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Content

Editor's note[1]

Pedro Duarte Neves

July 2021

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1. This issue of *Banco de Portugal Economic Studies* includes four studies. The first study develops fiscal indicators that help understand and assess the effects of fiscal policy on the economy. The second study proposes a methodological approach to calculate the contributions of final demand components to output growth. The third study assesses the conditions for determining interest rates in credit operations. The methodological approaches of these three studies are applied to the Portuguese economy. The final study included in this issue of *Banco de Portugal Economic Studies* presents a theoretical reflection on general tax principles applied to household expenditure on housing.

2. The study by Braz and Campos presents three types of fiscal effect indicators – automatic stabilisers, fiscal policy stance and fiscal impulse – framed by a review of the literature and applied to Portugal. The automatic stabilisers correspond to the effects on the fiscal balance resulting directly from fluctuations in economic activity; fiscal stance indicators (the most frequently used being the change in the structural primary balance) quantify the fiscal impact of discretionary fiscal policy measures; and lastly the fiscal impulse assesses the impact of fiscal policy on economic activity.

This editor's note highlights two aspects of this study, spanning the past two decades. The authors present a new fiscal stance indicator as an alternative to the change in the structural primary balance. This indicator considers the impact of legislative changes on tax revenue and uses nominal growth in potential output as a benchmark for developments in primary expenditure net of non-tax revenue. This proposal has the advantage of not needing estimates for the potential output level, while excluding the potentially cyclical impact of developments in fiscal revenue linked to composition effects and the unexplained component. The combined use of alternative fiscal stance indicators offers complementary views contributing to a better understanding of fiscal policy conduct, as illustrated by the authors.

Another noteworthy aspect is the case study applying the fiscal impulse indicator to 2020. The year was characterised by the enormous effort required of fiscal policy

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1. The analyses, opinions and conclusions expressed in this editorial are entirely those of the editor and do not necessarily coincide with those of Banco de Portugal or the Eurosystem.

to mitigate the impact of the COVID-19 pandemic on economic activity. This exercise suggests that the fall in output observed in 2020 might have been 11% instead of the 7.6% observed, had the fiscal policy measures not been implemented. This estimate has its limitations – related, for example, to difficulties in constructing a counterfactual and to the non-linearities between variables – but it clearly illustrates the key role played by fiscal policy since March 2020 and the importance of having fiscal impulse measures.

3. The study by Braz and Campos is a very comprehensive review of the literature on fiscal indicators. In this respect, due recognition must be given to the study "Suggestions for a New Set of Fiscal Indicators", published in 1990 as an OECD *working paper*[2] by the economist Olivier Jean Blanchard, who was then professor at the Massachusetts Institute of Technology.

This study's summary reads as follows: "There are four sets of questions that fiscal indicators can help answer: (1) Of the changes in the fiscal position, what part is due to changes in the economic environment and what part is due to policy? (2) Can the current course of fiscal policy be sustained, or will the government have to adjust taxes or spending? (3) What is the effect of fiscal policy on activity, through its effects on relative prices, be it the price of labour or the price of capital? (4) What is the macroeconomic impact of fiscal policy, through deficit and debt finance?" It is fair to acknowledge the key importance of this study, as it identifies the main issues to be addressed with the use of fiscal indicators – that go well beyond the use of cyclically adjusted fiscal indicators, with their virtues and limitations, which Olivier Blanchard calls "the uses and abuses of the cyclically adjusted budget balance" – and makes suggestions for these indicators, which greatly influenced future discussions on the assessment of the fiscal effects of economic policy.[3] The study by Braz and Campos, benefiting from the debate that has been taking place over the last 30 years, presents concrete proposals to address some of the issues raised by Olivier Blanchard.

4. The study by Cardoso and Rua develops and presents a methodology to identify the net contributions of global demand components[4] to output growth. These contributions are obtained, for each final demand component, after the deduction of direct

2. Blanchard, Olivier Jean (1990). "Suggestions for a New Set of Fiscal Indicators". OECD, *Economics Department Working Papers* No. 79, OECD Publishing. This is the oldest bibliographic reference in the study by Braz and Campos.

3. In parallel to this study by Olivier Blanchard, the OECD applied this methodology to a set of OECD countries not including Portugal. See Chouraqui, Hagemann and Sartor (1990), "Indicators of Fiscal Policy: A Re-Examination", OECD, *Economics Department Working Papers* No. 78, OECD Publishing. Subsequently, in 1994, the Banco de Portugal published a study on these indicators applied to Portugal. See "Política orçamental: Indicadores e análise", Centeno, M., *Quarterly Bulletin*, Banco de Portugal, Vol. 16, No 1, March 1994.

4. Global demand corresponds to the sum of domestic demand (private consumption, public consumption and investment) and (goods and services) exports. The expressions *global demand* and *final demand* are used interchangeably.

imports (corresponding to imports that directly meet final demand) and indirect imports (used as intermediate consumption in the domestic production of goods and services). Despite a variable degree of disaggregation, the Banco de Portugal's *Economic Bulletin* has shown these net contributions in its macroeconomic analyses and projections. Therefore, this study is a methodological refinement of the Bank's elements of economic analysis.

This study also contributes in two ways to a better understanding and a more informed analysis of the Portuguese economy. The annex to the study presents annual import content – estimated in volume – of global demand components for the past two decades: the highest, at around 75%, for investment components in transport equipment and other machinery and equipment; in intermediate terms, consumption of durable goods and exports of goods, with figures at around 55% and 50% respectively; with a markedly lower import content, private consumption of goods and services, services exports and investment in construction, with figures at around 20%, and public consumption, at around 10%. These figures are useful rules of thumb for those interested in monitoring the Portuguese economy and who, one way or another, wish to predict developments in the main national accounts aggregates from short-term indicators.

The study by Cardoso and Rua presents a second important contribution. The import function is one of the most important equations of any macroeconomic model. Calculating the elasticity of imports to global demand and their short-term dynamics is particularly important. Using an indicator where global demand components are weighted by their – direct and indirect – import content is the best way to obtain an import function with a high explanatory value, and therefore more useful and precise for macroeconomic forecasting.[5]

5. In this issue's third study, Bonfim, Farinha and Queiró assess the calculation of interest rates in bank credit operations. For this purpose, they use a combination of statistical information developed by the Banco de Portugal: the Central Credit Register, the New Operations database, the Historical Time Series on the Portuguese Banking Sector and the In-house Credit Assessment System. The granularity of data enables several levels of fixed effects to be taken into account in the econometric analysis. The main purpose of the study is to analyse the differential between the profit margin charged by a specific banking institution and the average profit margin charged by the banking system for the same borrower – i.e. the applied dispersion of profit margins – which it attempts to explain through the characteristics of the firm, bank and loan in question.

