Moreover, Alesina and Perotti (1996, p. 1) found that budget adjustments based on cuts in transfers, social security programmes and public wages and employment "induce a more lasting consolidation of the budget and are expansionary" while the adjustments based mainly on broad increases in the tax base "are soon reversed by further deteriorations of the budget and have contractionary consequences on the economy". IMF (2010, p. 103) points out that spending-based deficits cuts that "rely on cuts to transfers, have smaller contractionary effects than tax-based adjustments."

Other contributions conclude that expenditure-based fiscal adjustment may even have expansionary effects. Alesina et al. (1998, p. 198) argue that there is "extended evidence that fiscal corrections relying mostly on spending cuts that are concentrated on government wages and transfers tend to be expansionary, whereas those relying on tax increases are contractionary". Alesina and Ardagna (1998, p. 3) state that "fiscal adjustments concentrated on the spending side and, in particular, on public wages and welfare spending are long lasting, while those which rely primarily on tax hikes do not lead to a permanent consolidation of government finances". Blanchard and Perotti (2002, pp. 1330-1331) extracted results that "consistently show positive government spending shocks as having a positive effect on output, and positive tax shocks as having a negative effect."

Another line of research extends the analysis to the components of the private demand impacted by the fiscal adjustment. Alesina and Ardagna (2013, p. 65)'s results show that "the component of private demand that react more positively to an expenditure-based adjustment is private investment". Afonso and Sousa (2011), in an analysis of the Portuguese economy, concluded that public spending shocks lead to a reduction in private consumption and investment. Romer and Romer (2010)'s work is supported by a methodology based on the historical analysis of the episodes coming from the tax policy (narrative approach) and concludes that tax increases have a large negative effect on investment.

Alesina et al. (2015a) consider that the correct way to study the effects of a fiscal adjustment should be based on the analysis of budgetary change plans (and not on individual budgetary shocks); of this study has resulted (Alesina et al., 2015a, p. S19) that (i) "fiscal adjustments based upon spending cuts are much less costly, in terms of output losses, than

tax-based ones and have especially low output costs when they consist of permanent rather than stop and go changes in taxes and spending", (ii) "the difference between tax-based and spending-based adjustments appears not to be explained by accompanying policies, including monetary policy" and (iii) "it is mainly due to the different response of business confidence and private investment."

Alesina et al. (2017b, pp. 3-4) found that (i) "plans based, on reductions in spending (current and investment) or reductions in transfers (...) cause, on average, a mild recessionary effect after one year from the start of the consolidation, but this effect starts vanishing the following year", (ii) "tax-based adjustments confirm to cause much larger output losses than expenditure-based fiscal consolidation", (iii) "tax-based plans also have long lasting recessionary effects", and (iv) "consumption drops almost equally across components in the short term, but recovers quickly for spending and transfer-based consolidations" but also that (v) "private investments strongly respond to taxes only."

Based on a study of multi-year plans on the output effects of EB (expenditure-based plans) and TB (tax-based plans) austerity, Alesina et al. (2019, p. 116) conclude that "EB plans have very small costs in terms of output losses. The average low costs of the former are the result of some of them producing deeper recessions and other being expansionary. TB plans are associated with deep and long-lasting recessions. The component of aggregate demand that responds very distinctly in the two types of plans is private investment. In fact, investors' confidence (which reflects their expectations about the future) reacts positively to EB plans and negatively to TB ones. Consumers' confidence moves in the same general direction but with a smaller difference between types of plans".

Finally, Alesina et al., (2017a, pp. 33-34) suggest that "the state of the economic cycle may influence the economic outcome of fiscal adjustments, but the composition effect is much more robust" and "the dynamic response of the economy to a consolidation plan does depend on whether this is adopted in a period of economic expansion or contraction".

In short, this literature review highlights the conclusion that the composition of the fiscal adjustment seems to be relevant to its effectiveness and indicates the general way that expenditure-based plans are less contractionary (or even expansionary) than tax-based plans. This result particularly holds when spending cuts are based on wages and welfare items, which is not surprising as the literature emphasises the unproductive nature of current public spending. The empirical evidence is biased towards private investment being positively impacted by expenditure-based adjustments and negatively impacted by tax-based adjustments. As reviewed in the previous paragraphs, some studies emphasize the appropriateness of, when analysing the composition of the adjustment, considering comprehensive budget plans instead of individual shocks and also of taking into account the economic cycle.

3. **Does International Financial Assistance Shape Fiscal Policy?**

In case of a fragile situation in public accounts and a subsequent need for public financing, the government may, theoretically, resort to monetary or market financing. The former mechanism is not available in a situation of central bank independence or integration in a monetary union and the latter may not be possible if there are no lenders or the financing

cost is too high. Governments may then choose not to comply with the debt obligations (which harms the credibility of the country and further increases the cost of financing), to renegotiate the public debt conditions (which, of course, depends on the creditors' will) or to request international financial assistance. This last option was the way out of the financial and public debt crisis that hit Portugal in the aftermath of the last global economic and financial crisis and led to the Portuguese 2011-2014 EAP, negotiated with the EC, the ECB and the IMF, of which fiscal consolidation was a key element. As such, the EAP included an austerity plan based both on spending cuts and tax increases.

Before exploring the hypothesis that a choice different from the adoption of the 2011-2014 EAP would have been a better solution, we must reflect on the need for international financial assistance and stress the main characteristics of the EAP.

3.1. The need for international financial assistance

A financial crisis arises when a loss of confidence in the economy makes agents unwilling to lend or accepting to lend at significantly high interest rates. The sources of financial crises can be external and/or internal and, the weaker the domestic economy, the stronger the effects will be. The external causes are often motivated by sudden unexpected increases or decreases in global demand, which lead to significant increases in the prices of goods and interest rates.

The internal causes may be of various natures but the most common are persistent public deficits. Expectations of an unsustainable public debt undermine the trust of (external and internal) economic agents in government who will find it increasingly difficult to borrow at reasonable interest rates.

Adjustment programmes were introduced in the 1980's (Duncan, 2002), initially with a focus on physical infrastructures and later extended to social assistance. At the time, in the aftermath of the two major oil crises, developing countries, unable to service external debts, were facing serious economic problems. Within this international environment, the role of international financial agencies as lenders of last resort was enhanced.

Soon, it became clear that for the financial aid to be successful, both changes in economic policy as well as structural economic reforms were needed. Microeconomic policies, mainly trade and industry policies, should be at the service of the needed structural changes in the economy. Macroeconomic policies should be designed to enhance economic growth and stabilize the economy, by leading to the reduction of public and external deficits, to the full use of resources and to the stability of prices (including interest rates). However, some conflicts are likely to arise if, for example, the promotion of economic growth is based on weak public finances. In particular, if the country is a member of a common currency area – as Portugal is –, the available macroeconomic tools at the national level are solely the fiscal ones. If the situation is of fragile fiscal accounts, the challenge is to boost the economy and at the same time promote sound public finances. Moreover, structural changes have short-run costs and so getting the people's and the parliament's political support for the reforms is a key part of the process (Duncan, 2002).

So, in exchange for financial assistance, the financing organizations – initially, mainly the IMF and the World Bank – explicitly demand that some changes should be made in the recipient economy. This is often seen as a loss of sovereignty, even though the financial assistance is provided at the invitation of the recipient country.

3.2. The 2011-2014 economic adjustment programme for Portugal

The April 25, 1974 revolution introduced democracy in Portugal, after more than 40 years of dictatorship. This year marked the beginning of persistent budget deficits and the significant increase of public intervention in the economy. According to Marinheiro (2005), in this post-revolution period, one observes a shift to an unsustainable path in the Portuguese fiscal policy.

The entry into the European Community in 1986, and the run-up to the third phase of the Economic and Monetary Union led to increased fiscal discipline in the late 1990s (Marinheiro, 2005). In 1997, Portugal fully complied with the Maastricht convergence criteria and joined the euro area as a founding member. According to Viegas and Ribeiro (2014), the consolidation that occurred in the 1997-2000 period was mainly due to stock-flow adjustments and snow-ball effects, reflecting a weak economic performance. Facing difficulties in keeping fiscal discipline, Portugal became, in 2001, the first euro area member to be subject to an Excessive Deficit Procedure (EDP) for breaking the 3% ceiling for the deficit defined in the Treaty on the European Union and in the Stability and Growth Pact. The Portuguese economy became under an EDP again in 2005 and 2009. Public finances were clearly in an unsustainable path.

The EAP for Portugal was agreed between the Portuguese authorities, the EU and the IMF in May 2011. While in Greece the key driver of the request for external help was the fiscal indiscipline and in Ireland was the real estate market lack of robustness, the need for the Portuguese EAP was mainly due to low productivity growth and large public and external imbalances (European Commission, 2011), which together with the negative developments of the sovereign bond markets forced the Portuguese government to ask for external assistance in April, 2011. At that time, the socialist minority government had resigned after the parliament rejected a proposal for a stability programme, and new elections had been called for June.

The total amount of funding provided for the EAP was of €78 billion, channelled by the European Financial Stabilisation Mechanism, the European Financial Stability Facility and the IMF's Extended Fund Facility. Of this total amount, €12 billion were earmarked for the capital increase of private banks during an initial phase. With a strategy aimed at restoring the confidence of international financial markets and promoting competitiveness and sustainable economic growth, the programme expired on June 30, 2014.

Portugal is now under a post-programme surveillance by the European institutions, and a post-programme monitoring by the IMF. In line with the EU and IMF rules, at this stage of enhanced supervision, the aim is to monitor Portugal's economic situation, with a view to assessing the maintenance of its ability to repay outstanding debt to the European institutions and the IMF. The duration of this stage is directly related to the level of this

debt. The post-programme surveillance stage involves carrying out biannual missions, usually simultaneously, of staff from the EC, the ECB and the IMF (Banco de Portugal, 2019).

4. A Counterfactual Scenario

Fiscal consolidation was one of the three pillars of the 2011-2014 Portuguese EAP. Our literature review suggests that the economic impact of fiscal adjustments is not necessarily negative in the short run, with the composition of the adjustment playing an important role in the outcome. Moreover, as reviewed, the economic environment in which the adjustment process takes place – namely in terms of the degree of fiscal stress, the external environment and the conduction of monetary policy – matters for the outcome of such consolidations.

The purpose of this paper is to help answering the question of how the Portuguese economic path without the fiscal adjustment programme would compare with the actual one. In order to do so, we designed a model that plausibly portraits the relevant economic framework and proceed with its estimation and the discussion of the empirical findings.

4.1. The conceptual model

The hypothesis that it would not have been inevitable to have resorted to the EAP, and that the country would not have implemented a fiscal consolidation programme, raises the question of whether the EAP has led the Portuguese economy to perform worse than what would have resulted from the situation of non-adherence to that programme. As in Alesina et al. (2019, p. 117), we "do not know what would have happened without austerity". But we can design a possible, and plausible, scenario grounded on past relations between variables assumed as determinant to this operation.

It is assumed that the economic regime relevant to this exercise is characterized by the following variables: real GDP; tax revenue[4]; primary public expenditure; long-term nominal interest rate; economic sentiment indicator and short-term real interest rate.

The real GDP is the variable adopted to evaluate the economic performance shaped by the economic policy adopted in the country.

Tax revenue determines the volume of resources subtracted from the economy with an implication on economic performance and is an expression of the nature of the selected fiscal policy.

Primary public expenditure determines the volume of public provision of goods and services and is also an expression of the nature of fiscal policy. As reviewed previously, the composition of the fiscal adjustment, in terms of revenue increases or spending cuts, is not irrelevant when it comes to assess the impact of fiscal adjustments on the economy.

The nominal long-term interest rate, representative of the cost of the Portuguese public debt, influences total public expenditure and conditions fiscal policy. It is expected that an increase in this variable will produce a contractionary effect on the economy both by the

[4] Unless otherwise expressed, tax revenue is assumed from now on to include social contributions.

reduction of the public demand and by the adverse expectations that it generates in the economic agents. The inclusion of the long-term nominal interest rate as an endogenous variable represents an extension to Alesina et al. (2019)'s model.

The economic sentiment indicator, that is, the sentiment in the partner economies of the country is a determining factor of external demand and foreign investment. It is expected that the favourable evolution of this indicator, including the perception on the degree of fiscal stress, generates an expansionary effect on the Portuguese economy.

The real short-term real interest rate reflects the monetary policy conducted by the ECB, influencing the economic activity.

The conceptual model underlying this exercise is shown schematically in Table 2, with the selection of the exogenous variables being in line with our literature review which stressed the importance of the economic environment, in terms of the external environment and the conduction of monetary policy influence the economic outcome of fiscal consolidations.

Table 2: The conceptual model

Indicator of the economic regime	Economic nature	Type of variable in the model
Real GDP (*gdp*)	Goal	Endogenous
Tax revenue ratio on GDP (*reven*)	Instrument	Endogenous
Primary public expenditure ratio on GDP (*spend*)	Instrument	Endogenous
Nominal long-term interest rate (*nltr*)	Control	Endogenous
Economic sentiment indicator (*esi*)	Control	Exogenous
Real short-term interest rate (*rstr*)	Control	Exogenous

4.2. The empirical strategy

The method used to develop our empirical analysis consists in estimating an econometric model representing the Portuguese economy and able to capture the effects of the specific economic regime put in place during the EAP (that is, from the second quarter of 2011 to the last quarter of 2015) and in the following period (from the first quarter of 2016 to the last quarter of 2019). We choose to extend the EAP economic regime till the end of 2015, even though the formal end occurred in June 2014, since the government that was in office till the end of 2015 kept the economic guidelines set in the EAP.

This representation of the economy (factual representation[5]) will make it possible to project in the period of application of the EAP and in the subsequent period the economic regime purged of the effects of that application (counterfactual representation).

The values generated by the counterfactual representation for the period of application of the EAP and for the following period will allow comparing the economic performance that could have been achieved without the application of the EAP with the factual economic performance.

The econometric model to support the empirical analysis is an estimated vector autoregressive (VAR) based on quarterly observations ranging from the first quarter of 1999 to the last quarter of 2019[6] for the following variables: real GDP growth rate (*g_gdp*), change in tax revenue to GDP ratio (*v_reven*), change in primary public expenditure to GDP ratio (*v_spend*), change in nominal 10-year Portuguese government bond yield (*v_nltr*), economic sentiment indicator in the EU (*esi*) and real short-term interest rate (*rstr*). The VAR specification also includes two binary variables: one that takes the value 1 for observations in the economic adjustment period (2011Q2 to 2015Q4) and the value 0 for other observations (*eap*) and another that takes the value 1 for observations in the period after the economic adjustment period and the value 0 for other observations (*peap*). The use of high frequency data allows for a more accurate monitoring of the fiscal position.

The variables and their sources are described in the Annex. The variables *log*(*gdp*), *reven*, *spend* and *nltr* were differentiated to ensure stationarity[7]. As for the exogenous variables, despite the evidence of units roots it was decided not to differentiate as suggested in Sims, Stock and Watson (1990) to avoid the loss of relevant information. Table 3 shows the descriptive statistics of these variables.

Table 3: Descriptive statistics, 1999Q2-2019Q4

Variable	Minimum	Average	Maximum	Standard deviation
Real GDP growth rate (*g_gdp*)	-2.55% [2009Q1]	0.24%	2.20% [2000Q1]	0.78
Change in tax revenue ratio (*v_reven*)	-5.55 p.p. [2005Q3]	0.03 p.p.	7.84 p.p. [2018Q3]	2.88
Change in primary public expenditure ratio (*v_spend*)	-16.63 p.p. [2014Q4]	0.02 p.p.	12.46 p.p. [2017Q1]	3.94

[5] Factual representation is distinguished from the actual representation in that it does not capture the effects of variables represented by random disturbances.

[6] Even though provisional data for 2020 is already available, we chose not to include it so that our results are not disturbed by the effects of the Covid-19 pandemics.

[7] The presence of unitary roots in the stochastic processes generating these variables was assessed using the usual Augmented Dickey-Fuller and Phillips-Perron tests complemented by the development of the Kwiatwoski-Phillips-Schmidt-Shin test.

Variable	Minimum	Average	Maximum	Standard deviation
Change in nominal 10-year Portuguese government bond yield (*v_nltr*)	-1.84 p.p. [2012Q2]	-0.05 p.p.	2.53 p.p. [2011Q2]	0.67
Economic sentiment indicator (*esi*)	69.50 [2009Q1]	100.80	116.80 [2000Q2]	9.38
Real short-term interest rate (*rstr*)	-5.55 p.p. [2015Q1]	-0.32 p.p.	5.03 p.p. [2008Q3]	2.26

Notes: The observations for 1999Q1 are used in the calculation of the transformed variables. The quarter in which the minimum or maximum has been reached is given in brackets. As described in the Annex, the GDP and fiscal variables are seasonally adjusted. The number of observations is 83.

The correlation coefficients between the pairs of endogenous variables are, in absolute value, lower than 0.6.

In the VAR specification, it is assumed that the variables *esi* and *rstr* are exogenous variables and the other are endogenous variables. The VAR specification took into account the results of applying standard information criteria for determining the number of lags of endogenous variables. In view of the parsimony required by the small size of the database, the VAR was specified without lags in exogenous variables. The estimated VAR satisfies the stability condition defined in Lütkepohl (2007, p. 15).

The specification adopted has the following assumptions:

- there is no contemporary interaction between the endogenous variables since, due to the high frequency data used, the changes in the values of those variables in one quarter only impact the other variables in the following quarter;
- there was no break in the economic regime in force during the period prior to the entry into force of the EAP;
- during the implementation period of the EAP, an economic regime different from that of the previous period was in force and the values of endogenous variables of the factual representation in that period capture both the effects of the previous economic regime and the effects of the change in the economic regime; and
- in the post-EAP period, a third economic regime was in force and the values of endogenous variables of the factual representation in this period capture both the effects of the economic regime in force before the entry into force of the EAP and the effects of changing that regime.