5. The advantage of using final demand weighted by an estimation of an import function as opposed to non-weighted final demand is illustrated by the authors in Chart 8 of their study.

The study's main finding is the identification of a positive correlation between the Tier 1 capital ratio and the aforementioned (relative) applied profit margin. The findings are valid for a number of segments in the sample under analysis: for firms with a lower credit risk, for larger firms and finally for firms with links with more than two banking institutions. However, in certain respects, special care is needed when interpreting the findings: the share of credit used in the estimation (resulting from the econometric approach selected), the practical impossibility of using the margins of capital requirements in relation to the minimum levels corresponding to the lending institution's level of own risk and, finally, the specific conditions of the Portuguese economy and, consequently, of the Portuguese banking system in the period under review (2012-19). This warrants additional research with the same key aim of characterising pricing in credit operations.

6. The final study in this issue of *Banco de Portugal Economic Studies*, by Teles, is a review of the literature on guiding tax principles. Starting from the seminal work of Frank Ramsey and more recent findings by Andrew Abel, this study summarises a number of important findings by the author and co-authors on the optimum taxation of capital income and the optimum taxation of household expenditure on housing. Rather than providing a summary of the findings, we take this opportunity to invite the readers of this issue to read and analyse these "Simple guidelines for the taxation of housing".

Non-technical summary

July 2021

Challenges in measuring fiscal effects

Cláudia Braz, Maria Manuel Campos

This article focuses on the direct influence of governments on the economy. It presents the associated economic concepts – automatic stabilisers, fiscal stance and fiscal impulse – and the most commonly used methodologies for their measurement, assessing relative merits and disadvantages. Portuguese fiscal developments over the last two decades are analysed through the lens of this well-defined analytical framework. Special emphasis is given to 2020, highlighting the impact of fiscal policy amidst the Covid-19 pandemic.

Automatic stabilisers, which correspond to elements embedded in the budget balance that automatically smooth the business cycle, are proxied in this article by the cyclical component of the budget balance. For the measurement of the fiscal stance, which synthetises the budgetary impact of government's discretionary decisions and policy actions, the article reviews several well-established methods. It concludes that the approach based on the change in the structural primary balance is the most encompassing but it also proposes an alternative that is simpler to compute and provides reasonable results in normal times.

The joint assessment of automatic stabilisers and the fiscal stance in Portugal over 2000-2020 shows stronger discretionary reactions in or around crisis years: 2003, 2009 and 2020 as regards fiscal stimulus, whereas 2011 and 2012 are characterised by significant tightening. When cyclical conditions improve, active fiscal policy tends to be relatively muted (Figure 1).

The fiscal impulse measures the impact of fiscal policy on economic activity, and can encompass the effects from both discretionary actions as well as automatic stabilisers. In this article it is measured through a very stylised framework that considers a set of detailed multipliers drawn from the literature which refer to specific key fiscal instruments and the corresponding fiscal shocks, derived from the breakdown of the fiscal stance.

Zooming in into 2020, the fiscal stance is computed in accordance with three approaches and results vary in the range of 2.5 to 3.7 per cent of GDP. The breakdown by instrument is also assessed and it is shown that for the main categories contributing to the stance - subsidies, other net expenditure and public consumption - results are very much aligned. The differences in the remaining items are also well understood. The computation of the fiscal impulse follows directly from these fiscal shocks, adding the automatic stabilisers effect, and the identified multipliers. It is shown that, in the absence of the joint effect of automatic stabilisers and active fiscal policy, the drop in real

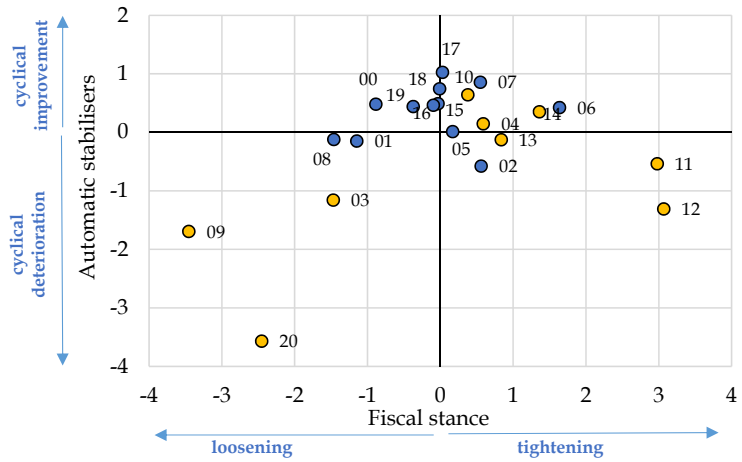

FIGURE 1: Fiscal stance and automatic stabilisers | Percentage points of potential GDP

Source:Authors' calculations.
Notes: The fiscal stance is measured using the change in the structural primary balance. Yellow markers correspond to years with negative real GDP growth and the one immediately after.

GDP in 2020 could have reached at least 11 per cent, instead of the observed 7.6 per cent decline.

Without having the ambition of providing a counterfactual scenario, which would be in any case impossible to accurately design, the approach renders a rough approximation, showing that fiscal policy was decisive in countering GDP fallout in Portugal in the pandemic year. Actually, this overall impact represents a lower bound for the fiscal impulse in 2020 as measures without a direct budgetary impact, like the granting of government guarantees on loans, are not considered.

Challenges in measuring fiscal effects

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July 2021

Abstract
The channels through which governments affect the economy are manifold. In this article the focus is exclusively on direct fiscal effects stemming from the budget balance. The article presents and assesses the most frequently used methodologies for computing automatic stabilisers, the fiscal stance and the fiscal impulse. Alternative simpler approaches for the determination of the stance and the impulse are also proposed. This clear-cut conceptual framework is applied to Portuguese public finances in the last two decades, with a particular focus in 2020. The contribution of the fiscal stance to fiscal developments is only slightly higher than that of the automatic stabilisers in the 2000-20 period and there is no clear pattern between the two indicators. In 2020, both indicators have played a major role in explaining the deterioration in the budget balance. Moreover, calculations for the fiscal impulse show that, in their absence, GDP could have dropped by 11 per cent in 2020, instead of the observed 7.6 per cent decline.

1. Introduction

The channels through which governments affect the economy are manifold. Governments' regulations, decisions and activities may have a direct and an indirect influence on output. In general, the direct effect is reflected in the budget balance and/or the public debt. It is very much concentrated on the tax and social security systems and the provision of public goods and services. Indirect effects stem from mechanisms rooted in national or EU legislation, financial transactions, decisions with a fiscal impact lagged in time, among others. This article focuses exclusively on direct fiscal effects stemming from the budget balance.

Headline balances react automatically to changes in economic activity, notably through tax and social security revenue and unemployment benefits. As these elements contribute to smooth the economic cycle regardless of government interventions, they are called automatic stabilisers. In addition, the budget balance reflects discretionary decisions and policy interventions, as well as structural trends and non-cyclical effects outside governments' control. The fiscal stance is the economic concept that attempts to summarize in a single indicator the aggregate effects of fiscal policy actions on the

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government's budget balance. Its role in fiscal analysis is of import: it serves as a basis for policy discussions and international comparisons of policy actions. The impact of the fiscal stance in economic activity is the so-called fiscal impulse. The fiscal impulse can be broadened to encompass total fiscal effects, i.e. considering also the impact of automatic stabilisers.

The objective of this article is to present and assess the main methodologies currently used for computing automatic stabilisers, the fiscal stance and the fiscal impulse. To our knowledge, an encompassing and updated reference cannot be found in the literature. In this article, automatic stabilisers are proxied by the cyclical component of the budget balance. For the fiscal stance several methodologies are presented: the top-down approach, anchored in the change in the structural primary balance; the pure narrative approach which focuses only on inventories of fiscal measures; and mixed-approaches, like the expenditure benchmark used in the context of the Stability and Growth Pact (SGP). The top-down approach is assessed as the most comprehensive measure for the fiscal stance. It is herein proposed an alternative mixed approach that, although less encompassing, is simpler to compute and provides pertinent results in normal times. Finally, to obviate the fact that the fiscal impulse measurement is model-dependent, it is computed herein on the basis of selected fiscal multipliers drawn from the extensive literature available on the subject.

This clear-cut conceptual framework is applied to understand fiscal developments in Portugal in the last two decades. This is an interesting case from an analytical perspective, as the recent past has been particularly eventful in terms of fiscal policy. Until recently, Portuguese public finances have been essentially characterised by high deficits and a rising trend in the debt ratio. According to the statistical rules currently used, the budget balance averaged -4.5 per cent of GDP in 2000-2008 (and never stood below the -3 per cent threshold) and the debt-to-GDP ratio was on a steady increasing path since 1999, exceeding 75 per cent by end-2008 (Figure 1). By 2010, the general government deficit had widened to -11.4 per cent of GDP and public debt had reached 100.2 per cent. Unsurprisingly, as disruptions in financial markets intensified leading to the euro area sovereign debt crisis, Portugal was at the centre stage with Greece and Ireland. Portuguese authorities requested international economic and financial assistance in 2011 and a Programme was set up, jointly financed by the EU and the IMF. The country entered a sharp fiscal adjustment process under the close monitoring of the international creditors and regained market access in 2014. In this year, government debt still exceeded 130 per cent of GDP and the deficit was only slightly lower than that at the beginning of the financial assistance programme. Since then, however, the balance improved substantially and a surplus was recorded in 2019, while the public debt was following a downward path - until the pandemic hit. At the end of 2020, the budget balance stood at -5.7 per cent of GDP and the debt ratio had escalated to 133.6 per cent.

The article discusses the contributions of fiscal policy for these developments, covering both the role of automatic stabilisers and discretionary decisions. Regarding the fiscal impulse, the analysis focuses exclusively on 2020, as the first year of the pandemic provides a *quasi-natural* experiment extremely interesting and rich to analyse.

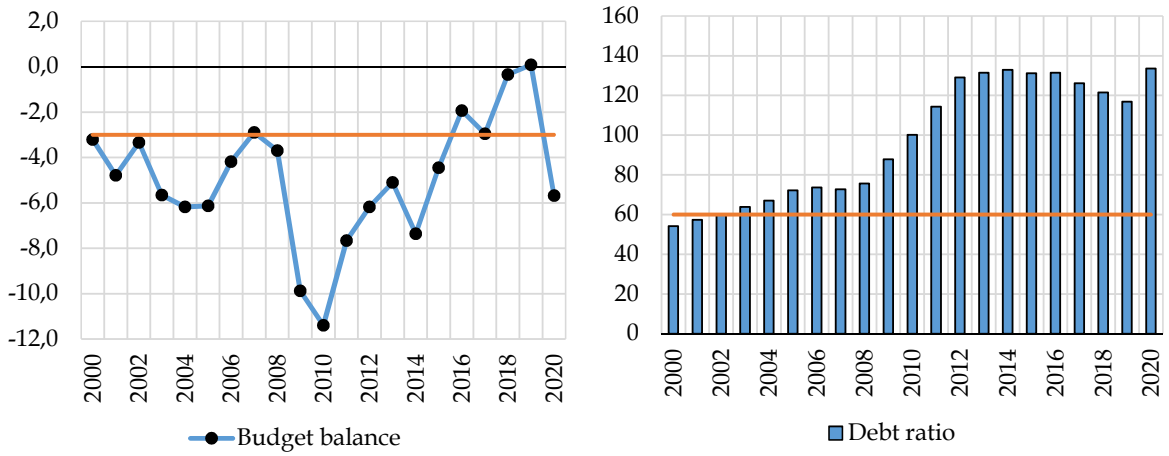

FIGURE 1: Budget balance and public debt in Portugal: 2000-2020 | Percentage of GDP
Sources: Statistics Portugal and Banco de Portugal.

The article is organised as follows. The Section 2 describes the most frequently used method for the computation of automatic stabilisers and briefly discusses other alternatives. In Section 3, the main methods for measuring the fiscal policy stance are presented and an alternative mixed approach is proposed. Both sections provide an application of the main methodologies for the analysis of Portuguese public finances in 2000-2020. The fourth section explains the concept of fiscal impulse and defines a simplified mechanical approach for its computation. Before concluding, a particular focus is placed on 2020 fiscal developments, applying the previously laid-out framework for the analysis.

2. The automatic reaction of government balances: the automatic stabilisers

Headline balances are affected by economic fluctuations. This reflects the fact that revenue from taxes and social contributions and expenditure on social transfers - notably unemployment benefits - automatically react to changes in economic activity. These elements, the so-called automatic stabilisers, contribute to smooth the economic cycle regardless of government interventions. Implicit automatic stabilisation mechanisms are also built into non-cyclical budgetary items. This reflects the fact that a large share of government expenditure does not react to changes in economic activity, thereby contributing to avoid further dampening or overheating effects.

The budgetary impact of automatic stabilisers is often gauged on the basis of estimates of the cyclical component of the budget balance. Mohl *et al.* (2019) dub this the "statistical approach". In practice, most international institutions - including the

Eurosystem - rely on aggregate methods[1] for the computation of the cyclical component, obtaining it as the product between a budgetary semi-elasticity (ε^{BB}) and the output gap (og):

$$CC_t = \varepsilon^{BB} \times og_t \tag{1}$$

where both the semi-elasticity ε^{BB} and og are unobserved and must be estimated.