Given these assumptions, the specified VAR is given by:

$$\widehat{x_t} = \widehat{B_0} + \left(\widehat{B_1}L + \widehat{B_2}L^2 + \widehat{B_3}L^3 + \widehat{B_4}L^4\right)x_t + \widehat{B_5}z_t + \widehat{B_6}\,\text{eap} + \widehat{B_7}\,\text{peap} + \varepsilon_t \qquad (1)$$

where:

- x_t stands for the 4x1 vector of endogenous variables: g_gdp, v_reven, v_spend and v_nltr;
- z_t stands for the 2x1 vector of exogenous variables: esi and rstr;
- L stands for the one-quarter lag operator;
- $\widehat{B_0}$ stands for the 4x1 vector of independent terms;
- $\widehat{B_1}$, $\widehat{B_2}$, $\widehat{B_3}$ and $\widehat{B_4}$ stand for the 4x4 matrix with the coefficients associated with one-quarter, two-quarter, three-quarter and four-quarter lagged endogenous variables, respectively;
- $\widehat{B_5}$ stands for the 4x2 matrix with the coefficients associated with the contemporary *esi* and *rstr* variables;
- *eap* stands for a binary variable that assumes the value 1 in the period from the second quarter of 2011 to the fourth quarter of 2015 and that assumes the value 0 otherwise;
- $\widehat{B_6}$ stands for the 4x1 vector with the coefficients associated with the *eap* variable;
- *peap* stands for a binary variable that takes the value 1 in the period from the first quarter of 2016 to the fourth quarter of 2019 and that takes the value 0 otherwise;
- $\widehat{B_7}$ stands for the 4x1 vector with the coefficients associated with the *peap* variable; and
- ε_t stands for the 4x1 estimated vector with the error terms, assuming that $E(\varepsilon_t) = 0$, $E(\varepsilon_t \varepsilon_t') = \Omega$ and $E(\varepsilon_t \varepsilon_{t-1}) = 0$ for whatever element of the vector ε_t.

Table 4 presents the results of this estimation.

Table 4: Baseline VAR estimation results, 2000Q2-2019Q4

	g_gdp_t	v_reven_t	v_spend_t	v_nltr_t
intercept	-5.281 [-4.179] ***	-3.742 [-1.032]	17.061 [2.861] ***	-1.365 [-1.034]
g_gdp_{t-1}	-0.130 [-1.030]	0.444 [1.226]	0.445 [0.748]	-0.097 [-0.737]
g_gdp_{t-2}	-0.031 [-0.267]	-0.268 [-0.812]	0.073 [0.135]	-0.02 [-0.165]
g_gdp_{t-3}	-0.11 [-1.045]	-0.103 [-0.341]	1.096 [2.202] **	-0.063 [-0.572]
g_gdp_{t-4}	-0.158 [-1.566]	0.087 [0.300]	-0.457 [-0.963]	-0.046 [-0.442]
v_reven_{t-1}	-0.098 [-2.132] **	-1.159 [-8.742] ***	0.197 [0.903]	0.005 [0.111]
v_reven_{t-2}	-0.052 [-0.879]	-1.045 [-6.112] ***	0.273 [0.971]	-0.009 [-0.144]
v_reven_{t-3}	-0.083 [-1.420]	-0.881 [-5.245] ***	0.282 [1.022]	-0.033 [-0.532]
v_reven_{t-4}	-0.088 [-1.873] *	-0.122 [-0.906]	0.222 [1.002]	0.004 [0.083]
v_spend_{t-1}	0.012 [0.454]	-0.048 [-0.659]	-1.038 [-8.595] ***	-0.01 [-0.364]
v_spend_{t-2}	0.013 [0.415]	-0.003 [-0.037]	-0.692 [-4.550] ***	-0.007 [-0.200]
v_spend_{t-3}	0.022 [0.705]	0.002 [0.025]	-0.604 [-4.037] ***	-0.029 [-0.866]
v_spend_{t-4}	-0.002 [-0.092]	0.021 [0.306]	-0.338 [-2.934] ***	-0.012 [-0.454]
v_nltr_{t-1}	-0.128 [-1.017]	0.077 [0.213]	-0.658 [-1.112]	0.613 [4.678] ***
v_nltr_{t-2}	-0.048 [-0.336]	0.523 [1.266]	0.36 [0.529]	-0.123 [-0.818]
v_nltr_{t-3}	-0.301 [-2.119] **	-0.534 [-1.309]	-1.289 [-1.922] *	0.146 [0.985]

	g_gdp_t	v_reven_t	v_spend_t	v_nltr_t
v_nltr_{t-4}	-0.249 [-1.895] *	-0.138 [-0.365]	1.258 [2.028] **	-0.303 [-2.203] **
esi_t	0.056 [4.256] ***	0.038 [1.022]	-0.167 [-2.701] ***	0.015 [1.067]
$rstr_t$	0.093 [2.351] **	0.064 [0.562]	0.066 [0.354]	0.027 [0.651]
eap_t	-0.347 [-1.826] *	0.726 [1.330]	-2.039 [-2.271] **	-0.247 [-1.244]
$peap_t$	0.388 [2.029] **	-0.456 [-0.830]	-0.608 [-0.674]	-0.102 [-0.510]
R-squared	0.599	0.778	0.668	0.451
F-statistic	4.333 ***	10.173 ***	5.832 ***	2.387 ***
Number of observations (after adjustments)	79	79	79	79

Notes: *t-statistic* in given in brackets. ***, ** and * indicate levels of significance of 1%, 5% and 10%, respectively.

Considering each VAR equation and applying the F test we conclude for the global significance at the level of 1%.

It is assumed that the most relevant variable for the current exercise is real GDP as the economic performance is measured, under conditions of low inflation, by the trajectory of that variable. It is also assumed that the path of employment depends on the behaviour of real output.

Regarding the estimated VAR, the following strategy is developed focusing on the period from the second quarter of 2011 to the last quarter of 2019:

– recursively generate the series of values of the endogenous variables corresponding to the factual situation (*g_gdpf*, *v_revenf*, *v_spendf* and *v_nltrf*);
– recursively generate the series of values of the endogenous variables corresponding to the counterfactual situation (*g_gdpc*, *v_revenc*, *v_spendc* and *v_nltrc*);

and based on the values of these series, the following series are generated:

– *ga_gdpf* and *ga_gdpc*, corresponding to real gross domestic product growth rates, measured each quarter by the annual equivalent in factual and counterfactual situations, respectively;
– *revenf* and *revenc*, corresponding to the tax revenue ratio in factual and counterfactual situations, respectively;
– *spendf* and *spendc*, corresponding to the primary public expenditure ratio in factual and counterfactual situations, respectively;

– *nltrf* and *nltrc*, corresponding to the nominal long-term interest rate in factual and counterfactual situations, respectively; and
– *taxgapf* and *taxgapc*, corresponding to the differences between *spend* and *reven* in factual and counterfactual situations, respectively; and
– finally, the variables *vcf_gdp*, *vcf_reven*, *vcf_spend*, and *vcf_nltr* are generated, corresponding to the differences, in percentage points, between the counterfactual and factual values as described in the previous indent, which allows comparing the results that would be obtained for the counterfactual situation (that is, not capturing the effects of the austerity policy) with those obtained for the factual situation (that is, capturing the effects of austerity policy).

The persistence in maintaining high tax gaps (that is, the part of primary public expenditure not covered by tax revenue) in the counterfactual situation would probably not be accommodated by public debt markets. Therefore, the empirical strategy is adjusted by imposing ceilings on the tax revenue and primary public expenditure ratios corresponding to the levels at which these ratios were in the first quarter of 2011.

4.3. The empirical results

Table 5 summarizes the results obtained with the application of the strategy described in the previous section.

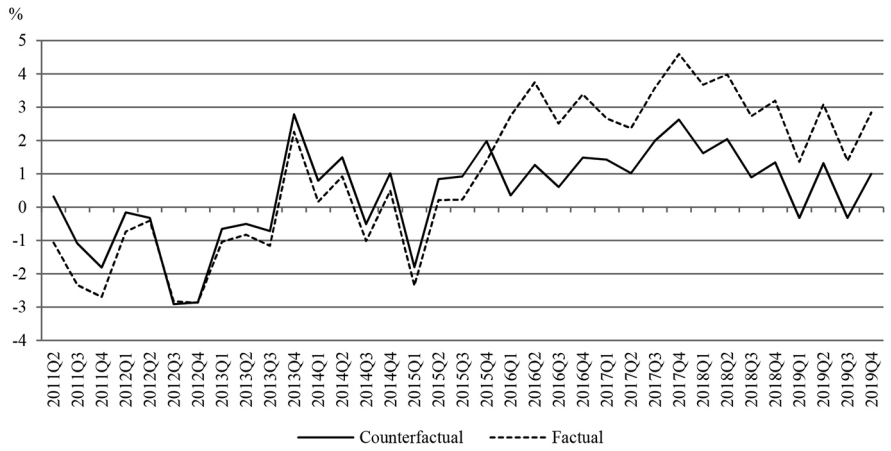
Table 5: Empirical results, 2011Q2-2019Q4

		Contrafactual situation	Factual situation	Contrafactual-factual change
Real GDP growth rate (in annual equivalent rates)	Minimum	-2.9 %	-2.9 %	-2.5 p.p.
	Average	0.4 %	1.0 %	-0.5 p.p.
	Maximum	2.8 %	4.6 %	1.4 p.p.
	Standard deviation	1.4 p.p.	2.2 p.p.	1.3 p.p.
Tax revenue ratio	Minimum	32.7 %	34.1 %	-3.5 p.p.
	Average	33.9 %	36.0 %	-2.1 p.p.
	Maximum	34.8 %	37.3 %	-0.3 p.p.
	Standard deviation	0.6 p.p.	0.9 p.p.	0.8 p.p.
Primary public expenditure ratio	Minimum	41.7 %	39.2 %	-3.4 p.p.
	Average	44.0 %	43.4 %	0.7 p.p.
	Maximum	45.0 %	48.4 %	2.7 p.p.
	Standard deviation	1.3 p.p.	3.1 p.p.	2.0 p.p.
Nominal long-term interest rate	Minimum	7.8 %	0.6 %	0.2 p.p.
	Average	9.2 %	3.3 %	5.9 p.p.
	Maximum	11.3 %	7.7 %	10.8 p.p.
	Standard deviation	1.2 p.p.	2.0 p.p.	3.0 p.p.
Tax gap	Minimum	6.9 p.p.	2.3 p.p.	-2.8 p.p.
	Average	10.1 p.p.	7.3 p.p.	2.8 p.p.
	Maximum	12.3 p.p.	13.8 p.p.	6.2 p.p.
	Standard deviation	1.8 p.p.	3.9 p.p.	2.7 p.p.

The following figures show the behaviour over time of the real GDP growth rate and of the change in the tax revenue ratio, in the primary public expenditure and in the nominal long-term interest rate in factual and counterfactual situations. As explained before, the counterfactual scenario is assumed to be a plausible one, in which the ceilings of the tax revenue and the primary public expenditure ratios were set at the levels of the corresponding ratios in the first quarter of 2011.

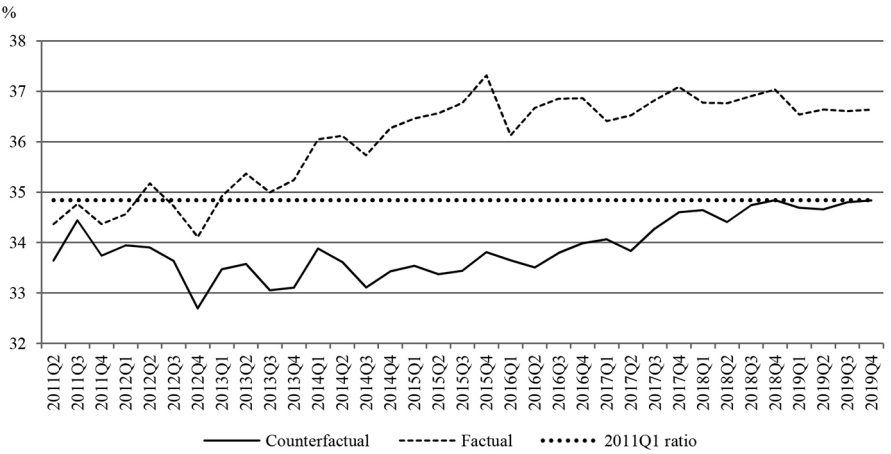
Figure 1 suggests that, in the absence of the EAP, the real GDP growth rate would have been negative on average but higher until 2013Q3 (+0.5 p.p. higher on annual equivalent average corresponding to -1.1% *versus* -1.6%), would have been positive on average and also higher between 2013Q4 and 2015Q4 (+0.5 p.p. higher on annual equivalent average corresponding to +0.8% *versus* +0.3%) and would have been positive on average but lower from 2016Q1 (-1.9 p.p. lower on annual equivalent average corresponding to +1.1% *versus* +3.0%). Therefore, there is evidence that the austerity plan may have been harmful in terms of the economic activity in the short run, but in a longer horizon the austerity policy produced a better outcome than the one without the EAP application.

Figure 1: Real GDP growth rate (annual equivalent), 2011Q2-2019Q4



The counterfactual scenario outlined in this exercise – which, it must be remembered, would imply the adoption of a budget constraint limited by the tax revenue and primary public expenditure ratios in 2011Q1 (34.8% and 45.0%, respectively) – would lead to a level of the tax revenue ratio standing at 33.9% on average and on an upward trend (Figure 2), where the 34.8% threshold is often non-effective. However, in the absence of the fiscal adjustment, the tax ratio would remain persistently below the factual one.

Figure 2: Tax revenue ratio, 2011Q2-2019Q4



The counterfactual scenario could have led to the level of the primary public expenditure ratio being lower than in factual scenario until 2014Q3 and being higher afterwards. The expenditure threshold (45.0%) would be effective until 2015Q1; afterwards, the counterfactual ratio would have followed with a downward trend (Figure 3).

Figure 3: Primary public expenditure ratio, 2011Q2-2019Q4

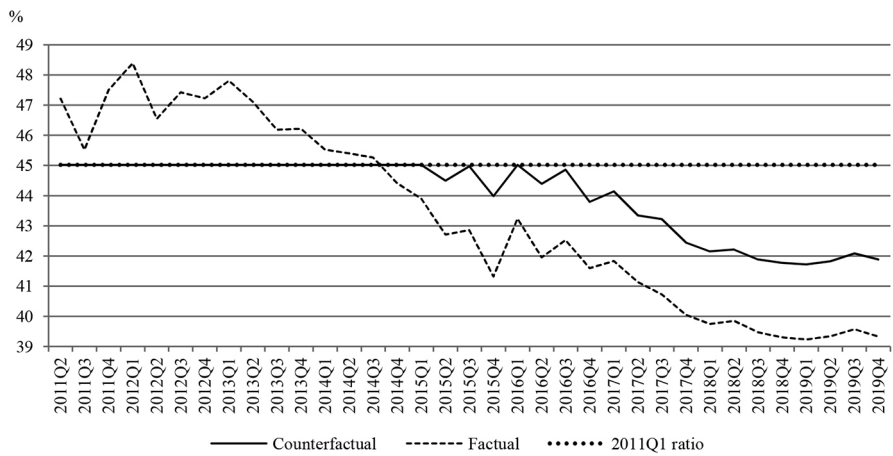
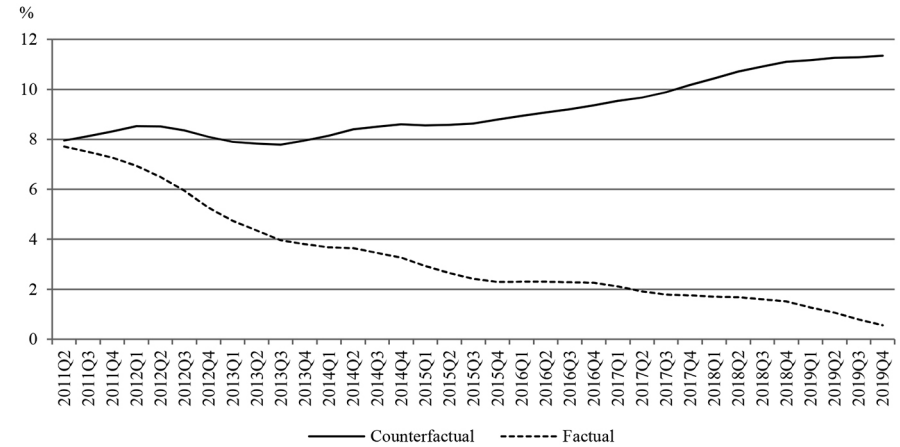


Figure 4 suggests that the long-term interest rate, representative of the public debt cost, in the counterfactual situation could have followed an upward trend in opposition to the downward trend of the factual scenario. This result is consistent with the likelihood of less disciplined fiscal accounts in the absence of the EAP.

Figure 4: Nominal long-term interest rate, 2011Q2-2019Q4



The combination of the counterfactual situation for the two budgetary variables would lead to smaller tax gaps by 2013Q2 (-1.1 p.p. on average, corresponding to 11.4% *versus* 12.5%) and the larger tax gaps as of 2013Q3 (+4.2 p.p. on average, corresponding to 9.7% *versus* 5.5%) (Figure 5).

Figure 5: Tax gap (primary public expenditure ratio - the tax revenue ratio), 2011Q2-2019Q4

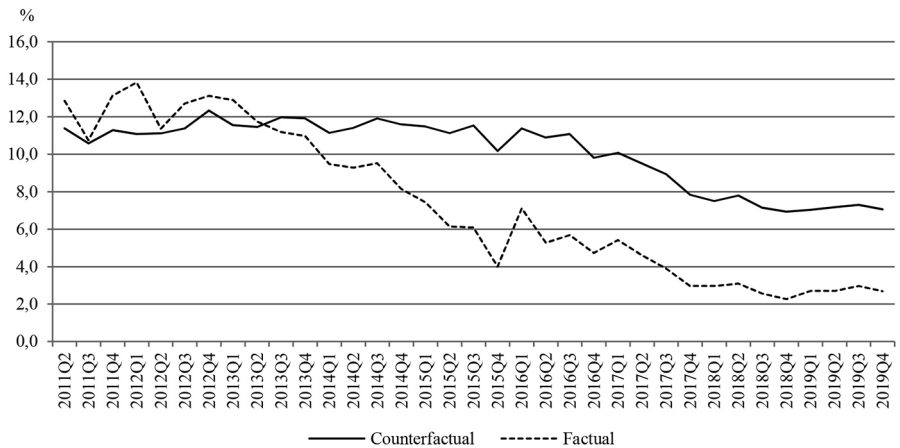
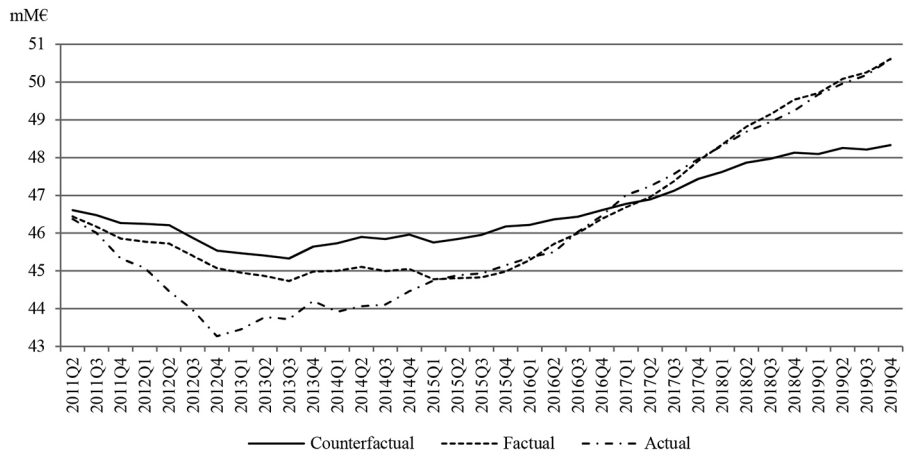


Figure 6 shows the trajectory of real GDP at levels (2015 prices) in the counterfactual, factual and actual representations.

Figure 6: Real GDP at levels (2015 Mm€), 2011Q2-2019Q4



4.4. Alternative specifications

In order to allow for a further assessment of the baseline model, its specification was changed in two directions:

– assuming that the economic regime in force during the adjustment period (2011Q2-2015Q4) would persist in the following period (2016Q1-2019Q4) (alternative A); and
– reducing to 1 the number of lags of endogenous variables and introducing interactive dummy variables with the other variables in order to admit different slopes for *pre-eap*, *eap* and *peap* periods (alternative B).

Except for the variable *v_nltr* in B, these alternatives do not improve the model quality.

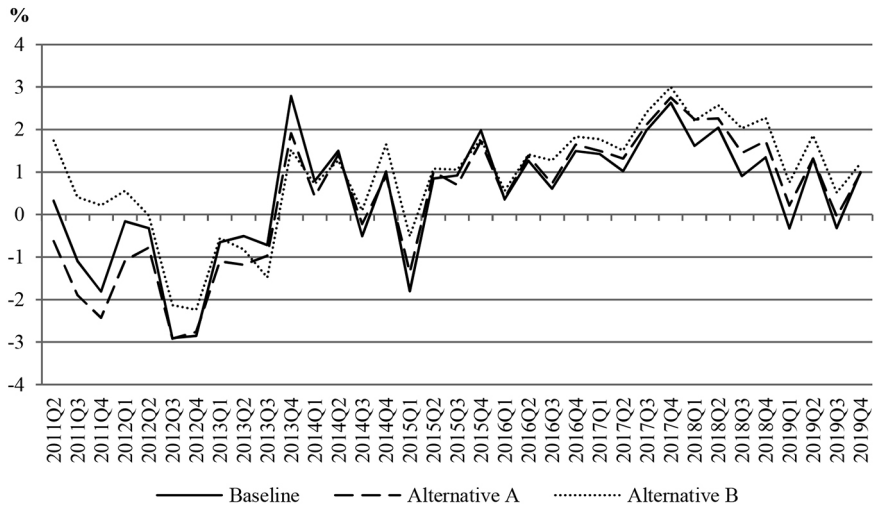
Table 6 summarizes the values of the R^2 and the *p-value* of the F test that support these results.

Table 6: R^2 and P-values of the baseline and alternative specifications

Equation	Specification	R^2	p-value
g_gdp	Baseline	0.599	0.000
	Alternative A	0.538	0.000
	Alternative B	0.415	0.017
v_reven	Baseline	0.778	0.000
	Alternative A	0.768	0.000
	Alternative B	0.502	0.001
v_spend	Baseline	0.668	0.000
	Alternative A	0.659	0.000
	Alternative B	0.530	0.000
v_nltr	Baseline	0.451	0.005
	Alternative A	0.448	0.004
	Alternative B	0.461	0.004

Figure 7 shows the path of the counterfactual real GDP growth rate in the baseline and in the alternative specifications revealing no significant differences.

Figure 7: Counterfactual real GDP growth rate (annual equivalent): Baseline versus alternative specifications, 2011Q2-2019Q4



Note: Alternative A means that it is assumed that the economic regime in force during the adjustment period (2011Q1-2015Q4) would have persisted in the following period (2016Q1-2019Q4). Alternative B corresponds to the reduction in the number of lags in endogenous variables to 1 and the introduction of interactive dummy variables with the other variables.

5. Conclusion

The global financial crisis of 2007 and the resulting sovereign debt crisis determined Portugal's resort to an international financial assistance that entailed the adoption, among others, of an austerity programme composed of public spending cuts and tax increases. The question that emerges is whether the adoption of this programme – which was followed by the deterioration of the Portuguese economy performance – could have been ruled out in favour of a better solution.

The literature review highlights the two following issues. The first is that the plausibility of an expansionary austerity hypothesis is not to be rejected even though the circumstances in which it may take place matter. The second is that the composition of the fiscal adjustment seems to be relevant to its effectiveness and indicates the general way that expenditure-based adjustments are less contractionary (or even expansionary) than tax-based adjustments.

When the country's fiscal position becomes fragile (with the accumulation of fiscal deficits and public debt) and public financing cannot depend on the monetary issuance, on the financial market or on the restructuring of public debt, the use of international financial assistance is often inevitable. In Portugal, an economic adjustment programme, the EAP, was agreed in May 2011 between the Portuguese authorities, the EU and the IMF.

The method adopted in our counterfactual empirical analysis consists in estimating an econometric model representing the Portuguese economy and able to capture the effects of the specific economic regime put in place during the EAP (2011Q2-2015Q4) and in the following period (2016Q1-2019Q4). Our counterfactual scenario is assumed to be a plausible one, in which the ceilings of the tax revenue and the primary public expenditure ratios were set at the levels of the corresponding ratios in the first quarter of 2011.

According to our empirical results, there is evidence that the austerity programme may have been harmful for the economic activity in the short run, but in a longer horizon the austerity policy would produce a better outcome than the one without the EAP application.

The counterfactual scenario outlined in this exercise would lead to a level of the tax revenue ratio standing persistently below both the 2011Q1 threshold and the factual path. As for the primary public expenditure ratio, the 2011 threshold would have been effective by 2015 and then the ratio would have remained on a downward trend, albeit at higher levels than in the factual situations.

Accordingly, the combination of the counterfactual situation for the two budgetary variables would lead to larger tax gaps from 2013Q3 onwards.

The long-term interest rate, representative of the public debt cost, in the absence of an adjustment programme, could have followed an upward trend in opposition to the downward trend of the factual scenario. This result is consistent with the likelihood of less disciplined fiscal accounts in the absence of the EAP.

References

Afonso, A. (2010) Expansionary fiscal consolidations in Europe: New evidence. *Applied Economics Letters*, 17(2), 105-109.

Afonso, A.; Alves, J.; Jalles, J. (2022) (Non-)Keynesian effects of fiscal austerity: New evidence from a large sample. *Economic Systems*, 46(2), 100981.

Afonso, A.; Jalles, J. (2014) Assessing fiscal episodes. *Economic Modelling*, 37, 255-270.

Afonso, A.; Leal, F. (2019) Fiscal multipliers in the Eurozone: A SVAR analysis. *Applied Economics*, 51(51), 5577-5593.

Afonso, A.; Martins, L. (2016) Monetary developments and expansionary fiscal consolidations: Evidence from the EMU. *International Journal of Finance and Economics*, 21, 247-265.

Afonso, A.; Sousa, R. (2011) The macroeconomic effects of fiscal policy in Portugal: A bayesian SVAR analysis. *Portuguese Economic Journal*, 10, 61-82.

Alesina, A. (2010) Fiscal adjustments: Lessons from recent history, Ecofin, Madrid. Retrieved from https://scholar.harvard.edu/files/alesina/files/fiscaladjustments_lessons-1.pdf

Alesina, A.; Ardagna, S. (1998) Tales of fiscal adjustment. *Economic Policy*, 13(27); 489-545.

Alesina, A.; Ardagna, S. (2010) Large changes in fiscal policy: Taxes versus spending. *NBER Tax Policy and the Economy*, 24, 35-68.

Alesina, A.; Ardagna, S. (2013) The design of fiscal adjustment. *NBER Tax Policy and the Economy*, 27, 19–67.

Alesina, A.; Azzelini, G.; Favero, C.; Giavazzi, F.; Miano, A. (2017a) Is it the 'how' or the 'when' that matters in fiscal adjustments? *NBER Working Paper*, 22863.

Alesina, A.; Barbiero, O.; Favero, C.; Giavazzi, F.; Paradisi, M. (2015b) Austerity in 2009-2013. *Economic Policy*, 2015(July), 384-437.

Alesina, A.; Barbiero, O.; Favero, C.; Giavazzi, F.; Paradisi, M. (2017b) The effects of fiscal consolidations: Theory and evidence. *NBER Working Paper*, 23385.

Alesina, A.; Favero, C.; Giavazzi, F. (2015a) The output effect of fiscal consolidation plans. *Journal of International Economics*, 96(Supplement 1), S19-S42.

Alesina, A.; Favero, C.; Giavazzi, F. (2019) *Austerity When It Works and When It Doesn't*. Princeton and Oxford, Princeton University Press.

Alesina, A.; Perotti, R. (1995) Fiscal expansions and fiscal adjustments in OECD countries. *NBER Working Paper*, 5214.

Alesina, A.; Perotti, R.; (1996) Fiscal adjustments in OECD countries: Composition and macroeconomics effects. *NBER Working Paper*, 5730.

Alesina, A.; Perotti, R.; Tavares, J. (1998) The political economy of fiscal adjustments. *Brookings Papers on Economic Activity*, 1998(1), 197-266.

Baker, D. (2010) The myth of expansionary fiscal austerity. *CEPR-Center for Economic and Policy Research*, 2010(October).

Banco de Portugal (2019) Programa de assistência económica e financeira. https://www.bportugal.pt/en/page/efap-and-post-programme-surveillance

Bhattacharya, R.; Mukherjee, S. (2013) Non-keynesian effects of fiscal policy in OECD economies: An empirical study. *Applied Economics*, 45(29), 4122-4136.

Blanchard, O. J.; Perotti, R. (2002) An empirical characterization of the dynamic effects of changes in government spending and revenues on output. *Quarterly Journal of Economics*, 117(November), 1329-1368.

Duncan, R. (2002) Structural adjustment programs: The roles of the IMF and the World Bank. *KSI 2002 Conference*.

European Commission (2011) The economic adjustment programme for Portugal. Directorate-General for Economic and Financial Affairs, *European Economy Occasional Papers* 79.

Giavazzi, F.; Pagano, M. (1990) Can severe fiscal contractions be expansionary? Tales of two small European countries. *NBER Macroeconomics Annual*, 1990(5), 75-122.

Guajardo, J.; Leigh, D.; Piscatory, A. (2011) Expansionary austerity: New international evidence. *IMF Working Paper*, 11/158.

IMF (2010) Will it hurt? Macroeconomic effects of fiscal consolidations. *World Economic Outlook*, 2010 (October), Chapter 3.

Jayadev, A.; Konczal, M. (2010) The boom not the slump: The right time for austerity. *The Roosevelt Institute*, 2010 (August).

Lütkpohl, H. (2007) *New Introduction to Multiple Time Series Analysis*. Berlin, Spring, 2nd printing.

Marinheiro, C. F. (2005) Sustainability of Portuguese fiscal policy in historical perspective. *CESifo Working Paper*, 1399.

Romer, C.; Romer, D. (2010) The macroeconomic effects of tax changes: Estimates based on a new measure of fiscal shocks. *American Economic Review*, 100(3), 763-801.

Sims, C. A.; Stock, J. H.; Watson, M. W. (1990) Inference in linear times series models with some unit roots. *Econometrica*, 58(1), 113-144.

Viegas, M.; Ribeiro, A. P. (2014) The economic adjustment program for Portugal: Assessing welfare impact in a heterogeneous-agent framework. *Portuguese Economic Journal*, 13, 53-70.

Annex

A. THE DATABASE

Real gross domestic product (*gdp*)

The values for this variable were taken from the Eurostat series "Gross domestic product at market prices, chain linked volumes (2015) [*namq_10_gdp*]" and are expressed as million euro. The series values were seasonally adjusted by Eurostat.

Tax revenue ratio (*reven*)

The values for this variable were composed by the addition of the indicators "Taxes on production and imports, receivable", "Current taxes on income, wealth, etc., receivable", "Capital taxes, receivable" and "Net social contributions, receivable" from the Eurostat series "Quarterly non-financial accounts for general government [*gov_10q_ggnfa*]". The values are expressed as a percentage of the gross domestic product. The series values were seasonally adjusted applying the "*seas(m)*" filter processed in software EViews.

Primary public expenditure ratio (*spend*)

The values for this variable were composed by the difference between the indicators "Total general government expenditure" and "Interest, payable" from the Eurostat series "Quarterly non-financial accounts for general government [*gov_10q_ggnfa*]". The values are expressed as a percentage of the gross domestic product. The series values were seasonally adjusted applying the "*seas(m)*" filter processed in software EViews.

Nominal long-term interest rate (*nltr*)

The values for this variable were taken from the Bank of Portugal series "BPstat/ Statistics Online/Data domains/Securities/Secondary market/Yield on fixed rate treasury bonds residual maturity-10 years-monthly" and correspond to the quarterly average of the monthly rates. The values are expressed as annual percentages.

Economic sentiment indicator (*esi*)

The values for this variable were taken from the Eurostat series "Sentiment indicators/ Monthly data /Economic sentiment indicator [*ei_bssi_m_r2*]". These values are seasonally adjusted. The values correspond to the quarterly average of the three values in each quarter. A value of 100 indicates a neutral situation, values greater than 100 indicate a positive sentiment and values below 100 indicate a negative sentiment. The geographic reference of the indicator is the EU.

Real short-term interest rate (*rstr*)

The values of this variable come from the application of the following transformation operator: $rstr_t = nstr_t - inf_t \times 4$.

The values for $nstr_t$ (*nominal short-term interest rate*) were taken from the European Central Bank website in "Statistics Bulletin/Monetary policy statistics/1.2 Key ECB interest rates" and correspond to the quarterly average of the "Main refinancing operations" (variable rate tenders/minimum bid rate between June 28, 2000 and October 14, 2008; fixed rate in other observations) daily interest rates. The values are expressed as annual percentages. The values for inf_t (*inflation*) were taken from the Eurostat series "Gross domestic product at market prices, price index (implicit deflator), percentage change on previous period, euro [*namq_10_gdp*].

Output gap (*outgap*)

The values of this variable come from the application of the following transformation operator: $outgap_t = \left(\frac{gdp_t - gdpast_t}{gdpast_t} \right) \times 100$, where $gdpast_t$ represents the potential output in period t obtained by applying the HP filter (lambda = 1600).

Economic adjustment period (*eap*)

It is a binary variable that takes the value 1 for observations in the economic adjustment period (from 2011Q2 to 2015Q4) and the value 0 for observations in the other periods.

Post-economic adjustment period (*peap*)

It is a binary variable that takes the value 1 for observations in the period after the economic adjustment period (from 2016Q1) and the value 0 for observations in the other periods.

Additionally, the following transformations were adopted.

Rate of change in real gross domestic product (*g_gdp*):
$g\_gdp_t = [lognatural(gdp_t) - lognatural(gdp_{t-1})] \times 100$;

Change in tax revenue ratio (*v_reven*): $v\_reven_t = reven_t - reven_{t-1}$;
Change in primary public expenditure ratio (*v_spend*):
$v\_spend_t = spend_t - spend_{t-1}$;

Change in nominal long-term interest rate (*v_nltr*): $v\_nltr_t = nltr_t - nltr_{t-1}$;
Change in economic sentiment indicator (*v_esi*): $v\_esi_t = esi_t - esi_{t-1}$;
Change in real short-term interest rate (*v_rstr*): $v\_rstr_t = rstr_t - rstr_{t-1}$

B. SUMMARY OF THE UNIT ROOT TESTS

Variable	Test	Test for unit root/ stationarity	Include in test equation	t-Statistic	p-value	LM-Statistic	
Lrgdp	adf	level	intercept	-0,9014	0,7832		
			trend	-1,2794	0,8860		
		1.ª diferença	intercept	-6,1149	0,0000		No unit root
			trend	-6,0825	0,0000		No unit root
	pp	level	intercept	-1,1692	0,6844		
			trend	-1,5336	0,8100		
		1.ª diferença	intercept	-6,3551	0,0000		No unit root
			trend	-6,3188	0,0000		No unit root
	kpss	level	intercept			0,5083	Stationary
			trend			0,1415	
		1.ª diferença	intercept			0,1868	
			trend			0,1860	Stationary
reven	adf	level	intercept	-1,2615	0,6438		
			trend	-2,5905	0,2858		
		1.ª diferença	intercept	-15,5606	0,0001		No unit root
			trend	-15,4582	0,0001		No unit root
	pp	level	intercept	-8,1933	0,0000		No unit root
			trend	-11,3172	0,0000		No unit root
		1.ª diferença	intercept	-42,2526	0,0001		No unit root
			trend	-42,6225	0,0001		No unit root
	kpss	level	intercept			1,1482	Stationary
			trend			0,0787	
		1.ª diferença	intercept			0,0864	
			trend			0,0855	

Variable	Test	Test for unit root/ stationarity	Include in test equation	t-Statistic	p-value	LM-Statistic	
spend	adf	level	intercept	-2,9831	0,0407		No unit root
			trend	-2,8505	0,1841		
		1.ª diferença	intercept	-19,9425	0,0001		No unit root
			trend	-7,6570	0,0000		No unit root
	pp	level	intercept	-6,6638	0,0000		No unit root
			trend	-6,6749	0,0000		No unit root
		1.ª diferença	intercept	-40,5675	0,0001		No unit root
			trend	-72,4941	0,0001		No unit root
	kpss	level	intercept			0,2983	
			trend			0,2460	Stationary
		1.ª diferença	intercept			0,3228	
			trend			0,1127	
nltr	adf	level	intercept	-2,3244	0,1669		
			trend	-2,4877	0,3334		
		1.ª diferença	intercept	-4,5594	0,0003		No unit root
			trend	-4,5732	0,0022		No unit root
	pp	level	intercept	-1,6221	0,4669		
			trend	-1,8225	0,6850		
		1ª diferença	intercept	-4,5858	0,0003		No unit root
			trend	-4,6085	0,0019		No unit root
	kpss	level	intercept			0,2019	
			trend			0,1561	Stationary
		1.ª diferença	intercept			0,1300	
			trend			0,0542	

Leonor Mesquita
Univ Coimbra, Faculty of Economics
leonoroliveiramesquita@gmail.com
Carlos Carreira
Univ Coimbra, CeBER, Faculty of Economics
ccarreir@fe.uc.pt
orcid.org/0000-0002-4786-5605
Rita Martins
Univ Coimbra, CeBER, Faculty of Economics
rvmartin@fe.uc.pt
orcid.org/0000-0001-5300-9322

DOI: https://doi.org/10.14195/2183-203X_55_4

Market Power in Manufacturing and Services Industries

Poder de Mercado nas Indústrias Transformadoras e de Serviços

Leonor Mesquita
Carlos Carreira
Rita Martins

Received for publication: September 18, 2022
Revision accepted for publication: October 20, 2022

ABSTRACT
This study analyzes the extent of the market power of the manufacturing and services industries in Portugal over the last decade. The results show that Portuguese industries are mostly operating under imperfect competition. Mark-ups are heterogeneous across industries, with services having higher mark-ups on average than manufacturing. The *apparel* and the *administrative activities* industries have the highest mark-ups; in turn, the *food* and the *beverages* industries have the lowest mark-ups, while the *rubber and plastics* industry seems to operate under competitive conditions. There is therefore room for improving product market competition in Portugal.
Keywords: Mark-up ratio; Market power; Manufacturing; Services; Portugal.