The semi-elasticity provides a measure of the reaction in the balance-to-GDP ratio induced by a 1 per cent change in GDP. Typically, the semi-elasticity of the balance is obtained as the difference between the semi-elasticities of revenue and expenditure. In turn, these are derived on the basis of fiscal-to-base elasticities for individual tax and expenditure items (measuring their responses to changes in the macroeconomic bases) and base-to-output elasticities (capturing the reaction of macroeconomic bases to changes in the output gap), weighted by the share of each category in GDP.

Banco de Portugal currently uses the estimate obtained by Braz *et al.* (2019) on the basis of the ESCB method which stands at 0.54. It should be noted that it takes into account lagged responses to the output gap: the contemporaneous component is 0.49.[2] Following the latest revisions, respectively in 2015 and 2019, both the OECD and the Commission have estimated the budgetary semi-elasticity for Portugal to stand also at 0.54 (Price *et al.*, 2015 and Mourre *et al.*, 2019).

This standard approach to proxy the budgetary semi-elasticity is subject to some criticism. In particular, it provides a stylized and simplified depiction of the relationship between fiscal and macroeconomic aggregates that prevails, on average, over a long period of time. However, in practice, in each year, cyclical revenues and spending may deviate from such historic relationship, giving rise to windfalls and shortfalls that may be wrongly interpreted as structural developments. This may happen due to changes in the composition of GDP, or because some tax bases respond to fluctuations in asset prices that do not necessary follow the economic cycle (Eschenbach and Schuknecht, 2002). Moreover, "true" tax elasticities are also affected by changes in compliance and the relative size of the informal sector, which, in turn, tend to respond to cyclical swings. Finally, structural reforms or legal changes would also warrant frequently revisiting the elasticities - which is often not the case.

In addition to the semi-elasticity, computing the cyclical component of the budget balance also requires determining the output gap, a measure of the amount of slack (or lack thereof) in an economy. It is proxied as the difference between actual and potential output, and expressed as a ratio to potential output. Potential output is an intrinsically theoretical concept that may be defined as the highest production level

1. Disaggregated approaches rely on the notion that specific components of the budget balance respond to changes in specific macroeconomic variables, which may differ from the fluctuations exhibited by the output gap.

2. Braz *et al.* (2019) provide a detailed description of the ESCB cyclical adjustment method, as well as on the derivation of the budgetary semi-elasticity, with an emphasis on the estimation of fiscal-to-base and base-to-output elasticities for Portugal.

that would be achieved with full resource employment, without triggering inflationary pressures. It is an unobservable variable whose estimation is surrounded by several sources of uncertainty, mainly in terms of modelling (Banco de Portugal, 2017). Although there is no consensus in academic or policy fora on the most accurate method, widely used approaches rely on Cobb-Douglas production functions and some sort of filtering process to extract trend components of relevant series. This is the case with the estimation methods used at Banco de Portugal (Duarte *et al.*, 2020 and Braz *et al.*, 2019, the latter used for cyclical adjustment of budget balances), as well as with the commonly agreed methodology used by the European Commission (Havik *et al.*, 2014).

Estimates for potential output - and hence for the output gap - are unstable and subject to frequent and large revisions. This has implications for policy analysis and policy making as the output gap is a key variable in the European fiscal surveillance framework. There is evidence of some pro-cyclicality in potential output estimates (Deutsche Bundesbank, 2014). Revisions appear to be asymmetric over the cycle, with upward revisions in the output gap in good times tending to be larger than downward revisions in bad times (Burriel *et al.*, 2021). The uncertainty in the measurement of potential output is heightened at the current juncture. In particular, the severity of the pandemic shock makes it difficult to fit in any model and this is likely to result in significant revisions in estimates for potential output, including as regards historical figures (as it typically happens around large cyclical swings - Duarte *et al.*, 2021).

While the so-called "statistical approach" just described is the most widely used to estimate the size of automatic stabilisers, alternative methods exist. They are categorized as "microeconomic" or "macroeconomic" approaches by Mohl *et al.* (2019). Microeconomic approaches focus on the extent to which the tax and benefit systems help in cushioning the impact of changes in market (gross) income in households' disposable income (respectively income before and after taxes and social transfers). The ability of the system to absorb shocks is typically captured by the stabilisation coefficient proposed by Dolls *et al.* (2012), corresponding to the ratio between changes in disposable income and changes in gross income. Although this coefficient may be estimated directly through microeconometric regressions (see Freier *et al.*, 2021 for an example using panel regressions on EU-SILC data), it is more often computed on the basis of microsimulation techniques. These methods, however, capture a relatively narrow definition of automatic stabilisers which does not consider indirect taxation, taxes on corporations or social benefits that depend on previous contributions (such as old-age pensions). This is also a partial equilibrium approach which overlooks second order effects. As such, direct comparisons of the size of automatic stabilisers as estimated by the statistical and microeconomic approaches should be avoided. Macroeconomic approaches rely on DSGE models to gauge overall automatic stabilisation effects of fiscal policy. In particular, these models take into account behavioural and feedback effects when measuring the response of aggregate disposable income to shocks. The same effects are also implicitly taken into account in the determination of the budgetary cyclical component underlying the statistical approach. However, the actual size of automatic stabilisers as estimated using DSGEs is very much contingent on the type

of shock. Moreover, the accuracy and comprehensiveness of the estimates also depends on the richness of the fiscal block of the underlying model.

All in all, and despite its limitations, the cyclical component presents a number of advantages compared to the alternative methods for assessing the size of automatic stabilisers. It is comprehensive in scope and relatively easy to compute and replicate based on publicly available data. For these reasons, it is the approach adopted in the article.

Figure 2 highlights the contribution of automatic stabilisers to the annual change in the budget balance. Several facts are worth highlighting. First, in only around half of the years the sign of the change in the cyclical component coincides with that of the change in the budget balance. Second, in terms of magnitude, the standard deviation of the automatic stabilisers (1.1) is considerably smaller than that of the overall change in the budget balance and the remaining component. Also, in absolute terms, it averages 0.7 pp of GDP per year. Taken together, these pieces of evidence suggest that automatic stabilisers have contributed to smooth out macroeconomic fluctuations in Portugal, but have played a relatively minor role in explaining past fiscal developments.