JEL Classification: L13; L16; L60; D43

Acknowledgement: This work has been funded by the FCT – Fundação para a Ciência e a Tecnologia, Project ENtRY (PTDC/EGE-ECO/31117/2017) and CeBER (UIDB/05037/2020).

1. Introduction[1]

The analysis of market power is essential for researchers, managers and policymakers to better understand the functioning of the markets, the implications that this power may have on the economy and, consequently, to support their decision making (Christopoulou & Vermeulen, 2012). In particular, the knowledge of the level of market power can be useful for regulatory reforms, which is a growing concern in Portugal. The practice of market power itself is not forbidden, but its abuse is, as it leads to a reduction in consumer welfare due to restrictions on competition. Although several studies can be found for different European countries (see Polemis & Fotis, 2016, for a survey), there are few works analyzing the level of market power in Portugal.

This study contributes to this strand of the literature by investigating the market power in the manufacturing and service industries in Portugal over the last decade. The price-cost margin has a long tradition as a measure of market power: the difference between price and marginal cost is zero under conditions of perfect competition; the larger the gap, the closer to a monopoly the industry is. However, since marginal costs are not directly observable in the data, the challenge is how to estimate them. Several authors have proposed analyzing market power using the mark-up index, defined as the ratio between price and marginal cost, where a result greater than one nullifies the hypothesis of perfect competition, using either the Solow residual or the production function (Hall, 1988; Roeger, 1995). For the purposes of this study, we estimate the mark-up index using both methods. First, we will use the macroeconomic (or industry-level) model proposed by Hall (1988) and Roeger (1995) and extended by Polemis (2014), which uses the Solow residual to estimate the market power (here abbreviated as HR). We then move on to the microeconomic methodology proposed by De Loecker and Warzynski (2012), which uses the firm's production function to estimate the mark-up index (abbreviated as DLW). As far as we know, this is the first study to apply the DLW method to the Portuguese case.

2. Background

2.1. Theoretical framework

Market power can be defined as the ability of a firm (or a group of firms acting together) to profitably raise price above marginal cost. When a firm exercises market power, it may result in allocative inefficiency. Conversely, if markets are perfectly competitive, the allocation of resources is efficient, ensuring equality between the marginal cost and price.

The degree of competition in each market depends on technology and therefore varies from industry to industry. However, competition may also be affected by factors such as the number and size of firms operating in the market, the degree of concentration, the regulatory

[1] A previous version of this work was presented by Leonor Mesquita, as a Master's Thesis, with the title "Poder de mercado em Portugal: Uma comparação das indústrias transformadoras e de serviços", under the supervision of professors Carlos Carreira and Rita Martins, at the University of Coimbra, Faculty of Economics.

regime, the degree of openness to international competition, the existence of anti-competitive behavior, product differentiation, and barriers to entry, among others (Martins et al, 1996).

The number of firms operating in a market is a key factor. In principle, the greater the number of firms, the greater the competition and the lower the market power. However, the size of the firms also affects competition. Large firms can exercise market power and deter the entry of new competitors.

There are two measures of market power widely used in the literature: the Lerner index and the mark-up index (Christopoulou and Vermeulen, 2012). The Lerner index is widely used in Industrial Organization and is given by:

$$B_{it} = \frac{P_{it} - MC_{it}}{P_{it}}, \tag{1}$$

where P_{it} denotes the price of a product produced by the firm i in year t, and MC_{it} is its marginal cost. The Lerner index varies from zero in the case of perfect competition (i.e., $P_{it} > CM_{it}$) to one in the case of a monopoly where the price exceeds the marginal cost (i.e.,).

The mark-up index is defined as the ratio between price and marginal cost and indicates how much the price of a product is higher than its marginal cost:

$$\mu_{it} = \frac{P_{it}}{CM_{it}}, \tag{2}$$

This index varies between one and infinity, and the higher it is, the greater the market power. The relationship between the two indices is: $\mu_{it} = \frac{1}{1 - B_{it}}$.

The main disadvantage of both indices is that marginal costs are not directly observable. Besides, estimating marginal costs is also not straightforward. Two main methods are proposed in the literature: the first is based on the cost function; and the second, which is the most commonly used, is based on the production function (Hall, 2018; De Loecker et al., 2020). We follow the latter study.

Hall (1988) rearranges the Solow residual by removing the assumption of perfect competition in product markets to estimate the industry-level mark-up index. The Solow residual must be independent of the log variation in output if there is no monopoly. The problem with Hall's (1988) methodology, however, is that technical progress is not a directly observable variable. Roeger (1995) proposes a solution that eliminates this problem. Instead of the Solow residual based on the production function (primal), he creates the Solow residual based on the cost function (dual). By subtracting both equations, technical progress is eliminated (see Section 3.2 for a more detailed technical description). The advantage of the HR method is its ease of implementation.

De Loecker and Warzynski (2012) estimate the firm-level mark-up index linking the production function, input shares and the price-cost margin. The empirical implementation of the DLW method is straightforward, as it is determined by the relationship between the

input elasticities and the input shares in production (see Section 3.3 for a detailed technical description).

The DLW method is advantageous not only because it does not require a model of firm demand or input prices, but also because it makes use of directly observable data (De Loecker et al., 2020). Moreover, it does not assume the rather restrictive hypothesis of constant returns to scale, which in the case of the HR method is likely to give us a biased assessment of mark-ups.

2.2. Related literature

While the HR and DLW methods have been increasingly used in various studies, there are only a small number of studies on Portugal. Most of the studies conclude that the mark-up ratio exceeds unity in a large number of industries, thus the hypothesis of perfect competition is rejected.

We begin the literature review by mentioning works that use the HR method. Martins et al. (1996) estimate mark-ups for 36 manufacturing industries in 14 OECD countries for the period 1970-1992. They found that mark-ups greater than one are statistically significant in all countries and in almost all manufacturing industries, indicating deviations from perfect competition. The authors conclude that the level of mark-ups is directly related to the market structures of a given industry and is significantly lower in fragmented industries than in concentrated ones. The highest mark-ups for radio, television and communication equipment, pharmaceutical products, and computer equipment can be explained by innovation. They also conclude that the differences between countries can be explained by the specific policies of each country.

Christopoulou and Vermeulen (2012) confirmed the findings of Martins et al. (1996) by analyzing 50 industries in eight countries in the Eurozone and the US over the period 1981–2004. In particular, the authors found that mark-ups are generally greater than one and therefore rejected the perfect competition hypothesis for almost all industries in all countries. Christopoulou and Vermeulen (2012) also observed heterogeneity in mark-ups both across countries and across sectors, with the services sector having a higher index than manufacturing. Comparing the euro area with the US, services have higher mark-ups in the euro area, while the opposite is true for manufacturing.

Borg (2009) also conducted a study of 15 industries for 22 EU countries for the period 1990–2006 (due to a lack of data, some countries were studied only for the period 1994–2005). The mark-up values range from 1.46 (Cyprus) to 1.22 (Switzerland), with most values in the range of 1.25 to 1.35, nullifying the hypothesis of perfect competition. Portugal does not stand out as it ranks 17th in the mark-ups. Looking at the individual sectors of the economy, the author concludes that the highest mark-ups are in *agriculture*, *fishing*, *publishing and printing*, *furniture*, *trade and maintenance of motor vehicles*, *hotels and restaurants* and *real estate*. The lowest mark-ups are observed in the manufacturing activities, especially in the export-oriented sectors. Overall, the average mark-ups in the services are higher than in manufacturing in all countries studied, findings that are backed up by Christopoulou and Vermeulen (2012).

Bottini and Molnár (2010) analyzed the services sector in 21 OECD countries for the period 1993–2006 and found that mark-ups tend to be higher in professional services, real estate, rentals and utilities and substantially lower in construction, computer services, wholesale and retail trade and restaurants. They also found that there are large differences between countries, with higher values for Central European members and for Italy, Portugal and Sweden, while the United Kingdom and most Scandinavian countries have lower mark-up values.

In the case of Portugal, Alves and Figueira (2019) analyzed the period 1910–2016 and also rejected the hypothesis of perfect competition. The industries with the highest mark-up are electricity, gas and water, and transport and communications, which can be explained by the fact that they are capital-intensive sectors and therefore have strong economies of scale. The lowest mark-up is in the trade sector, which consists of numerous micro-enterprises and only a few large firms. The authors conclude that regulatory reforms should be strengthened to increase competition in Portugal.

In contrast to the above studies, Polemis and Fotis (2016) found that there is no evidence of imperfect competition in most manufacturing and service industries in the Eurozone, the US and Japan in the period 1970–2007, as estimated mark-ups are generally no higher than unity. Service industries have higher average mark-ups than manufacturing and the Eurozone exhibits the lowest mark-ups. Industries that are more open to internationalization, along with those that are deregulated, have relatively lower mark-ups than industries that are less open and regulated.

Recently, some authors have been using the DLW method to determine the mark-up index. For example, Weche and Wambach (2021), who studied 17 EU countries over the period 2007–2015, showed that there was a sharp decline in average mark-ups during the crisis years of 2008 and 2009, followed by a post-crisis increase. Conversely, García-Perea et al. (2021) found that mark-ups increased during the Great Recession (2008-2013) in Spain, and that small firms had greater market power than their larger competitors in the same industry. Finally, Dai and Cheng (2018) observed that product innovation significantly increased the mark-up of Chinese manufacturing firms during the period 1998–2007.

3. Data and Methodology

3.1. Data

Our data are extracted from the Integrated Business Accounts System (Portuguese acronym, *SCIE*), administered by the Portuguese Statistical Office (INE), and produced under the project ENtRY (grant FCT No. PTDC/EGE-ECO/31117/2017). It covers all enterprises operating in the manufacturing and service industries in Portugal, except the financial sector, and education, health and cultural services, for the period 2010-2019.

After apply cleaning filters,[2] the final dataset encompassed 480,993 firms and consisted of 2,794,324 year-firm observations.

The database contains detailed input and output information required for the computation of firm-level mark-ups. The gross output was measured as the value of production and deflated by the producer price index at the two-digit industry level. Materials included the cost of materials and services purchased and were deflated by the GDP deflator index. Capital was computed by applying the perpetual inventory method to the changes in tangible and intangible assets, and book values were deflated by the GDP deflator index.

3.2. Macro-approach of Hall (1988) and Roeger (1995)

Our first approach uses the methodology developed by Hall (1988) and Roeger (1995) and extended by Polemis (2014), who adds intermediate inputs to the production function. The inclusion of this new input allows mark-ups to be defined using gross output, overcoming the upward bias that would result if value added were used instead.

Assume the production function of an *industry* that is homogeneous of degree one (returns to scale) and defined as follows:

$$Y = Af(L, M, K), \tag{3}$$

where Y represents the gross output, L, M and K are the labor, intermediate (materials) input and capital, respectively; A denotes the multifactor productivity growth (Hicks-neutral technical progress). Considering a Cobb–Douglas production function (in log form), equation (3) can be rewritten as follows:

$$y = \varepsilon_L l + \varepsilon_M m + \varepsilon_K k + \theta, \tag{4}$$

where lower-case letters denote the log of corresponding upper-case variables in (3); θ is the technical progress; and ε_f denotes factor elasticities, with $f = L, M, K$.

Under constant returns to scale and perfect market competition of product and labor, the elasticities are equal to the observed input shares. In the case of imperfect competition, the elasticities correspond to input shares and the mark-up, that is:

$$y = \mu\alpha_L l + \mu\alpha_M m + \mu\alpha_K k + \theta, \tag{5}$$

where α_f are input shares and μ is the mark-up defined by equation (2). Assuming constant returns to scale and given that $\mu = \frac{1}{1-B}$, equation (5) can be rewritten as the Primal Solow Residual:

[2] We omitted data with missing or non-positive output, employees, cost of purchased materials and services or total net assets.

$$PSR = y - \alpha_L l + \alpha_M m - (1 - \alpha_L - \alpha_M)k = B(y - k) + (1 - B)\theta, \quad (6)$$

This equation can be used to calculate B, the Lerner index, and therefore μ. However, because the term $(1 - B)\theta$ is not observable, instrumental variables become necessary to obtain consistent estimates. Roeger (1995) proposed eliminating the unobservable term by combining the primal and dual solutions, DSR, by using the cost function associated with the production function (4) as follows:

$$DSR = \alpha_L w - \alpha_M p - (1 - \alpha_L - \alpha_M)r - P = (1 - B)\theta - B(P - r), \quad (7)$$

where w denotes the wage, p, r and P are the prices of materials, capital and final product. Subtracting the equations (7) and (6), an expression for B is (adding an error term e):

$$\Delta y = B\Delta x + e, \quad (8)$$

where $\Delta y = (y + P) - \alpha_L(l + w) - \alpha_M(m + p) - (1 - \alpha_L - \alpha_M)(k + r)$ and $\Delta x = B[(y + P) - (k + r)]$.

Since there are no price series for capital, we use the approach of Hall and Jorgensen (1967):

$$r = (i - \pi_e + \delta)P_t, \quad (9)$$

where P_t is the GDP deflator, $(i - \pi_e)$ is the real interest rate and δ is the depreciation rate, which is set at 5% across all sectors. The real interest rate is the long-term interest rate minus the expected inflation rate.

3.3. Micro-approach of De Loecker and Warzynski (2012)

De Loecker and Warzynski (2012) assumes a production function with Hicks-neutral technology as a starting point:

$$Y_{it} = f_{it}(A_{it}, L_{it}, M_{it}, K_{it}), \quad (10)$$

where subscripts i and t refer to firm and year, respectively.

The firms are cost-minimizing. Therefore, their optimization problem can be written as a Lagrangian function:

$$LG(L_{it}, M_{it}, K_{it}, \lambda_{it}) = w_{it}L_{it} + p_{it}M_{it} + r_{it}K_{it} + \lambda_{it}[Y_{it} - f_{it}(.\,)], \quad (11)$$

where λ_{it} is the Lagrange multiplier.

To compute firm-level mark-ups, De Loecker and Warzynski (2012) consider labor as the baseline variable input of reference. However, given the rigidities in the Portuguese labor market, labor is a quasi-fixed input that can be associated with market power on both

the consumer and seller side (e.g., the bargaining power of workers). We therefore use the materials input as it is a more flexible input, free of adjustment costs (Dai and Cheng, 2018; García-Perea et al., 2021).

The first-order condition with respect to intermediate inputs is:

$$\frac{\partial LG_{it}}{\partial M_{it}} = p_{it} - \lambda_{it} \frac{\partial f_{it}(.)}{\partial M_{it}} = 0, \tag{12}$$

where $\frac{\partial f_{it}(.)}{\partial M_{it}}$ is the marginal productivity of intermediate input. Rearranging equation (12) and multiplying both sides by $\frac{M_{it}}{Q_{it}}$ we get:

$$\frac{\partial f_{it}(.)}{\partial M_{it}} \frac{M_{it}}{Q_{it}} = \frac{1}{\lambda_{it}} \frac{p_{it} M_{it}}{Q_{it}}. \tag{13}$$

Note that $\frac{\partial L_{it}}{\partial Q_{it}} = \lambda_{it}$ is the shadow cost, which represents the marginal cost of production for any given level of output Q_{it}, therefore mark-up can be defined as $\mu_{it} = \frac{P_{it}}{\lambda_{it}}$. Using the optimality condition (13), firm-level mark-up can be measured as:

$$\mu_{it} = \frac{\varepsilon_{it}^{M}}{\alpha_{it}^{M}}, \tag{14}$$

where $\varepsilon_{it}^{M} = \frac{\partial f_{it}(.)}{\partial M_{it}} \frac{M_{it}}{Q_{it}}$ is the output elasticity of materials, and $\alpha_{it}^{M} = \frac{p_{it} M_{it}}{P_{it} Q_{it}}$ is the share of expenditures on materials in sales revenue.

While the computation of α_{it}^{M} from the data is straightforward, firm-level estimates of ε_{it}^{M} cannot be easily obtained. Assuming that all firms within an industry share the same technology, we estimate the Cobb-Douglas production function (4) using the estimator proposed by Levinsohn and Petrin (2003).

4. **Empirical Results**

The empirical results from using the HR and DLW methodology – equations (8) and (14), respectively – are shown in Table 1.[3] The mark-ups exceed unity for both methods, except in the *rubber and plastic products* and *transport and storage* industries for the HR method.[4] Therefore, the scenario of perfect competition for the Portuguese manufacturing and service industries over the period 2010–2019 is rejected for almost all industries. The clear excep-

[3] Estimates were made using the "markupest" command of Stata/SE 16.0 software (Rovigatti, 2020).

[4] Caselli et al. (2018) documented the incidence of firms displaying mark-ups lower than unity (markdowns) for French manufacturing firms for the period 1990–2007.

tion seems to be the *rubber and plastics* industry, where the mark-up for the HR and DLW methods is almost one, indicating the presence of competitive conditions (in the case of the *furniture* industry, the result is also significantly equal to one, but only for the DLW method).

In general, mark-ups are higher for the HR method than for the DLW method – the average mark-ups are 1.815 and 1.350, respectively. This could be due to the fact that the DLW method is conducted at the firm level and can therefore better capture the market power of the firms (Rovigatti, 2020). The average HR mark-up estimated in this study is higher than the estimated mark-ups for Portugal by Alves and Figueira (2019), who reported values of 1.49 in 2012 and 1.41 in 2016, and by Borg (2009), who reported an index of about 1.25 for the period 1990–2006. In the case of the DLW method, the average mark-up in manufacturing is similar to the estimates by De Loecker and Warzynski (2012) for Slovenian manufacturing firms in the period 1994-2000, but lower than the median value of 1.84 estimated by Weche and Wambach (2021) for 17 EU countries in the period 2007-2015.

Table 1: Mark-up index by sector, 2010–2019

CAE	Industry	HR	DLW
10	Food products	1.1448	1.1571
11	Beverages	1.1954	1.1135
13	Textiles	2.1084	1.3926
14	Wearing apparel	2.9678	2.1626
15	Leather and related products	1.3176	1.6171
18	Printing and reproduction of recorded media	3.1653	1.2335
20	Chemicals and chemical products	1.9516	1.1996
22	Rubber and plastic products	0.9510	1.0565
23	Other non-metallic mineral products	1.5260	1.1980
24	Basic metals	1.2358	1.3312
25	Fabricated metal products (except machinery/equipment)	1.8311	1.1340
26	Computer, electronic and optical products	1.2892	1.2292
27	Electrical equipment	1.4685	1.1593
28	Machinery and equipment n.e.c.	1.7102	1.1932
29	Motor vehicles, trailers, semi-trailers and accessories	1.5129	1.2996
31	Furniture	2.25760	1.0179
32	Other manufacturing activities	2.27565	1.3969
33	Repair and installation of machinery and equipment	2.1687	1.4414
37-39	Sewerage, waste management and remediation activities	1.7767	1.4187
41-43	Construction	1.1393	1.3639
45-47	Wholesale and retail trade; repair of motor vehicles	2.7114	1.4798
49-53	Transportation and storage	0.7846	1.2902
58-63	Information and communication activities	1.9699	1.4989
69-75	Consultancy, scientific and technical activities	2.1179	1.5992
77-82	Administrative and support service activities	2.7937	1.7646

Notes: HR and DLW denote Hall (1988) and Roeger (1995) method and De Loecker and Warzynski (2012) method, respectively. Two-digit level of the Portuguese Classification of Economic Activities (CAE-Rev.3). At this disaggregation level there is a direct correspondence between the CAE and the classifications of both the European Community (NACE-Rev.2) and the United Nations (CITA-Rev.4).

There are significant differences across industries. According to the HR method, the highest market power is found in the *printing* industry with a mark-up of 3.165. However, this result is not confirmed by the DLW method. Borg (2009) also found that the *printing* sector has relatively high HR mark-ups in 22 EU countries.

Both methods agree that mark-ups are relatively high in *wearing apparel* and *administrative activities*—in fact, they have the highest values in the DLW method, where average mark-ups are 116% and 76% above marginal costs, respectively. In the first-mentioned industry, the high mark-ups can be explained by innovation and the export behavior of firms (Martins et al., 1996; De Loecker and Warzynski, 2012; Dai and Cheng, 2018). According to Fraga et al. (2008), the apparel industry has one of the highest shares of patented production in Portugal. Moreover, this industry is increasingly engaged in international trade, with a positive trade balance of 982.4 million euros in 2019 (source: PORDATA). In the latter industry, the explanation may be different, as there is a high and growing number of large firms.

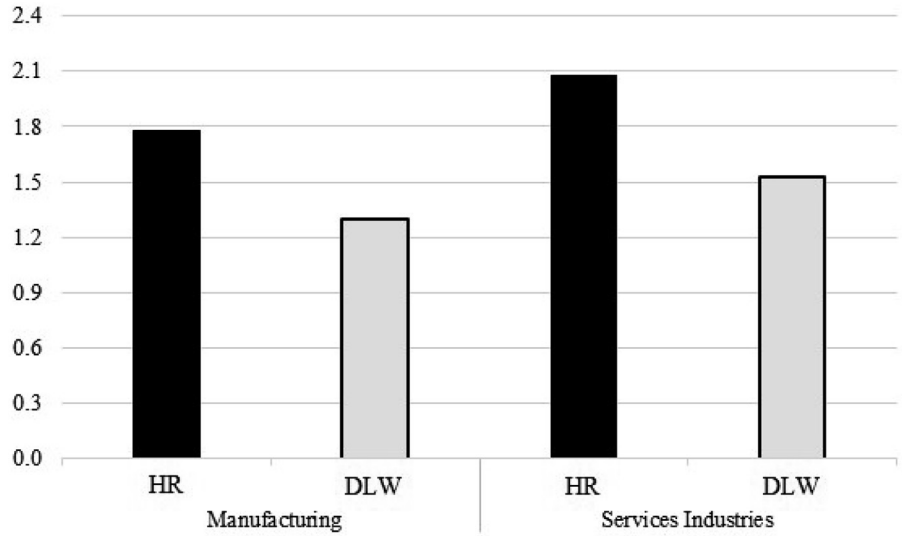
The trade industry also has one of the highest mark-ups for both methods. There are, in fact, several micro-enterprises in this industry, however, a few, but very large, firms may exercise market power. Borg (2009) also found a high mark-up for trade, in contrast to the low mark-ups found by Bottini and Molnár (2010) and Alves and Figueira (2019).

The *consultancy and scientific* and *information and communication* sectors also have one of the highest mark-ups, but only for the DLW method. The high market power in the latter could be due to the telecommunications sub-sector. Indeed, there is a lack of competition, resulting in high prices in this sector, with three operators accounting for almost all the market share (OECD, 2021). Alves and Figueira (2019) also reports high market power in the *communication* sector.

According to the two methods, mark-ups are low in the *food* and *beverages* industries – mark-ups are 14/16% (HR/DLW method) and 20/11% above marginal costs, respectively. These two industries – as well as the *rubber and plastics* industry, which was considered competitive – face strong foreign competition on the domestic market (the trade balance is negative; source: PORDATA).

Finally, Figure 1 compares the average mark-ups of the manufacturing and services industries according to the two methods. Mark-ups are higher in the service sector than in the manufacturing sector as found in almost all the studies discussed in Section 2.2.

Figure 1: Average mark-ups of manufacturing and services industries



Note: HR and DLW denote Hall (1988) and Roeger (1995) method and De Loecker and Warzynski (2012) method, respectively.

5. Concluding Remarks

This study analyzed the extent of market power of the manufacturing and services industries in Portugal over the 2010-2019 interval. We used two different methodologies: the macroeconomic (i.e. industry-level) model of Hall (1988) and Roeger (1995) and the microeconomic (i.e. firm-level) model of De Loecker and Warzynski (2012). The empirical analysis was conducted at the two-digit level, which allowed for the examination of differences across industries.

Estimated mark-ups are higher than unity in almost all industries, suggesting that Portuguese firms in the manufacturing and services industries exercise market power. Mark-ups are heterogeneous across industries, with services having higher mark-ups on average than manufacturing, which is in line with the findings of previous studies. Both methods agreed that the *apparel* industry and *administrative activities* have the highest levels of market power; the *food* and the *beverages* have the lowest; and the *rubber and plastics* industry seems to operate under competitive conditions. The *printing* industry also has a high murk-up, according to RH method, but this is not confirmed by the DLW method.

The number of firms operating in each industry is not the only factor explaining these different levels of market power. Size, regulatory regime, degree of openness to international

competition, and product differentiation, among others, can also be important factors in explaining market power. Thus, there is room for the government, and regulators especially, to improve competition in product markets. For the future, it would be important to study the explanatory factors of market power more thoroughly in the different industries and their evolution over the past decades.

References

Alves, R. P.; Figueira, C. (2019) O que nos diz a margem preço-custo e o poder negocial dos trabalhadores sobre os mercados em Portugal? In Banco de Portugal (ed.), Crescimento Económico Português: Uma Visão sobre Questões Estruturais, Bloqueios e Reformas. Lisboa, Banco de Portugal, 185-193.

Borg, M. (2009) Measuring market competition in the EU: The mark-up approach. *Bank of Valletta Review* 39, 20-31.

Bottini, N.; Molnár, M. (2010) How large are competitive pressures in services markets? Estimation of mark-ups for selected OECD countries. *OECD Journal: Economic Studies* 1, 1-51.

Caselli, M.; Schiavo, S. ; Nesta, L. (2018) Markups and markdowns. *Economics Letters*, 173, 104-107.

Christopoulou, R.; Vermeulen, F. (2012) Markups in the Euro Area and the US over the Period 1981-2004: A Comparison of 50 Sectors. *Empirical Economics* 421, 53-77.

Dai, X.; Cheng, L. (2018) The impact of product innovation on firm-level markup and productivity: Evidence from China. *Applied Economics,* 50(42), 4570-4581.

De Loecker, J.; Eeckhout, J.; Unger, G. (2020) The rise of market power and the macroeconomic implications. *Quarterly Journal of Economics,* 135(2), 561-644.

De Loecker, J.; Warzynski, F. (2012). Markups and firm-level export status. *American Economic Review,* 102(6), 2437-2471.

Fraga, M.; Martins, O.; Anciaes, P. (2008)Patterns of innovation diffusion and technological competition in Portuguese manufacturing and service industries. *International Review of Applied Economics*, 22(3), 353-372.

García-Perea, P.; Lacuesta, A.; Roldan-Blanco, P. (2021) Markups and cost structure: Small Spanish firms during the Great Recession. *Journal of Economic Behavior & Organization*, 192, 137-158.

Görg, H.; Warzynski, F. (2006) The dynamics of price cost margins: Evidence from UK manufacturing. *Revue de l'OFCE*, (5), 303-318.

Hall, R. E. (1988) The relation between price and marginal cost in US industry. *Journal of Political Economy,* 96(5), 921-947.

Hall, R. E.; Jorgenson, D. W. (1967) Tax policy and investment behaviour. *American Economic Review* 57, 391-414.

Levinsohn, J.; Petrin, A. (2003) Estimating production functions using inputs to control for unobservables. *Review of Economic Studies*, 70(2), 317-341.

Martins, J. O.; Scarpetta, S.; Pilat, D. (1996) Mark-up ratio in manufacturing industries: Estimation for 14 OECD Countries. *OECD Economics Department Working Papers* 162, OECD Publishing.

OECD (2021) *OECD Economic Surveys: Portugal 2021*, OECD Publishing, Paris.

Polemis, M. (2014) Measuring market power in the Greek manufacturing and services industries. *International Review of Applied Economics* 28(6), 742-766.

Polemis, M. L.; Fotis, P. N. (2016) Measuring the magnitude of significant market power in the manufacturing and services industries: A cross country approach. *Journal of Industry, Competition and Trade,* 16(1), 51-79.

PORDATA (n.d.) International Trade. Retrieved on September 18, 2021, from https://www.pordata.pt/en/subtheme/portugal/international+trade-253

Roeger, W. (1995) Can imperfect competition explain the difference between primal and dual productivity measures? Estimates for US manufacturing. *Journal of Political Economy,* 103(2), 316-330.

Rovigatti, G. (2020). MARKUPEST: Stata module for markup estimation via Micro and Macro approaches. Statistical Software Components. Boston College Department of Economics. https://EconPapers.repec.org/RePEc:boc:bocode:s458820

Weche, J. P.; Wambach, A. (2021) The fall and rise of market power in Europe. *Jahrbücher für Nationalökonomie und Statistik*, 241(5-6), 555-557.

Nelson Gomes
Univ Coimbra, Faculty of Economics
nma_gomes@hotmail.com
Nuno Gonçalves
Univ Coimbra, Faculty of Economics
npocinhogoncalves@outlook.pt

DOI: https://doi.org/10.14195/2183-203X_55_5

Innovation and the Financial Performance of Firms during the Great Recession and Recovery Period

Inovação e Desempenho Financeiro das Empresas durante a Grande Recessão e o Período de Recuperação

Nelson Gomes
Nuno Gonçalves

Received for publication: September 29, 2022
Revision accepted for publication: October 30, 2022

ABSTRACT
This study analyzes the relationship between innovation and financial constraints. To this end, a database extracted from the Community Innovation Survey (CIS) and the System of Business Accounts (SCIE) was used. The sample consisted of 24,679 active companies operating in Portugal in the manufacturing and service industry between 2008 and 2016. A Recursive Bivariate Probit Model (RPBM) was used for making estimates. When analyzing the relationship between innovation and financial constraints, the results reveal a negative relationship between the two, confirming that firms that are financially constrained are more limited in their investments in R&D, and innovation is less accessible to them. The severity of the effects of financial constraints is heterogeneous across economic activities, strongly affecting innovative industries, while service industries appear to be the least affected. It was also observed that larger companies are better able to innovate. There was a positive relationship between *innovation* and the variables *sales* and *exports*, indicating that innovation will positively affect the financial results of companies.
Keywords: Innovation; R&D investment; financial constraints; Portugal.

JEL Classification: O30; D92; G32; L00; L20

Acknowledgements: We would like to thank Carlos Carreira for his helpful comments, time and effort devoted to this research work. This work has been funded by the FCT – Fundação para a Ciência e a Tecnologia, Project ENtRY (PTDC/EGE-ECO/31117/2017) and CeBER (UIDB/05037/2020).

1. Introduction[1]

Innovation is a key element for long-term economic growth. At the micro level, innovation is also extremely important, leading to the competitive differentiation of firms from their competitors, with good production and financial performances of the firms.

The innovation process is expensive, time-consuming and the end results are uncertain. Firms need funds to develop these projects, which they may not have and, therefore, they must seek funds in the financial market. Because the outcomes of R&D investments are uncertain, financial institutions prefer to invest in more traditional, non-innovative projects (Mazzucato, 2013). When this happens, firms are often left without financing or being partially financed, leading to financial constraints on the firms.

Innovative projects are associated with a higher risk, which can cause a higher loss for the financier in the event of default. One of the reasons for this is that most of the R&D investment is directed towards the creation of intangible assets. These firms therefore have fewer physical assets, most of them instead having intangible assets that are harder to use as collateral, which leads to greater uncertainty on the part of investors and financiers in embracing innovative projects (Hall and Lerner, 2010).

The main objective of this study will be to analyze the relationship between innovation and financing, controlling for other fundamental characteristics of the company such as the financial results of its economic activity, size, or age, analyzing for this purpose a sample of 24,679 active Portuguese companies in the period between 2008 and 2016. This study highlights the period of deep Portuguese economic recession and recovery period. In fact, the issue gained greater relevance after the outbreak of the 2008 financial crisis, when enterprises saw their external financing costs increase due to the uncertainty in the markets and the greater information asymmetries found in small companies compared to those in larger ones (Guellec and Wunsch-Vincent, 2009).

2. Literature Review

2.1. Market failures and sources of financing

There are several formal and informal channels for financing the innovative projects of firms. The formal financing can be of two types, either through sources external to the firm, such as bank loans and other forms of debt, or through internal financing, using funds held by the company itself. Informal channels can be defined as funding sources that escape the structures mentioned, such as friends and family. One advantage of these channels over formal ones is the absence of bureaucracy. It should be noted that external financing is not always private, and the creation of subsidies for firms that want to innovate is the States' response to market failures. State intervention helps overcome the fact that R&D investments and innovation activities are particularly prone to financial constraints.

[1] A previous version of this work was presented by Nelson Gomes, as a Master's Thesis, with the title "Inovação e o seu impacto nas finanças das empresas", under the supervision of Prof. Carlos Carreira, at the University of Coimbra, Faculty of Economics.

There may be several reasons why credit to finance innovation projects is rationed or not granted, due to the existence of market failures. Modigliani and Miller (1958) state that in perfect capital markets, investment decisions would not depend on the financial structure of the firms or their financial policy, so there would be no financial constraints for firms. However, the existing conditions prevent this from happening. One of these is the existence of information asymmetries, that is, at the time of any transaction, one of the agents has more or better information than the other party. This creates an imbalance in the market, giving rise to situations of moral hazard and adverse selection as explained by Akerlof (1970) in his famous study on the lemon market, and by works of Stiglitz and Weiss (1981) and Myers and Majluf (1984). Moral hazard occurs when an economic agent changes its behavior after granting credit, in accordance with the different contexts that present themselves, and fails to comply with what was previously agreed (Jensen and Meckling, 1976). Adverse selection leads to firms with good projects not being financed or not being fully financed, or, on the other hand, high risk projects are financed, resulting in an inefficient allocation of credit (Leland and Pyle, 1977).

2.2. R&D investment, innovation and financial constraints

Most studies show that financial constraints in developed countries have a negative effect in R&D investment (Savignac, 2008; Aghion et al., 2012; Carreira and Silva, 2010; Lööf and Nabavi, 2016; García-Quevedo et al., 2018; Santos and Cincera, 2020). However, this conclusion has not been confirmed for some developing countries, such as Vietnam, a socialist market economy (Archer et al., 2020), India (Sasidharan et al., 2015), and even for some developed economies, such as Ireland (Hewitt-Dundas, 2006).

García-Quevedo et al. (2018) provided evidence that financial constraints increase the probability of bankruptcy for Spanish firms with innovative projects. Silva and Carreira (2012) found a negative relationship between credit constraints and innovation in Portuguese firms and state that support allocated to innovative projects does not mitigate financial constraints despite promoting innovation. In Sweden, firms with credit constraints are less likely to invest in patents (Lööf and Nabavi, 2016). Aghion et al. (2012) show that, due to sensitivity to long-term exogenous shocks, firms operating in France with financial constraints are less likely to invest in innovative projects. Again, in regard to the reality of French firms, Savignac (2008) states that, in the period between 1997 and 1999, the existence of constraints decreased the likelihood of innovation. In a study conducted with companies from various European countries, being an innovative company is known to increase the probability of financial constraints from 21% to 32% (Santos and Cincera, 2020).

Of the companies that invest more in R&D, those that invest in the development of physical assets are less likely to suffer restrictions compared to those that seek to develop intangible assets. This is due to the difficulty in quantifying intangible assets and their being accepted as collateral for external financing (Hall and Lerner, 2010) and because of the associated uncertainty and risk (Mazzucato, 2013). In contrast, a recent study by Montresor and Vezzani (2022) shows that there is no difference between credit constraints on intangible innovative firms and those on non-innovative firms.

It is important to note that the degree of financial constraint is not homogeneous across firms. Lee et al. (2015) conducted a study on SME access to credit following the financial crisis and show that when SMEs present projects for new products, they have an even greater difficulty in obtaining financing. Efthyvoulou and Vahter (2016) found that the impacts of financial constraints vary according to the sector of activity, their negative effect being greater in the goods production sector than in the services sector, and the constraints are greater if the company is a non-exporter. Financial constraints are also more pronounced in smaller and younger firms (Czarnitzki, 2006; Oliveira and Fortunato, 2006). Companies with limited access to finance are less likely to survive (Lahr and Mina, 2021), which is also the case when relations are unstable (Farinha, 2005).