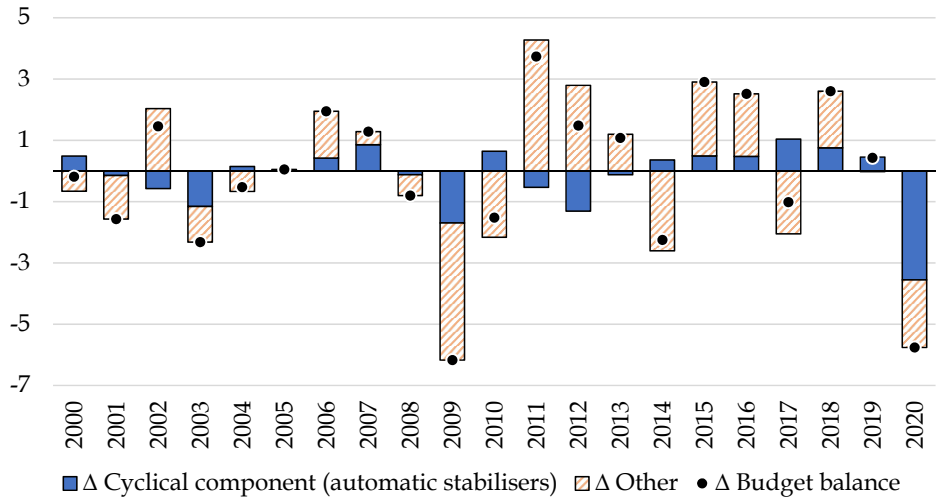

FIGURE 2: Contribution of automatic stabilisers to the change in the budget balance in Portugal: 2000-2020 | Percentage points of GDP

Sources: Own representation based on authors' calculations.
Notes: The impact of automatic stabilisers is calculated on the basis of a statistical approach which proxies it as the change in the cyclical component of the budget balance. The latter is estimated following the Eurosystem methodology described above and considering Banco de Portugal's current estimates for potential output.

3. The discretionary component of government balances: the fiscal stance

Governments influence economic activity through their decisions and policy interventions. The fiscal stance is the economic concept that designates this discretionary influence. Its measurement is not straightforward. Conventional approaches rely to a large extent in a detailed analysis of the budget balance in order to identify the

components resulting from active fiscal policy and thus proxy the stance. The most commonly used approaches are described, assessed and applied to the case of Portugal in this section.

3.1. Top-down approach: the change in the cyclically-adjusted (or structural) primary balance

The most established metric for gauging the stance of fiscal policy is based on the change in cyclically adjusted/structural balances, ie, the change in the balance that would prevail if the economy was at its potential (see Blanchard, 1990, Alesina and Perotti, 1995 or Alesina *et al.*, 1998 for some early definitions and applications)[3]. The concept of structural fiscal balance is at the core of the European surveillance framework, both in levels and in changes, being used to assess compliance with rules prevailing in the preventive and the corrective arm of the SGP. The European Commission, the European Fiscal Board (the institution mandated to assess the appropriateness of the euro area fiscal stance), the Eurosystem, the IMF and the OECD all use some formulation of the change in cyclically adjusted/structural balances to assess the fiscal stance. In the case of the Eurosystem, the stance is measured as the change in the cyclically adjusted primary balance (CAPB) excluding the impact of bank sector support measures. The focus thereon is on the most frequently used indicator, which is the change in the structural primary balance (SPB).

The calculation of the SPB relies on a top-down approach that starts from the headline balance (BB) as a ratio to nominal GDP (Y) and nets out the impact of interest payments (i) and the cyclical component of the balance (CC). Further excluding the impact of temporary measures (TM) yields the structural primary balance (SPB):

$$SPB_t = \frac{BB_t}{Y_t} - CC_t - \frac{i_t}{Y_t} - \frac{TM_t}{Y_t} \tag{2}$$

Interest payments are excluded as the outlays on government debt service primarily reflect decisions and commitments made in the past years (or decades). Temporary measures (or 'one-offs') include non-recurrent exceptional factors which typically have significant but not permanent budgetary impact in fiscal balances. These effects may be identified on the basis of more or less stringent definitions and heavily rely on expert-judgment made on a case-by-case basis. Nonetheless, these operations are generally deficit-decreasing or, if deficit-increasing, they are triggered by factors outside governments' control, such as court decisions or natural disasters.[4] Recently, in the context of the financial crisis, expenditure on banking sector support gained prominence as typical one-offs, given their significant - albeit not permanent - impact on euro area public finances. There is some debate on whether all temporary measures should

3. The structural balance corresponds to the cyclically-adjusted balance net of the impact of temporary/one-off measures.

4. European Commission (2018) presents the guiding principles followed by the Commission for identifying one-off factors. The Eurosystem definition will be used throughout this article which follows, to a large extent, the Commission guidelines.

be netted-out when trying to gauge the fiscal stance, depending on how much they influence macroeconomic developments and how exogenous are from governments' actions, but all main alternative metrics exclude, at least to some extent, the impact of temporary measures.

Difficulties in determining the "true" budgetary semi-elasticity and uncertainty around potential GDP and the output gap, result in limitations in using the change in the SPB to measure active fiscal policy. Although Duarte *et al.* (2021) document that estimates for changes in structural balance tend to be more stable since they are conditional on changes in the output gap which are less revised than its levels, volatile estimates still have implications for the assessment of the fiscal stance. Any revision, small as it may be, implies that evaluating the stance of fiscal policy based on ex-post indicators may provide a different assessment than that steering governments' discretionary decisions in real time. The above-mentioned evidence of some pro-cyclicality in potential output estimates implies that fiscal policy steered on the basis of initial estimates may turn out excessively pro-cyclical (Fatás, 2019 and Kuusi, 2018).

Figure 3 illustrates the application of the top-down approach to identify the fiscal stance in Portugal in the last two decades. It builds on Figure 2 and it further isolates the change in the (cyclically adjusted) interest payments ratio and the effect of temporary measures. According to the top-down approach, the remaining category, which is the change in the structural primary balance, shows the fiscal policy stance. A positive (negative) value corresponds to a tightening (loosening) in the stance.

The figure shows that the change in the budget balance is explained to a large extent by the impact of temporary measures, particularly after the economic and financial crisis as operations to support the banking sector became more prominent. The average absolute change in the fiscal stance (1.1 pp) is only slightly higher than that of the automatic stabilisers (0.7 pp). Moreover, the stance is also only slightly more volatile than the change in automatic stabilisers (respectively with a standard deviation of 1.6 and 1.1).

A closer look at the relationship and magnitude of the fiscal stance and automatic stabilisers allows extracting pertinent conclusions (Figure 4). In the last two decades there is no clear pattern between the two components, neither in terms of relative size, nor regarding the combination of active fiscal policy and cyclical conditions (observations are spread by the four quadrants). The stronger discretionary reactions of fiscal policy occurred in crisis years: 2003, 2009 and 2020 as far as a stimulus is concerned, and 2011 and 2012, Programme years, in case of a tightening. At times of cyclical improvement active fiscal policy was more nuanced. Quite interestingly, the stimulus in the 2009 recession was larger than that in 2020, although the deterioration in the output gap was stronger in the latter. We will come back to this point later in the article.