3. **Data and Methodology**

The database used in this study is extracted from the System of Business Accounts (SCIE), and the Community Innovation Survey (CIS), which is the responsibility of the National Statistics Institute (INE) (Table A.1 in Online Appendix describes the industries analyzed). It covers four periods (surveys): the 1st period from 2008 to 2010; the 2nd period from 2010 to 2012; the 3rd period from 2012 to 2014; and finally, the 4th period of the years 2014 to 2016.

When the relationship between financial constraints and innovation is analyzed, endogeneity is an issue that we must keep in mind, due to the existence of unobserved factors that affect both variables. The factors presented in the literature include the uncertainty associated with the results and the time required to develop the innovation; the confidentiality of the project for strategic reasons can create or aggravate financial constraints; and in regard to the decision to move forward or not with the innovative project, the decision to engage is usually made at the time the funding is obtained (Savignac, 2008).

Simultaneous equation models are the most commonly used to study this topic (Savignac, 2008; Silva and Carreira, 2012; Santos and Cincera, 2020; Lahr and Mina, 2021), thus making it possible to deal with the problem of endogeneity. For that reason, in our estimates we used a Recursive Bivariate Probit Model (RPBM) with random effects, choosing to estimate the models based on the full sample regardless of a firm's attitude towards innovation, whether it is a potential innovator or not. This allowed us to avoid spurious relationships between innovation and financial constraints (Savignac, 2008). The RPBM assumes that the dependent variable in the second equation is explanatory in the first equation and the error terms are assumed to be correlated across equations:

$$\begin{cases} IN_{i,t}^{A} = FC2y_{i,t}^{A} + Z_{i,t}^{A}\beta^{A} + c_i^{A} + \varepsilon_{i,t}^{A} \\ FC2y_{i,t}^{B} = Z_{i,t}^{B}\beta^{B} + c_i^{B} + \varepsilon_{i,t}^{B} \end{cases} \tag{1}$$

with, $\begin{pmatrix} \varepsilon_{i,t}^{A} \\ \varepsilon_{i,t}^{B} \end{pmatrix} \sim N\begin{bmatrix} 0 \\ 0 \end{bmatrix}\begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix}$

The model assumes that the error terms are independent and identically distributed following a bivariate normal distribution, c_i^A and c_i^B are the time invariant error terms, $\varepsilon_{i,t}^A$ and $\varepsilon_{i,t}^B$ is a time shock-specific idiosyncratic term. The correlation coefficient ρ (rho) between the error terms explains the possible existence of omitted or unobservable factors that simultaneously affect the decision to innovate and the probability of facing financing constraints. If $\rho = 0$, FC2y is not correlated with the error term $\varepsilon_{i,t}^A$, and will be taken as an exogenous variable. In this case, the two equations could be estimated separately, through a univariate probit model. Whereas, if $\rho \neq 0$, a joint estimation is necessary to obtain consistent estimates.

The dependent variables IN and FC2y are binary, that is, whether firm *i* innovated (IN = 1), or not (IN = 0) and whether firm *i* is financially constrained (FC2y = 1) or not (FC2y = 0). We believe that innovation, in addition to financial constraints, is also influenced by the sales and the average percentage of sales in international markets, these variables being expressed by their average value over the last 3 years, AvSAL and AvEXP, respectively. Finally, we also consider the size of the company, translated through the number of employees (L) and the age of the company (AGE), which will be the age assumed when answering the first questionnaire.

The innovation variable comprises the development of new products and processes. It should be noted that product and process innovation does not only include conducting in-house R&D activities, but also the external acquisition of machinery, equipment, software and buildings, as well as the acquisition of existing knowledge from other companies or institutions, training, marketing, and design.

The sample has 24,679 companies, totaling 3,701,850 observations during the four periods mentioned. As can be seen in Table 1, 51.55% of the companies innovated and 42.72% of the companies had investments in R&D. Of the same universe, 43.08% of the enterprises presented process innovation and 36.08% presented product innovation. Of the total number of companies, 11,957 (48.45%) did not innovate; 3,621 (14.67%) companies innovated only in process; 2,090 (8.47%) innovated only in product; and 7,011 (28.41%) presented at least one innovation in process and product during the period described (Tables A.2 and A.3 in Online Appendix).

Table 1: Innovation activity and R&D investment

Has the company innovated?	Number	Percent
No	11,957	48.45
Yes	12,722	51.55
Total	24,679	100.00
Has the company invested in R&D?	Number	Percent
No	14,137	57.28
Yes	10,542	42.72
Total	24,679	100.00

One of the main questions on this topic is the definition and measurement of financial constraints. It should be noted that this issue depends on the company's own assessment

and is not directly observable (Carreira and Silva, 2010). Two of the most widely used definitions are that a company suffers from financial constraint if there is a cost between obtaining external or internal financing, and its inability to obtain the optimal level of financing for its projects. To identify the financial constraints of firms, the ASCL index was used (Mulier et al., 2016). The index ranking is based on company size, age, cash flow and leverage, identifying for each variable whether a company is scoring below (0) or above (1) the industry median in each year, at the end summing all the scores by company and year. The ASCL index is compressed between 0 (unconstrained) and 4 (constrained). Finally, companies with a score of 3 or higher on the ASCL index in at least two of the last three years are financially constrained.

Of the total of 24,679 companies, and according to the index we constructed, 2,615 (10.59%) suffered from financial constraints, 1,203 (0.48%) of which managed to present innovation, and 980 invested in R&D (0.39%). There were 22,064 (89.40%) companies that did not suffer from financial constraints (Tables 2 and A.4 in Online Appendix).

Table 2: Innovation/R&D investment and financial constrains

Has the company innovated?	Has the company found itself financially constrained?		
	No	Yes	Total
No	10,545	1,412	11,957
Yes	11,519	1,203	12,722
Total	22,064	2,615	24,679
Has the company invested in R&D?	Has the company found itself financially constrained?		
	No	Yes	Total
No	12,502	1,635	14,137
Yes	9,562	980	10,632
Total	22,064	2,615	24,679

To understand the impact of financial constraints, the following explanatory variables were used: the average of the last 3 years of the company's results before depreciation; financing expenses and taxes, considering the total assets of the company, respectively cash flow (AvCF) and average leverage ratio (AvLEV, i.e., short- and long-run borrowings over total assets).

The same models are estimated replacing the dependent variable of innovation with investment in R&D (RD), product innovation (INPROD) and process innovation (INPROC), all of them dummies. The same models are estimated with the explanatory variables lagged using a simple probit model. All variables are logarithmic, except the dummies. The descriptive statistics can be seen in Table A.5 in Online Appendix.

4. Results

4.1. Univariate random-effects probit regressions

The first step was to estimate the univariate probit models – in this case we are considering the financial constraint variable as being exogenous. The results obtained in the probit models are as expected and corroborate the findings in the literature, all variables being significant at the 1% level. The results are presented in Table 3.

In all the estimated models 1 to 4 of Table 3, there is an inverse relationship between the dependent variables and financial constraints; a positive relationship between innovation and average sales, exports and firm size; and a negative relationship with firm age. In regard to financial constraints (model 5), the probability of being financially constrained decreases with company size, good results and company age; the probability of being restricted increases with the level of debt. The restrictions seem to be greater in process innovation than in product innovation. The results are consistent with the literature and there are no significant differences between models.

Table 3: Results of Random-effects probit regression

Variable	IN	INPROD	INPROC	R&D	FC2y
	(1)	(2)	(3)	(4)	(5)
FC2y	-0.165*** (0.044)	-0.160*** (0.048)	-0.164*** (0.042)	-0.158*** (0.046)	
AvSAL	0.123*** (0.016)	0.103*** (0.017)	0.094*** (0.015)	0.134*** (0.016)	
AvEXP	0.037*** (0.004)	0.045*** (0.004)	0.030*** (0.003)	0.043*** (0.004)	
AvCF					-0.220*** (0.0117)
AvLEV					0.143*** (0.013)
L	0.183*** (0.023)	0.198*** (0.025)	0.194*** (0.014)	0.202*** (0.023)	-0.301*** (0.042)
AGE	-0.108*** (0.015)	-0.088*** (0.016)	-0.118*** (0.014)	-0.120*** (0.015)	-1.690*** (0.065)
Constant	-2.457*** (0.210)	-3.044*** (0.245)	-2.236*** (0.197)	-2.993*** (0.223)	2.580*** (0.297)
Industry dummies	YES	YES	YES	YES	YES
Log-likelihood	-15,439.10	-14,257.04	-15,555.45	-14,966.46	-4,793.20
Num. of obs. Wald chi2 Prob>chi2	24,645 1,272.96 0.000	24,645 1,278.25 0.000	24,645 1,100.77 0.000	24,645 1,418.11 0.000	24,672 717.24 0.000

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.1$ indicate the statistical significance levels. Standard erros are given in parentheses.

The marginal effects of the probit models were computed and show that firms with financial constraints have between -3.90% and -4.80% probability of innovating, which are respectively the marginal effects of financial constraint in firms with product and process innovation (Table 4).

The same models were estimated, but with the explanatory variables lagged. This approach seems to make more economic sense, since the innovation process is time-consuming and influenced by the firm's results observed in previous periods, however it is not possible to do so in the RPBM since the second equation dependent variable must be used in the first equation as an explanatory element. This approach also helps to see if there are significant differences using lagged variables.

Comparing these results with the results of the same models and marginal effects with lagged explanatory variables (Tables A.6 and A.7 in Online Appendix), we observe that the signs and magnitude of the coefficients are similar, which leads us to believe that there are no significant differences that alter the meaning or conclusions of our work, and the marginal effects are also similar, with no major differences. Note that the estimates of probit models without lag have 24,645 (models 1, 2, 3 and 4) and 24,672 (model 5) observations, and in the lagged models' observations decrease to 10,386 (models A1 and A2), 10,394 (models A3 and A4) and 10,401 (models A5).

Table 4: Marginal effects on probability to innovate, R&D invest and financially constrained

Variable	IN	INPROD	INPROC	RD	FC2y
	(1)	(2)	(3)	(4)	(5)
FC2y	-0.046*** (0.012)	-0.039*** (0.012)	-0.048*** (0.012)	-0.042*** (0.012)	
AvSAL	0.034*** (0.004)	0.025*** (0.004)	0.027*** (0.004)	0.036*** (0.004)	
AvEXP	0.010*** (0.001)	0.011*** (0.001)	0.009*** (0.001)	0.011*** (0.001)	
AvCF					-0.013*** (0.001)
AvLEV					0.008*** (0.001)
L	0.051*** (0.006)	0.048*** (0.006)	0.056*** (0.006)	0.054*** (0.006)	-0.018*** (0.002)
AGE	-0.030*** (0.004)	-0.021*** (0.004)	-0.034*** (0.004)	-0.032*** (0.004)	-0.099*** (0.002)

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.1$ indicate the statistical significance levels. Standard erros are given in parentheses.

4.2. Recursive bivariate probit

The results of the RPBM estimations (models 6 to 9 in Table 5) are similar to those in the probit models and have the same signs of the coefficients. This shows the robustness of our models. All variables have statistical significance at 1% level.

The rho is positive and significant at 10% at least in all models. This means that the equations should be calculated together considering the endogeneity of the financial constraint variable. If we do not do this, the coefficients of the FC2y variables will be overestimated; for example, the coefficient is larger in model 1 (= -0.165), than in model 6 (= -0.323). The same happens in all comparable models. The other coefficients of the remaining variables do not undergo important changes.

Comparing the results of the second equation (RPBM) with the probit model 5, there are differences in coefficient magnitude, mainly in the coefficient of the AGE variable.

Table 5: Recursive bivariate probit

Variable	IN	INPROD	INPROC	R&D
	(6)	(7)	(8)	(9)
FC2y	-0.323*** (0.081)	-0.274*** (0.083)	-0.384*** (0.081)	-0.362*** (0.084)
AvSAL	0.087*** (0.011)	0.067*** (0.011)	0.069*** (0.010)	0.093*** (0.011)
AvEXP	0.032*** (0.003)	0.037*** (0.003)	0.027*** (0.003)	0.037*** (0.003)
L	0.137*** (0.015)	0.146*** (0.015)	0.154*** (0.015)	0.153*** (0.015)
AGE	-0.109*** (0.015)	-0.084*** (0.015)	-0.129*** (0.015)	-0.123*** (0.016)
Constant	-1.639*** (0.150)	-1.989*** (0.158)	-1.534*** (0.150)	-1.977*** (0.155)
Endogenous variable	FC2y	FC2y	FC2y	FC2y
AvCF	-0.137*** (0.005)	-0.136*** (0.005)	-0.138*** (0.005)	-0.138*** (0.005)
AvLEV	0.078*** (0.006)	0.079*** (0.006)	0.078*** (0.006)	0.077*** (0.006)
L	-0.139*** (0.017)	-0.140*** (0.017)	-0.138*** (0.017)	-0.138*** (0.017)
AGE	-0.874*** (0.016)	-0.874*** (0.016)	-0.874*** (0.016)	-0.874*** (0.016)
Constant	1.187*** (0.127)	1.189*** (0.127)	1.183*** (0.126)	1.171*** (0.128)
rho	0.114** (0.047)	0.092* (0.049)	0.154*** (0.048)	0.140*** (0.050)

Variable	IN	INPROD	INPROC	R&D
	(6)	(7)	(8)	(9)
Log-likelihood	-21,131.40	-20,106.90	-21,117.70	-20,663.51
Wald chi2	6,529.82	7,127.84	6,022.80	7,062.57
Prob > chi2	0.000	0.000	0.000	0.000
Wald test of rho	5.846	3.623	10.2343	8.046
Prob > chi2	0.016	0.057	0.001	0.005
Num. of obs.	24,645	24,645	24,645	24,645

Note: *** *p<0.01*, ** *p<0.05*, * *p<0.1* indicate the statistical significance levels. Standard erros are given in parentheses.

Again, the effect of restrictions in product innovation is less severe than in process innovation, and firms with credit restrictions are less likely to invest in R&D than in innovation activities. Industry dummies can be interpreted as the differences in probability of innovating or the risk that exists across the different sectors of Portuguese industry (Tables A.8 to A.11 in Online Appendix).

The results of the marginal effects are given in Table 6. Due to homogeneity, and once controlled for, the effect of the variable FC2y is now more intense. The marginal effects of the remaining variables remain almost the same. The marginal effects of financial constraints range from -9.4% to -14.2%, and firms with process innovation are once again more constrained in obtaining credit, which affects the probability of firms innovating more.

Table 6: Marginal effects on probability to innovate and to invest in R&D

Variable	IN	INPROD	INPROC	RD
	(6)	(7)	(8)	(9)
FC2y	-0.120*** (0.030)	-0.094*** (0.029)	-0.142*** (0.029)	-0.129*** (0.030)
AvSAL	0.032*** (0.004)	0.0230*** (0.004)	0.025*** (0.004)	0.033*** (0.004)
AvEXP	0.012*** (0.001)	0.013*** (0.001)	0.010*** (0.001)	0.013*** (0.001)
L	0.050*** (0.006)	0.050*** (0.005)	0.057*** (0.005)	0.055*** (0.005)
AGE	-0.040*** (0.005)	-0.029*** (0.005)	-0.048*** (0.005)	-0.044*** (0.005)
Marginal effects on probability for being financially constrained (models 6 through 9)				
AvCF	-0.016*** (0.001)			
AvLEV	0.009*** (0.001)			
L	-0.016*** (0.002)			
AGE	-0.100*** (0.001)			

Note: *** *p<0.01*, ** *p<0.05*, * *p<0.1* indicate the statistical significance levels. Standard erros are given in parentheses.

These results are significantly lower than ones found by Savignac (2008) and García-Quevedo et al. (2018), in regard to French and Spanish firms respectively, which point to approximately -21% of the likelihood to take part in innovation activities, in both cases. Also, the marginal effects of financial constraints are lower than in the European case (Efthyvoulou and Vahter, 2016), results that were not expected at all. The magnitude of financial restrictions is influenced by the indicator we choose. Since our financial constraints variable is based on the characteristics of credit-constrained firms identified in the literature, rather than on whether *de facto* firms are financially restricted or not, we suspect the results are underestimated. In a situation of severe financial crisis and economic downturn, there is no reason why the constraints should be so low, even considering the economic recovery.

Finally, the probabilities of firms innovating were calculated using the mean values of each non-binary variable (see mean values in Table A.5). The probability of innovating decreases from 37.28% to 25.87% when the firm is in financial constraint. The likelihood of process innovation is lower compared with product innovation, 29.37% and 30.77% respectively, and the likelihood in each case drops to 20.71% and 18.77% in a situation of financial restriction. The probability differences between process and product innovation are not distinct; when firms are not financially constrained, they are more likely to innovate with a new product, which demonstrates the preference of financial intermediaries and companies to finance new products rather than a new process.

When firms are financially constrained, they are more likely to introduce process innovation, this type of innovation possibly having lower costs than those for introducing a new product.

The probability of engaging in investment in R&D is the lowest, registering 28.11% when not financially restricted and decreasing to 17.32% when financially restricted. In some sense, this is logical. In the previous examples, the firm can copy or buy a product or process; in this example, the firms choose to engage in a costly development process without the guarantee of a positive output. The higher risk is reflected in a lower probability.

5. Discussion

The results of the RPBM model estimations show there is an inverse relationship between innovation and financial constraints; a positive impact on the probability of innovating due to sales volume, degree of export orientation, and firm size; and, finally, a negative effect due to firm age. R&D investment is more constrained than innovation, but not more than process innovation. All these results corroborate the literature on the subject. The results of the various estimated models are similar, the difference to point out being that the impact of financial constraints on the probability of innovating is lower for product innovation than for process innovation.

Companies with good financial performance will find it easier to obtain external financing. Sales growth is usually seen as a good indicator of investment opportunities, and good investment opportunities attract more funding. Firms with a large sales volume might reserve some cash to self-finance their R&D projects. Also, less-constrained firms are also the ones who are more export oriented, evidence found previously in Portuguese reality

(Silva and Carreira, 2011). On the other hand, innovation is also fundamental to having a good market performance and financial performance, however this link is not always linear. In fact, Gök and Peker (2017), found a negative relationship or an inexistent link between innovation and financial performance when considering market performance. Older firms are less likely to present innovation, thus, the propensity to introduce innovations declines with a firm's increasing age. Larger firms are also more prone to innovate and make R&D investment, since they can more easily obtain funds to innovate and are more resistant and have the resilience to absorb the expenditures of an innovation or R&D project failure.

With respect to financial constraints, better results before depreciation and taxes, size and age decrease the probability of the company being in a financially constrained situation. Bigger firms are less likely to be constrained, and accordingly, smaller firms are more likely to be financially constrained. Oliveira and Fortunato (2006) had already found a positive relationship between external financing and firm size prior to the financial crisis, and the same relationship seems to hold.

Financially constrained Portuguese SMEs demonstrated a poorer financial performance than firms that are not constrained, and they have the highest odds of failure in the market. Access to credit sometimes is essential to firm survival, especially in tough crisis periods. In Portuguese cases during the great recession, the credit constraints reduced the efficiency in resource reallocation and productivity, an unfavorable economic cycle being one of the main factors of the increased exit of firms and a lower employment creation (Carreira and Teixeira, 2016).

Having close relations with banks combats information asymmetries and alleviates financial constraints (Farinha, 2005), something that is gained over time and as the firm grows in size. Due to the lack of information about younger and smaller firms, or because they still lack visibility or position in the markets, financial intermediaries can be expected to be more reluctant to grant them credit.

As expected, higher indebtedness increases the probability of financial constraint, and if the firm borrows more money, it runs the risk of being overburdened with future liabilities and being unable to pay them back. This is consistent with what we see through the results variable of firms, so having better financial results decreases the probability of financial constraint. Good firm performance is a positive indicator of the reliability of the firm's financing, while financial debt is a weakness indicator (Savignac, 2008), as it is to be expected that the most profitable industries are those with the least constraints.

Industry dummies show strong disparities in the likelihood of undertaking innovative projects across industries. So, as expected, the severity of financial constraints, as well as their effect on innovation performance, may vary across firms operating in different sectors, which contributes to a better understanding of sectoral risk heterogeneities.

Financial restrictions have a greater effect on product innovation industries than on service innovation. Some of the most restricted sectors were also the most innovative ones, showing some inefficiencies in credit channels, especially in regard to *manufacture of chemicals and chemical products, except pharmaceutical products* which appears as the leading process and product innovator, and R&D investor. The least restricted activity, by far, was *accommodation, restaurants and similar*, economic activities that are closely linked to tourism, reflecting the support that the recovery of the Portuguese economy had in tourism. The *building* sector,

one of the least restricted in credit, is shown to be an industry that is not innovative. The *information and communication activities* industry present product innovations and is one of the least restricted.

6. Conclusion

This study presents an analysis of the influence of the financial results of 24,645 Portuguese companies on the impact of financial constraints on innovation carried out. The temporal arc of the study extends from 2008 to 2016, in a period encompassing the Great Recession and the recovery period.

As expected, when a firm has a good sales volume and/or the more it is export-oriented, it more easily obtains financing from banks, and its probability of innovating increases. In line with what the literature has shown, size and age positively affect innovation and negatively affect the possibility of being credit constrained. Indebtedness increases the likelihood of being credit constrained, while having good cash flow results decreases the likelihood of being financially constrained.

Our results show that the effects of financial constraints decrease the likelihood of innovating by between 9% and 14%, and depending on whether one is likely to invest in R&D, or on the type of innovation one engages in, the probability of innovating can drop from 37.28% to 25.87%.

It is important to state that companies that innovate present better financial performance after innovating, given the positive relationship with the variables sales and exports, and companies that innovate present a higher probability of boosting financial performance, when compared with companies that do not innovate.

Observing the results, it can be seen that a large proportion of Portuguese companies have not invested in R&D or innovated. The reasons may be many, from the high bureaucracy of applying for financial support to reasons related to those who promote innovation, namely the very nature of Portuguese small and medium-sized companies, family businesses and the fact that a large part of their managers have low qualifications. The Great Recession period was a severe recession of counterproductive destruction, accompanied by the application of austerity policies, which contracted aggregate demand, consequently reducing the demand perspectives for the future and resulting in a lack of incentives and/or difficulties in obtaining external private financing to invest due to the unpredictable outcome of projects and market instability.

References

Aghion, P.; Askenazy, P.; Eymard, L.; Cette, G. (2012) Credit constraints and the cyclicality of R&D investment: evidence from France. *Journal of the European Economic Association*, 10(5), 1001-1024.

Akerlof, G.A. (1970) The market for "lemons": Quality uncertainty and the market mechanism. *Quarterly Journal of Economic*, 84(3), 488-500.

Archer, L.T.; Sharma, P.; Su, J. J. (2020) Do credit constraints always impede innovation? Empirical evidence from Vietnamese SMEs. *Applied Economics*, 52(44), 4864-4880.

Carreira, C.; Silva, F. (2010) No Deep Pockets: Some stylized results on firms' financial constraints. *Journal of Economic Surveys*, 24(4), 731-753.

Carreira, C.; Teixeira, P. (2016) Entry and exit in severe recessions: Lessons from the 2008-2013 Portuguese economic crisis. *Small Business Economics*, 46(4), 591-617.

Czarnitzki, D. (2006) Research and development in small and medium-sized enterprises: The role of financial constraints and public funding. *Scottish Journal of Political Economy*, 53(3), 335-357.

Efthyvoulou, G.; Vahter, P. (2016) Financial Constraints, Innovation Performance and Sectoral Disaggregation. *Manchester School*, 84(2), 125-158.

Farinha, L. (2005) The survival of new firms: Impact of idiosyncratic and environmental factors. *Financial Stability Report*, 101-113.

García-Quevedo, J.; Segarra-Blasco, A.; Teruel, M. (2018) Financial constraints and the failure of innovation projects. *Technological Forecasting and Social Change*, 127, 127-140.

Gök, O.; Peker, S. (2017) Understanding the links among innovation performance, market performance and financial performance. *Review of Managerial Science*, 11(3), 605-631.

Guellec, D.; Wunsch-Vincent, S. (2009) Policy Responses to the economic Crisis: Investing in innovation for long term economic growth. *I-WAYS, Digest of Electronic Commerce Policy and Regulation*, 32(4), 216-218.

Hall, B.H.; Lerner, J. (2010) The Financing of R&D and Innovation. *Handbook of the Economics of Innovation*, Vol. 1. Amsterdam, North-Holland, 609-639.

Hewitt-Dundas, N. (2006) Resource and capability constraints to innovation in small and large plants. *Small Business Economics*, 26(3), 257-277.

Jensen, M. C.; Meckling, W.H. (1976) Theory of the firm: Managerial behaviour, agency costs and ownership structure. *Journal of Financial Economics*, 3, 305-360.

Lahr, H.; Mina, A. (2021) Endogenous financial constraints and innovation. *Industrial and Corporate Change*, 30(3), 587-621.

Lee, N.; Sameen, H.; Cowling, M. (2015) Access to finance for innovative SMEs since the financial crisis. *Crisis. Research Policy*, 2, 370-380.

Leland, H. E.; Pyle, D. H. (1977) Informational Asymmetries, Financial Structure, and Financial Intermediation. *Journal of Finance*, 32(2), 371-387.

Lööf, H.; Nabavi, P. (2016) Innovation and credit constraints: Evidence from Swedish exporting firms. *Economics of Innovation and New Technology*, 25(3), 269-282.

Mazzucato, M. (2013) Financing innovation: Creative destruction vs. destructive creation. *Industrial and Corporate Change*, 22(4), 851-867.

Modigliani, F.; Miller, M. H. (1958) The cost of capital, corporation finance and the theory of investment. *American Economic Review*, 48(3), 261-297.

Montresor, S.; Vezzani, A. (2022) Financial constraints to investing in intangibles: Do innovative and non-innovative firms differ? *Journal of Technology Transfer*, 47(1), 1-32.

Mulier, K.; Schoors, K.; Merlevede, B. (2016) Investment-cash flow sensitivity and financial constraints: Evidence from unquoted European SMEs. *Journal of Banking and Finance*, 73, 182-197.

Myers, S. C.; Majluf, N. S. (1984) Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, 13(2), 187-221.

Oliveira, B.; Fortunato, A. (2006) Firm growth and liquidity constraints: A dynamic analysis. *Small Business Economics*, 27(2–3), 139-156.

Santos, A.; Cincera, M. (2020) Determinants of financing constraints: Evidence from European SMEs.

Sasidharan, S.; Jijo Lukose, P. J.; Komera, S. (2015) Financing constraints and investments in R&D: Evidence from Indian manufacturing firms. *Quarterly Review of Economics and Finance*, 55(December 2010), 28-39.

Savignac, F. (2008) Impact of financial constraints on innovation: What can be learned from a direct measure? *Economics of Innovation and New Technology*, 17(6), 553-569.

Silva, F.; Carreira, C. (2011) Financial constraints and exports: An analysis of Portuguese firms during the European monetary integration. *Notas Económicas*, 34, 35-56.

Silva, F.; Carreira, C. (2012) Do financial constraints threat the innovation process? Evidence from Portuguese firms. *Economics of Innovation and New Technology*, 21(8), 701-736.

Stiglitz, J. E.; Weiss, A. (1981) Credit rationing in markets with imperfect information. *American Economic Review*, 71(3), 393-410.

Appendix

(Appendix Tables A.1 through A.10 are available upon request)

Carlos Carreira
Univ Coimbra, CeBER, Faculty of Economics
ccarreir@fe.uc.pt
orcid.org/0000-0002-4786-5605
Joana Lopes
Univ Coimbra, CeBER, Faculty of Economics
joanarsimoeslopes@gmail.com

DOI: https://doi.org/10.14195/2183-203X_55_6

The Role of Different Types of Creditors on Zombie Firm Creation

O Papel de Diferentes Tipos de Credores na Criação de Empresas Zombies

Carlos Carreira
Joana Lopes

Received for publication: September 20, 2022
Revision accepted for publication: October 30, 2022

ABSTRACT
Despite the key role of trade creditors as sources of finance, the literature on their impact on the proliferation of zombie firms is rare. This study examines whether suppliers, such as banks, engage in "evergreen" lending to zombie firms and whether their behavior differs from that of banks. We found that highly productive, larger and younger firms are less likely to become zombie firms. The behavior of suppliers is, in fact, different from that of banks; they are indeed more cautious in lending to zombie firms. Unlike suppliers, banks seem to have contributed to the rise of resource misallocation, a key explanation for the productivity slowdown in the new century.
Keywords: Zombie firms; Trade credit; Financial constraints; Bank credit; Portugal.

JEL Classification: G21, G32, G33, L25, L60, L80

Acknowledgment: This work has been funded by the FCT – Fundação para a Ciência e a Tecnologia, Project ENtRY (PTDC/EGE-ECO/31117/2017) and CeBER (UIDB/05037/2020).

1. **Introduction**[1]

Zombie firms, that is, incumbent firms that are insolvent and kept alive only with the help of creditors, crowd out investment opportunities for more productive firms and discourage innovative firms from entering the market. Aggregate productivity is therefore harmed, not only by the existence of zombie firms, but also by the negative externalities they generate on the entry and growth of healthy firms (Caballero et al., 2008). Portugal is one of the European countries most affected by the proliferation of zombies (McGowan et al., 2018).

Why are there zombie firms? Several studies have identified the "forbearance" of banks as the main reason for their survival. Of course, banks have the incentive to continue lending to their troubled borrowers to avoid reporting nonperforming loans, which in turn allows these borrowers to avoid (or delay) bankruptcy (Peek and Rosengren, 2005; Caballero et al., 2008; Andrews and Petroulakis, 2017; Storz et al., 2017). However, these studies only consider the role of banks as lenders, ignoring other creditors. Most input suppliers give credit to their customers. Since we define zombies as those firms that are supported by creditors, the probability of becoming a zombie is likely to be influenced by the financial structure of the firm. Trade credit constitutes a major source of short-term financing and, facing bank credit constraints, firms postpone payments to their suppliers to avoid the risk of insolvency (Cuñat and García-Appendini, 2012; Casey and O'Toole, 2014).

The objective of this study is to analyze whether trade creditors engage in evergreen lending to zombie firms and whether their behavior differs from that of banks. Despite the key role of trade creditors as sources of financing, studies on their impact on zombie prevalence are scarce, which distinguishes our contribution from that of previous studies.

To analyze the relationship between trade creditors and zombie firms, we use a panel of the Portuguese population of firms in the manufacturing and services industries over the period 2010–2017. Our results show that zombie firms are very widespread in Portugal. However, suppliers did not contribute to increase the weight of zombies in the economy. Apparently, suppliers were more cautious in lending and artificially supporting firms.

2. **Related Literature**

2.1. The prevalence of zombie firms

Industry productivity growth is expected to be enhanced by the Schumpeterian process of "creative destruction", wherein innovations introduced by new and incumbent firms can be taken as business experiments subject to the market test and the shrink and exit of firms as a necessary selection mechanism through which non-competitive technologies (and products) are excluded. How does this process change when there are zombies? When there are zombies, new and healthy firms have to compete with zombies in the markets for finished products, labor, and funds. This may congest product markets and make it difficult to

[1] A previous version of this work was presented by Joana Lopes as a Master's Thesis, with the title "The walking dead: An analysis of the role of different creditors in zombie firms in Portugal", under supervision of Prof. Carlos Carreira, at the University of Coimbra, Faculty of Economics.

access workers and financial resources for non-zombie firms (e.g., depressed product prices and higher wages). As a consequence, innovative investments by new entrants and healthy firms may be depressed. Moreover, the congestion caused by the zombies can drive healthy incumbents into trouble, forcing them to exit. Aggregate productivity is therefore harmed, not only by the existence of zombie firms per se, but also by the negative externalities they generate on the entry of new firms and on the growth and exit of healthy incumbents, as well (Caballero et al., 2008).

McGowan et al. (2018) showed a high prevalence of resources sunk in zombie firms in several European countries over the period 2003–2013. In 2013, the highest share (in the sample) of zombies in terms of the number of firms was found in Spain at 10%, while the highest share of the capital stock and employment sunk in zombie firms was observed in Italy at 19% and in Belgium at 14%, respectively. From 2007 to 2013, the prevalence of zombies has increased in general (the exceptions were the United Kingdom and France). The previous shares are broadly confirmed by other studies using different methodologies to identify zombie firms—e.g. Andrews and Petroulakis (2017) for 11 European countries (2001–2014); Storz et al. (2017) for 7 European countries (2010–2014); Gouveia and Osterhold (2018) for Portugal (2006–2015); Hallak et al. (2018) for 19 UE countries (2008–2013); Acharya et al. (2019) for 5 European countries (2010–2014); Carreira et al. (2022) and Nieto-Carrillo et al. (2022) for Portugal (2004–2017); and Schivardi et al. (2022) for Italy (2004-2013).

The zombie problem is severe in the periphery of Europe – Greece, Italy Spain, and Portugal – countries that were particularly affected by the global financial crisis and the subsequent European sovereign debt crisis (Storz et al., 2017; Hallak et al., 2018; Acharya et al., 2019). In the case of Portugal, in fact, Carreira et al. (2022) and Nieto-Carrillo et al. (2022) found that, on average, about 11% of firms were classified as zombies between 2005 and 2016, with a peak in 2012, at 12.7% (see also Storz et al., 2017; Gouveia and Osterhold, 2018; Hallak et al., 2018).

2.2. Creditors and zombie firms

Why do creditors of zombie firms continue supporting them instead of claiming their debts? One would expect that lenders dealing with troubled borrowers would stop granting new loans, hastening their death. However, Peek and Rosengren (2005) showed that Japanese banks, especially the undercapitalized ones, misallocated loans in the 1990s. This was due to regulatory forbearance and perverse incentives that led them to make additional loans to severely impaired borrowers (the so called "evergreening" loans) to avoid having to declare the loans as nonperforming and record losses on their own balance sheets.

This seminal study from Japan seems to provide insights into the proximate causes of zombie prevalence in Europe. Using data on bank lending to individual enterprises in Croatia during the global financial crisis and the subsequent sovereign debt crisis, for example, Broz and Ridzak (2017) concluded that banks grant loans to zombie firms only when this is in their self-interest. Likewise, Acharya et al. (2019) and Schivardi et al. (2022) provide some evidence that banks undercapitalized during the crisis period directed loans to zombie firms to avoid the recognition of loan losses. Similarly, Andrews and Petroulakis (2017) and Storz

et al. (2017) found that zombie firms tend to be associated with weak banks, suggesting that the zombie problem is at least partly due to bank forbearance.

Blattner et al. (2019) observed that, following an unexpected increase in capital requirement imposed by the European Banking Authority in 2011, affected Portuguese banks significantly decreased lending. However, consistent with the evergreen lending to zombie firms, they also found that these banks reallocated credit to borrowers with previously underreported loan loss. A related study by Bonfim et al. (2022) found that Portuguese banks were less likely to refinance firms with negative equity after bank inspections of the credit portfolio, implying a significant reduction in the unconditional probability of refinancing.

When considering sources of financing, it is important to also consider other funding options besides bank credit, trade credit being a point in particular. It is a fact that trade credit is widely used and represents an important funding source for various firms (Cuñat and García-Appendini, 2012). However, to our knowledge, the behavior of suppliers as creditors of zombie firms has not yet been addressed in the literature for developed countries. Lu et al. (2020), using a sample of listed firms in China over the period 2005-2015, found that equity markets and suppliers provide substantial financing support to zombie firms, while banks are less important. In turn, Shiraishi and Yano (2021) found that zombie (private) firms in China from 2002 to 2009 avoided exiting the market by accessing trade credit.

A common explanation for trade credit is that suppliers may have a monitoring advantage over banks. In the course of their business, suppliers obtain information about the borrower that other lenders can only obtain at a cost (Biais and Gollier, 1997; Jain, 2001). They can also better control the actions of buyers, reducing moral hazard (Burkart & Ellingsen, 2004; Cuñat, 2007; Fabbri and Menichini, 2010). Moreover, Burkart and Ellingsen's (2004) model suggests that trade credit and bank credit can be either complements or substitutes. Actually, empirical evidence shows that trade credit is an important source of financing for firms facing bank credit constraints and that trade credit becomes even more important in a financial crisis (Danielson and Scott, 2004; Garcia-Appendini and Montoriol-Garriga, 2013; Casey and O'Toole, 2014; Carbó-Valverde, 2016). Furthermore, credit-constrained firms that face liquidity shocks are more likely to delay payments to suppliers (Boissay and Gropp, 2013). Suppliers reduce their business ties with distressed customers as they approach bankruptcy (Garcia-Appendini and Montoriol-Garriga, 2020).