3.2. (Pure) Bottom-up approach: narrative measures of the fiscal stance

In light of the drawbacks of assessing the fiscal stance on the basis of changes in the SPB and, in particular, its excessive reliability on the output gap, alternative methods have

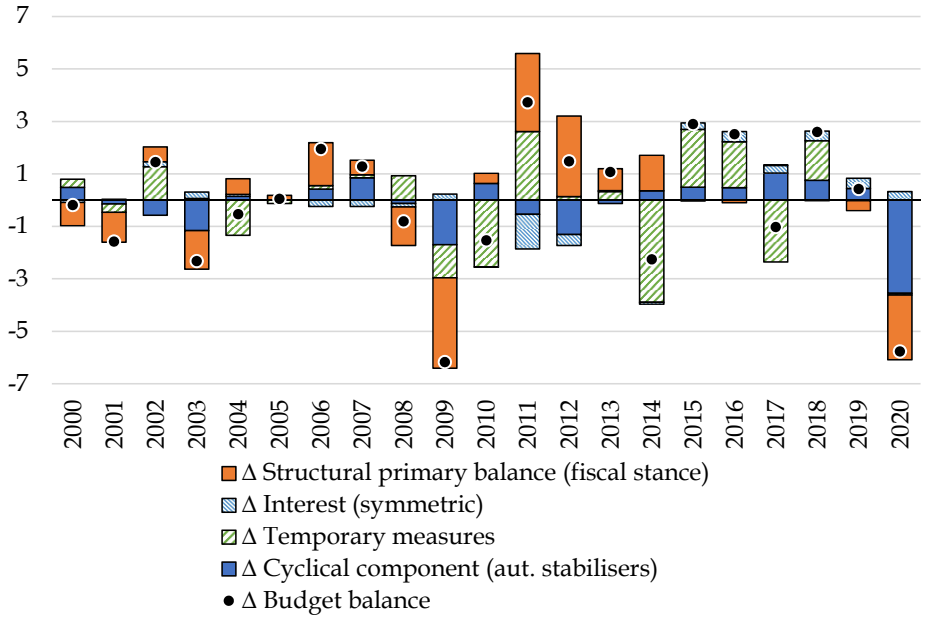

FIGURE 3: Further breakdown of the change in the budget balance in Portugal: 2000-2020 | Percentage points of GDP and potential GDP

Sources: Own representation based on authors' calculations.

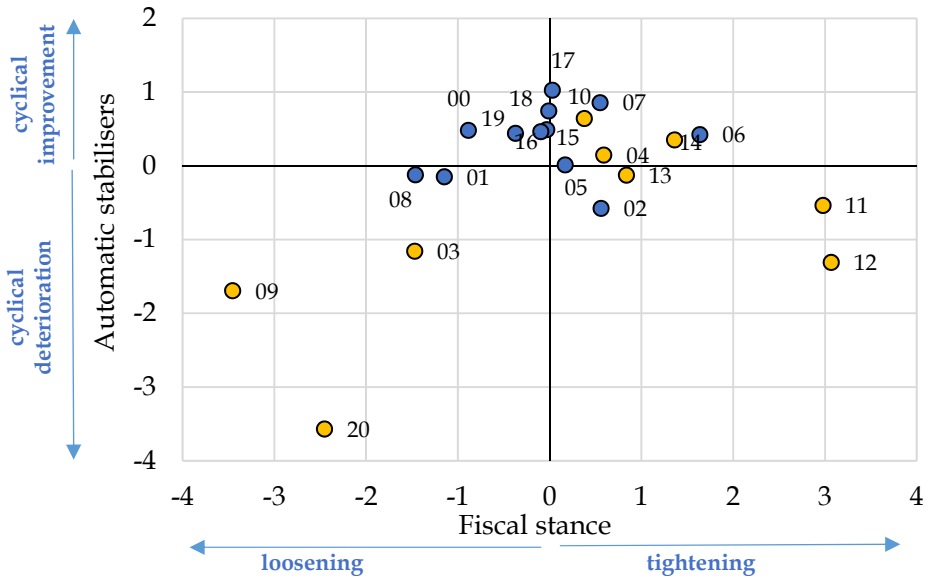

FIGURE 4: Fiscal stance and automatic stabilisers: top-down approach | Percentage points of potential GDP

Sources: Own representation based on authors' calculations.
Note: Yellow markers correspond to years with negative real GDP growth and the one immediately after.

been proposed. One of such proposals relies on "bottom-up" or "narrative" approaches, according to which active fiscal policy is evaluated on the basis of inventories of measures enacted by governments. The procedure draws heavily on official documents produced by governments, such as budgets and Stability Programmes, or

by international organisations. Other forms of government communications, including speeches and interventions in the media, are also often used. Typically, the yield of measures corresponds to estimates done at the time of their adoption and are not reassessed afterwards.

Originally, the narrative analyses have emerged as a tool to eliminate confounding factors such as endogenous interactions between fiscal policy and output in trying to estimate the macroeconomic effects of tax measures. In particular, Romer and Romer (2010) were the first to apply the narrative approach to disentangle the effects of discretionary tax changes from those induced by macroeconomic developments or prospects. They used the inventory of measures to estimate the macroeconomic impact of those changes in the United States. Similar subsequent studies employing narrative analyses include Cloyne (2013) for the United Kingdom, Hayo and Uhl (2014) for Germany, Pereira and Wemans (2015) for Portugal and Gil *et al.* (2019) for Spain. Finally, Devries *et al.* (2011) compiled a narrative dataset of measures announced in OECD countries in 1978-2009. In this case, the dataset also covers expenditure measures and it is used to exogenously identify fiscal consolidation episodes.

The pure narrative approach has some relevant limitations, that are even more detrimental in the case of cross-country analyses. Building an accurate repository of fiscal measures that is thorough enough to be useful is extremely time-consuming and demanding in terms of expertise. The sole identification and quantification of policy actions that should be included may prove challenging. The assumptions underlying the quantification of measures are rarely disclosed and may be influenced by political considerations. Also they are usually *ex-ante* estimates, not subject to *ex-post* revision.[5] Empirical analyses in Hernández de Cos and Moral-Benito (2016) and Jordà and Taylor (2016) suggest that the narrative approach may, after all, fail to adequately eliminate the endogeneity between discretionary fiscal policy and the economic cycle. Finally, it should be stressed that the identification of measures is especially complex when it comes to the expenditure side. This may explain the fact that most narrative datasets focus only on tax measures, for which the absence of decisions can arguably be seen as neutral stance and a no-policy change scenario is easier to conjecture. In turn, pinning down discretionary effects on the expenditure side requires the definition of a (counter-factual) neutral evolution that would prevail in the absence of governments' action - a limitation that semi-narrative/mixed approaches presented below try to overcome.