We can therefore assume that trade creditors, unlike banks, will no longer grant new loans when confronted with zombie debtors. Even so, late and non-payments are a major problem for Portuguese suppliers, with financial difficulties cited as one of the main causes (Intrum, 2018). Thus, it is important to know whether trade creditors are actually issuing zombie loans.

3. **Data and Methodology**

3.1. The dataset

The database used in this study was originally compiled by Carreira et al. (2022), who used raw data from the Integrated Business Accounts System (SCIE, Portuguese acronym),

administered by the Portuguese Statistical Office (INE). It covers the population of Portuguese firms with at least three employees operating in the manufacturing and services sectors, except utilities, financial sector, and education, health and cultural services, from 2010 to 2017. Our final sample comprises a panel of 225,567 firms, making up 1,216,768 firm-year observations.

Several strategies have been proposed in the literature to identify whether a firm can be classified as a zombie (see Carreira et al., 2022 for a survey). In this paper, we use the method proposed by Carreira et al. (2022). Specifically, a firm is flagged as a zombie whenever: (i) its return-on-assets is lower than the low-risk interest rate for at least three consecutive years; (ii) its leverage ratio is higher than the industry-median of the low return-on-assets exiting group; and (iii) it is older than 5 years. The first two criteria aim to fulfil the "profitability" and "evergreen lending" requirements (Fukuda and Nakamura, 2011). The three-consecutive years criterion ensures that the zombie status is not due to temporary difficulties in profitability, while the age criterion makes it possible to distinguish 'true' zombie firms from young (or emerging) firms (McGowan et al., 2018). (In the Appendix, we provide a robustness analysis of the findings using the alternative methods of Shen and Chen (2017) and Schivardi et al. (2022) to identify zombie firms.)

3.2. Empirical strategy

To investigate whether banks and suppliers are at the root of zombie firms, we estimate the probability of being a zombie as a function of both bank debt and supplier debt. Specifically, this paper estimates the following model:

$$Zombie_{it} = \alpha + \beta_1 BANK_{it} + \beta_2 SUPP_{it} + \beta_3 X_{it} + \varepsilon_{it}, \quad (1)$$

where subscripts *i* and *t* denote firm and year, respectively. The dependent variable *Zombie* is a dichotomous variable equal to 1 if the firm is a zombie and 0 otherwise. *BANK* and *SUPP*, our main explanatory variables, are the variables that capture a firm's indebtedness to banks and suppliers, respectively. *X* is a vector of control variables for business characteristics and environment, and includes productivity, size and firm age, as well as a business cycle variable (annual growth rate of GDP) and industry-dummies. Finally, å is the usual error term.

3.3. Explanatory variables and descriptive statistics

Because we define zombies as those firms that are highly indebted, which is measured using the leverage ratio (*i.e.* total debt to total assets), we consider here the natural logarithm of book value of bank debt and supplier debt as measures of the *BANK* and *SUPP* variables, respectively. Firm-level productivity is measured by revenue total factor productivity (TFP) obtained as the residual of a production function in log form (*i.e.* the difference between a firm's output and the weighted sum of inputs). The three-input Cobb-Douglas production

function was estimated using the method of Levinsohn and Petrin (2003). As proxies of firm size, we consider (natural logarithms of) the number of employees.

On average, about 9.1% of the firms in the sample were classified as zombies over the period 2010-2017. Table 1 shows the statistics of the main variables for the whole sample and for zombies versus non-zombies. Notice that the average zombie is less productive, smaller (labor size), older and has relatively more bank debt but less supplier (trade) debt than its non-zombie counterpart. The correlation between bank debt and zombie dummy is positive, while in the case of supplier debt the correlation is negative (Table 2). However, the correlation between supplier and bank debt is positive, suggesting that firms use both sources of financing.

Table 1: Descriptive statistics of zombie and non-zombie firms

Variable	*Full sample*		*Non-zombies*		*Zombies*	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Bank debt	7.700	5.503	7.706	5.508	7.888	5.506
Supplier debt	9.665	3.471	9.705	3.464	9.357	3.597
TFP	1.968	1.046	1.988	1.039	1.492	1.088
Labor	1.983	0.902	2.001	0.908	1.717	0.749
Age	2.323	0.942	2.289	0.954	2.683	0.530

Note: All variables are in logarithms.

Table 2. Correlation across covariates

Variable	[1]	[2]	[3]	[4]	[5]
[1] *Zombie dummy*	1				
[2] *Bank debt*	0,006	1			
[3] *Supplier debt*	-0,035	0,344	1		
[4] *TFP*	-0,160	-0,160	-0,237	1	
[5] *Labor*	-0,130	0,273	0,401	0,037	1
[6] *Age*	0,113	0,162	0,127	-0,121	0,113

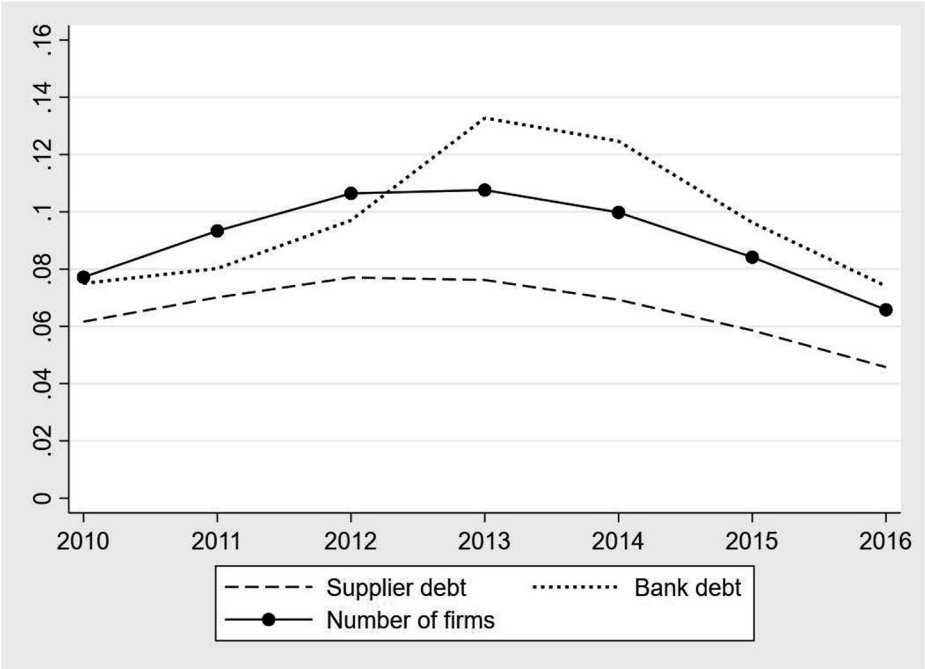
Notes: All variables are in log form, except the Zombie dummy. Pooled yearly values, 2010-2017. All coefficients are statistically significant at the 0.01 level.

4. **Empirical Analysis**

Figure 1 shows the share of zombies in terms of the number of firms and financial resources sunk into zombies. On average, about 9.1% of the firms in the sample were classified as zombies. The share of zombies in total bank corporate loans is larger than the

share in terms of number of firms, at 9.7%, on average, while the share in total debts to suppliers is clearly lower, at 6.6%. Moreover, the bank debt share rises from 7.5% in 2010 to 13.3% in 2013; after that it declines, probably due to the implementation of measures by the European Central Bank to strengthen the prudential supervision of credit institutions (Nieto-Carrillo et al., 2022).

Figure 1: Proportion of zombie firms



Notes: Share of zombie firms. Supplier and bank debt refer to the share pertaining to zombie firms.

The regression results of equation (1) are provided in Table 3—each column reports the coefficient estimates and their standard errors (in parentheses) for a *probit* model.[2] All regressions use Huber-White robust standard errors. Since all variables are expressed in logarithms, except GDP growth rate, the estimated coefficients can be interpreted as elasticity parameters. For all specifications considered, the results suggest that, as expected, highly productive firms are less likely to be zombies. Larger and younger firms are also less likely to be zombies. The likelihood of a firm being a zombie is also reduced in expansion periods.

[2] We also estimated equation (1) using a logit model. The results confirm those in Table3, that is, the corresponding coefficients have a similar magnitude.

Models (1) and (2) of Table 3 show the probability of being a zombie in the current and following year, respectively. As can be seen, the coefficient on bank debt is positively signed in both specifications and statistically significant at the 1% level, confirming that higher bank debt increases the likelihood of being a zombie. In contrast, the coefficient on supplier debt is negative, but statistically significant only in model (2), suggesting that suppliers are somewhat more cautious in lending to zombie firms.

Table 3: Determinants of zombie firms

Variable	*Zombie in year t*	*Zombie in year (t+1)*	*Continuing as a zombie*	*Become a zombie*
	(1)	(2)	(3)	(4)
Bank debt	0.013*** (0.001)	0.006*** (0.001)	0.018*** (0.001)	0.004*** (0.001)
Supplier debt	-0.003 (0.002)	-0.010*** (0.002)	-0.005** (0.002)	-0.019*** (0.001)
TFP	-0.535*** (0.007)	-0.452*** (0.007)	-0.516*** (0.009)	-0.169*** (0.004)
Labor	-0.383*** (0.008)	-0.280*** (0.008)	-0.582*** (0.011)	-0.164*** (0.005)
Age	1.119*** (0.010)	0.753*** (0.008)	1.137*** (0.012)	0.161*** (0.005)
Growth	-0.044*** (0.002)	-0.053*** (0.002)	0.007** (0.003)	-0.047*** (0.002)
No. of observations	1,060,811	843,107	807,699	767,535
Wald chi-square	17278.60	13922.26	10176.47	3545.15
Log pseudolikelihood	-189426.25	-164751.75	-116910.16	-94662.11
Pseudo-R^2	0.350	0.345	0.404	0.011

Notes: All variables are in log form, except GDP growth rate. The regression also includes industry dummies as well as a constant term. Models (1) and (2) show the probability of being a zombie in the current and following year, respectively. Model (3) shows the probability of a zombie firm remaining as a zombie in the current year vis-à-vis a non-zombie (control group), while model (4) shows the probability of becoming a zombie in *t*, given that in *t*-1 is not a zombie. Robustness check of results using alternative definitions of zombie firms in Appendix, Table A.1. Firm-cluster robust standard errors are given in parentheses. ***, ** and * statistical significance at the 0.01, 0.05 and 0.10 levels, respectively

Model (3) shows the probability of a zombie firm remaining as a zombie in the current year. Information asymmetry between creditors and debtors is expected to decrease over time. However, the behavior of banks and suppliers is not similar, with no change in the sign of the coefficients.

Finally, model (4) examines whether joining the zombie statute is associated with trade credit. The main result seems to be that, unlike banks, suppliers seem to have reduced their business relationships with distressed customers prior to firms actually becoming zombies.

We conduct sensitivity analysis by using alternative zombie identification methods and the main results, which are given in Table A1 in the Appendix, hold.

5. **Conclusion**

Zombie firms are those firms that are insolvent and have little hope of recovery but avoid exiting the market thanks to the financial support of their creditors. In this study, we

empirically investigated whether banks and trade creditors engage in "evergreen lending behavior" to zombie firms.

We found that the behavior of suppliers differs from that of banks. Unlike banks, suppliers seem to be more cautious in lending and artificially supporting zombies. Highly productive firms, larger firms and younger firms are less likely to be zombie firms.

The findings of this study contribute to the literature on zombie firms, providing new insights into the behavior of different types of creditors. It raises some concerns about the functioning and management of banks, an issue that remains open for future research. The main conjecture is that banks do not allow firms in fragile situations to exit the market, and as such, there will be a rise in resource misallocation in the economy, thus generating a slowdown in productivity growth.

References

Acharya, V. V.; Eisert, T.; Eufinger, C.; Hirsch, C. (2019) Whatever It Takes: The Real Effects of Unconventional Monetary Policy. *Review of Financial Studies* 32(9), 3366-3411.

Andrews, D.; Petroulakis, F. (2017) Breaking the Shackles: Zombie Firms, Weak Banks and Depressed Restructuring in Europe. OECD Economics Department Working Papers No. 1433. OECD Publishing, Paris.

Biais, B.; Gollier, C. (1997) Trade credit and credit rationing. Review of Financial Studies 10, 903–937.

Blattner. L; Farinha, L; Rebelo, F. (2019) When Losses Turn into Loans: The Cost of Weak Banks. ECB Working Paper No 2228. European Central Bank.

Boissay, F.; Gropp, R. (2013) Payment Defaults and Interfirm Liquidity Provision. *Review of Finance* 17(6), 1853-1894.

Bonfim, D; Cerqueiro, G; Degryse, H; Ongena, S. (2022) On-Site Inspecting Zombie Lending. *Management Science* (forthcoming).

Broz, T.; Ridzak, T. (2017) Lending activity and credit supply in Croatia during the crisis. *Journal of Policy Modeling* 39, 1102-1116.

Burkart, M.; Ellingsen, T. (2004) In-kind finance: A theory of trade credit. *American Economic Review* 94(3), 569-590.

Caballero, R.; Hoshi, T.; Kashyap, A. (2008) Zombie Lending and Depressed Restructuring in Japan. *American Economic Review* 98(5), 1943-1977.

Carbó-Valverde, S.; Rodríguez-Fernández, F.; Udell, G. F. (2016) Trade Credit, the Financial Crisis, and SME Access to Finance. *Journal of Money, Credit and Banking* 48(1), 113-143.

Carreira, C.; Teixeira, P.; Nieto-Carrillo, E. (2022) Recovery and exit of zombie firms in Portugal. *Small Business Economics* 59(2), 491-519.

Casey, E.; O'Toole, C. M. (2014) Bank lending constraints, trade credit and alternative financing during the financial crisis: Evidence from European SMEs. *Journal of Corporate Finance* 27, 173-193.

Cuñat, V. (2007) Trade credit: Suppliers as debt collectors and insurance providers. *Review of Financial Studies* 20(2), 491-527.

Cuñat, V.; García-Appendini, E. (2012) Trade Credit and its Role in Entrepreneurial Finance. In D. Cumming (ed.), *The Oxford Handbook of Entrepreneurial Finance*. Oxford: Oxford University Press, 526-557.

Danielson, M. G.; Scott, J. A. (2004) Bank Loan Availability and Trade Credit Demand. *Financial Review* 39(4), 579-600.

Nieto-Carrillo, E.; Carreira, C.; Teixeira, P. (2022) Giving zombie firms a second chance: An assessment of the reform of the Portuguese insolvency framework. *Economic Analysis and Policy* 76, 156-181.

Fabbri, D.; Menichini, A. M, (2010) Trade credit, collateral liquidation, and borrowing constraints. *Journal of Financial Economics* 96(3), 413-432.

Fukuda, S.; Nakamura, J. (2011). Why Did 'Zombie' Firms Recover in Japan? *World Economy* 34(7), 1124-1137.

Garcia-Appendini, E.; Montoriol-Garriga, J. (2013) Firms as Liquidity Providers: Evidence from the 2007-2008 Financial Crisis. *Journal of Financial Economics* 109(1), 272-291.

Garcia-Appendini, E.; Montoriol-Garriga, J. (2020) Trade Credit Use as Firms Approach Default. *Journal of Money, Credit and Banking* 52(5), 1199-1229.

Gouveia, A. F.; Osterhold, C. (2018) Fear the walking dead: zombie firms, spillovers and exit barriers. OECD Productivity Working Papers No. 2018-13. OECD Publishing, Paris.

Hallak, I.; Harasztosi, P.; Schich, S. (2018) Fear the Walking Dead? Incidence and Effects of Zombie Firms in Europe. JRC Technical Report No. 111915. Publications Office of the European Union, Luxembourg.

Intrum (2018). European Payment Report. Available at https://www.intrum.com/publications/european-payment-report

Jain, N. (2001) Monitoring Costs and Trade Credit. *Quarterly Review of Economics and Finance* 41(1), 89-110.

Levinsohn, J.; Petrin, A. (2003). Estimating production functions using inputs to control for unobservables. *Review of Economic Studies* 70(2), 317-341.

Lu, L.; Li, X.; Qian, Z. (2020) Monetary policy, financial development and the financing of zombie firms: evidence from China. *Economic and Political Studies* 8(2), 141-164.

McGowan, A.; Andrews, D.; Millot, V. (2018) The walking dead? Zombie firms and productivity performance in OECD countries. *Economic Policy* 33(96), 685-736.

Nieto-Carrillo, E.; Carreira, C.; Teixeira, P. (2022) Giving zombie firms a second chance: An assessment of the reform of the Portuguese insolvency framework. *Economic Analysis and Policy* 76, 156-181.

Peek, J.; Rosengren, E. (2005) Unnatural Selection: Perverse Incentives and the Misallocation of Credit in Japan. *American Economic Review* 95(4), 1144-1166.

Schivardi, F.; Sette, E.; Tabellini, G. (2022) Credit Misallocation During the European Financial Crisis. *Economic Journal* 132(641), 391-423.

Shen, G.; Chen, B. (2017) Zombie firms and over-capacity in Chinese manufacturing. *China Economic Review* 44, 327-342.

Shiraishi, M.; Yano, G. (2021) Do 'zombie firms' emerge among private firms in China? A survival analysis approach that pays attention to the reception of trade credit. *Journal of Chinese Economic and Business Studies* 19(1), 1-34.

Storz, M.; Koetter, M.; Setzer, R.; Westphal, A. (2017) Do we Want These Two to Tango? On Zombie Firms and Stressed Banks in Europe. ECB Working Paper No. 2104. European Central Bank.

Appendix

Table A1. Analysis of the robustness of the determinants of zombie firms using alternative definitions

Variable	*Zombie in year t*	*Zombie in year (t+1)*	*Continuing as a zombie*	*Become a zombie*
	(1)	(2)	(3)	(4)
Schivardi et al. (2022) zombie definition				
Bank debt	0.016*** (0,001)	0.010*** (0,001)	0.022*** (0,004)	0.009*** (0,001)
Supplier debt	-0.006*** (0,002)	-0.003** (0,002)	0.000 (0,006)	-0.008*** (0,001)
Shen and Chen (2017) zombie definition				
Bank debt	0.015*** (0,001)	0.001 (0,001)	0.021*** (0,002)	0.003*** (0,001)
Supplier debt	0.015*** (0,001)	-0.035*** (0,001)	0.003 (0,002)	-0.030*** (0,001)

Notes: *Probit* estimations of equation (1). The regression also includes control variables and constant term, the coefficient estimates of which are not reported. See notes to Table 3. ***, ** and * statistical significance at the 0.01, 0.05 and 0.10 levels, respectively.

IMPRENSA DA UNIVERSIDADE DE COIMBRA
COIMBRA UNIVERSITY PRESS