Figure 5 presents the impact of measures affecting revenue from taxes and social contributions in Portugal in the period 2000-2010, excluding those that have a temporary nature (such as tax amnesties). The largest increases took place in 2002/2003 (mainly concentrated on VAT and tax on oil products) and during the economic and financial assistance programme. These increases were partly reversed in the following years, widespread across different taxes and social contributions. When compared to the change in the structural tax burden underlying the top-down approach, there are

5. In this respect, Barrios *et al.* (2021) propose a novel approach for the assessment of tax reforms accounting for second-round effects, combining the use of a macroeconometric model with a microsimulation model.

important differences in several years. This means that there are further developments in tax revenues that go beyond the impact of discretionary measures. They comprise composition effects, resulting from deviations between the evolution of the macro bases and that implied by the elasticities with respect to the output gap, and other effects such as unanticipated revenue windfalls and shortfalls (see Braz *et al.*, 2019 for more details).

The difference vis-à-vis the top-down stance indicator is even more striking as the contribution of non-tax revenue and primary expenditure is not taken into consideration. While this would not be crucial for the recent years after the end of the Programme and until 2019, it would be very relevant for a year like 2020, where expenditure measures adopted in the context of the Covid pandemic were significant and quantifiable (2.3 per cent of GDP of a total budgetary impact of 3.1 per cent of GDP).

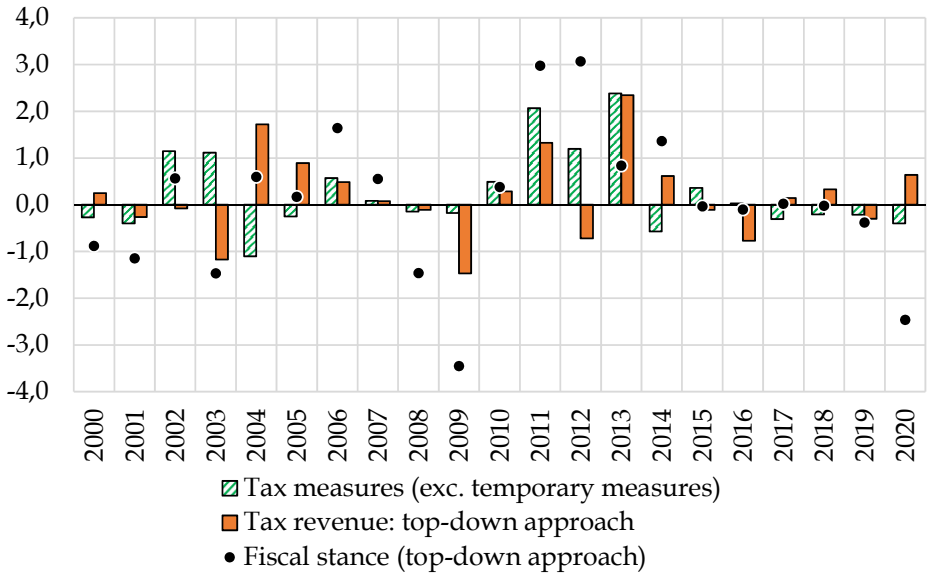

FIGURE 5: Tax measures and comparison with top-down approach | Percentage points of GDP and potential GDP

Sources: Own representation based on authors' calculations.

3.3. Mixed approaches to compute the fiscal stance

3.3.1. The expenditure benchmark

In 2011, the European Commission introduced the Expenditure Benchmark (EB) in the context of the "Six-Pack" reform of the SGP (European Commission, 2013b). It was presented as a complementary pillar to the structural balance in assessing progress towards the MTOs in the preventive arm of the Pact: it sets a limit for the annual growth of expenditure that is compatible with adequate progress. It was not therefore intended to be an alternative indicator for the stance of fiscal policy but provides an interesting lens through which it may be looked at, as suggested in European Fiscal Board (2020).

The expenditure aggregate relevant to assess compliance with the EB results from various adjustments. It excludes interest outlays (i), expenditure that is matched by

EU funds (E^{EU}) and a share of spending on unemployment benefits that is driven by cyclical developments (unb^{CYC}).[6] It is also corrected for the impact of temporary or one-off measures (TM^E). Moreover, it takes into account a four-year average of government investment (encompassing the expenditure incurred in the current and the previous three years, $\overline{INV_4}$). The impact of non-temporary revenue discretionary measures and of revenue increases mandated by law (R^{DISC}) is also deducted:

$$E_t^{EB} = E_t - i_t - E_t^{EU} - unb_t^{CYC} - TM_t^E - INV_t + \overline{INV_4} - R_t^{DISC} \tag{3}$$

This net expenditure aggregate is adjusted using an average of the figures for the GDP deflator in year t as per the Commission's Spring $t-1$ and Autumn t forecasts. Finally, the real growth rate is compared to a medium-term potential growth rate, averaged over a 10 year period and thus smoother and less likely to be revised than annual estimates.

In computing the fiscal stance, the EB offers a number of advantages compared to the structural balance. The theoretical concept of net expenditure is easier to communicate to policymakers and the general public. The assessment based on the EB is much less prone to revisions in the cyclical position, as the NAWRU plays only a minor role in the definition of net expenditure and the benchmark against which its growth is measured relies on a smoother definition for potential growth. Moreover, by also smoothing-out investment outlays, it downplays incentives for sharp cuts that may entail long-term costs, while avoiding penalising large-scale projects. However, it also presents drawbacks. Albeit to a lesser extent, the EB still relies on unobservable variables - both the NAWRU and potential output. The computation of the net expenditure aggregate requires information on outlays financed by EU funds, which are not always publicly available. The EB fails to capture the impact of some budgetary components, such as the composition of growth and the unexplained component (residuals) in tax revenues and other developments in non-tax revenue beyond the impact of discretionary measures and EU funds. Finally, the assessment of discretionary revenue measures shares the limitations highlighted above for the narrative approach. For a review of details underlying the calculation of the EB, refer to Marinheiro (2020).

3.3.2. Other methodologies and an alternative approach

In 2013, the European Commission introduced a complementary measure for the fiscal stance, the so-called Discretionary Fiscal Effort (DFE) indicator (European Commission, 2013a; Carnot and de Castro, 2015). It is a mixed approach in the sense that it entails a "bottom-up" or narrative approach on the revenue side, while on the expenditure side it is "top-down". In particular, the DFE is defined as

6. Cyclical unemployment expenditure is computed as $unb_t^{CYC} = unb_t \times \frac{unRate_t - NAWRU_t}{unRate_t}$. It depends on the overall expenditure on unemployment benefits (unb) and on an estimate for the labour market slack as implied by the relationship between the actual unemployment rate ($unRate$) and the estimated non-accelerating wage rate of unemployment ($NAWRU$, a measure of structural unemployment).

$$DFE_t = \frac{R_t^{DISC}}{Y_t} - \frac{(\Delta E_t^{'} - y^* \times E_{t-1}^{'})}{Y_t} \tag{4}$$

where R^{DISC} is the overall impact in year t of non-temporary revenue measures, based on a narrative approach, and Y_t corresponds to nominal GDP. The Commission avoids overly depending on governments' estimates for the yield of measures in R^{DISC} by relying on a dedicated database of discretionary fiscal measures internally built and updated, for which governments' figures are scrutinized and expert judgement can be employed. However, data is only available from 2010 onwards. $E_t^{'}$ corresponds to total expenditure excluding interest outlays, non-discretionary unemployment benefits and one-off or temporary expenditure measures. Variable y^* represents the medium-term potential growth rate relevant in the context of the EB.

Similar, albeit simpler, semi-narrative measures of the fiscal stance have been proposed in recent years. Morris *et al.* (2015) relies, on the revenue side, on a dataset of tax legislation changes covering essentially the first decade of the 2000s and a set of 8 EU countries. This draws on information collected by fiscal experts in the context of the ESCB Working Group on Public Finance. On the expenditure side, they present results based on three different benchmarks for "neutral" spending - nominal trend GDP, the GDP deflator, and the Consumer Price Index - and show that they all broadly lead to similar conclusions.

Braz and Carnot (2019) identify discretionary fiscal changes on the basis of an extended version of the ESCB dataset used by Morris *et al.* (2015) covering all euro area countries. As a robustness check, they also compare their results with those implied by the Commission's dataset of discretionary measures and assess differences to be negligible in most overlapping years. They capture the discretionary component of fiscal changes on the expenditure side by benchmarking against annual nominal potential growth. A sensitiveness analysis focusing on alternative benchmarks (namely real potential growth or the GDP deflator) shows that the magnitude of the discretionary effects varies considerably, and although results remain qualitatively unchanged in most years, in some cases the conclusions are contradictory.

Inspired by these analytical frameworks, this article proposes an alternative, simple mixed approach (AMA) based on the impact of discretionary measures on taxes and social contributions and taking annual nominal potential GDP growth as the benchmark for primary expenditure net of non-tax revenue. In the case of Portugal this netting out is particularly relevant as it allows eliminating the impact of EU funds expenditure financing. Indeed, although expenditure financed via EU funds may have an impact on economic activity, it should be disregarded when measuring the fiscal stance as it is not under the direct control of national governments. Temporary measures are also excluded, upfront, and so is the change in the cyclical component of unemployment benefits, computed in accordance with the Eurosystem methodology. The latter adjustment has, overall, a minor impact on results. In terms of formula, AMA is defined as

$$AMA_t = \frac{R_t^{DISC}}{Y_t} - \frac{(\Delta E_t^{''} - y_t^* \times E_{t-1}^{''})}{Y_t} - \Delta CC_t^{unb} \quad (5)$$

where R^{DISC} is the overall impact in year t of (non-temporary) discretionary revenue measures; $E_t^{''}$ corresponds to total expenditure excluding interest outlays and non-tax revenues, adjusted also for the impact of one-off or temporary measures; y_t^* represents the annual nominal potential GDP growth rate; and CC_t^{unb} is the change in the cyclical component of unemployment benefits (derived as a ratio to GDP).

Figure 6 compares the fiscal stance in Portugal as obtained with the top-down approach and the mixed framework proposed in this article. In most years results are qualitatively similar and broadly convey the same message in terms of the stance of fiscal policy, even if the magnitudes involved might somewhat differ. The major exceptions occur in years 2003 to 2005 and 2014. Differences between the two approaches are also significant, but without changing the qualitative stance assessment, in 2009, 2012 and 2020. The difference between the two approaches stems almost exclusively from developments in the tax burden captured as composition effects and residuals, which go beyond the direct impact of discretionary measures, and affect the change in the SPB (Figure 7). This is aligned with insight provided in European Commission (2013a), according to which the SPB provides an overly favourable view on the stance of fiscal policy in good times (when revenue windfalls are larger), while in bad times (when shortfalls emerge) it tends to underestimate consolidation efforts.[7]

To sum up, the mixed approach herein suggested is a simpler alternative for computing the fiscal stance, as it requires essentially an assumption on potential GDP growth (rather than in levels as is the case of the top-down approach) and the identification of discretionary revenue measures. It provides robust results when tax revenues evolve as expected, i.e., in line with historical elasticities and the impact of legislative changes. In theory, its accuracy could even be superior to that of the top-down approach when tax residuals and composition effects are significant and have essentially a cyclical nature. In the case of residuals, while some amounts may correspond to specific events (e.g, related to refunds behaviour), in practice it is extremely difficult to assess its cyclical/structural nature. Similarly, since the behaviour of macroeconomic bases does not necessarily follow the real business cycle and may reflect governments' decisions, assessing the structural nature of composition effects is also not straightforward.[8]

Figure 6 also depicts the stance as measured on the basis of the expenditure benchmark for the available period, i.e., after 2010. Results somewhat differ from the

7. This insight stems from a comparison between the DFE and the SPB-based fiscal stance in 2004-2013 in EU countries presented in European Commission (2013a). It is shown that the difference between the two indicators is pro-cyclical due to the cyclicality of effects captured as revenue shortfalls or windfalls.

8. Indeed, at least in the case of Portugal, there is no evidence of cyclicality in composition effects: the correlation coefficient between composition effects and the change in the cyclical component is small and negative.

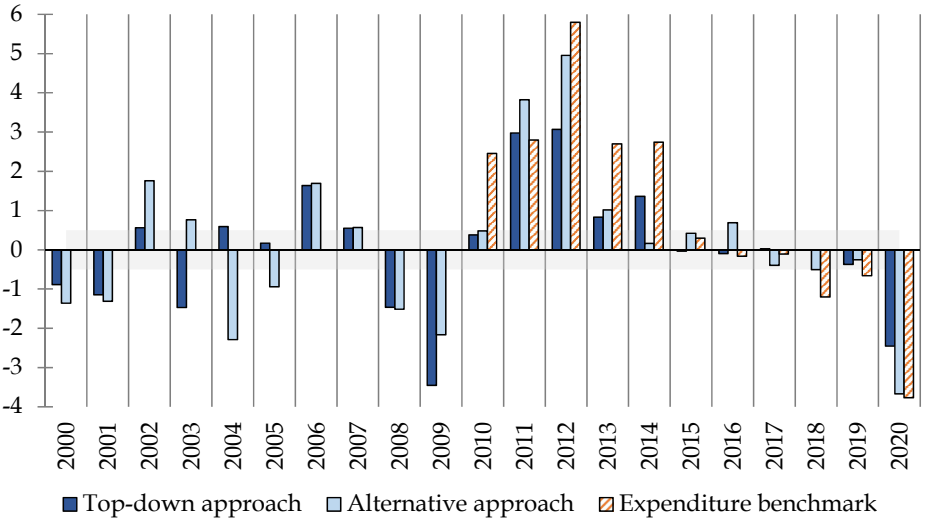

FIGURE 6: Alternative measures of the fiscal stance in Portugal | Percentage points of GDP and potential GDP

Sources: Own representation based on authors' calculations.

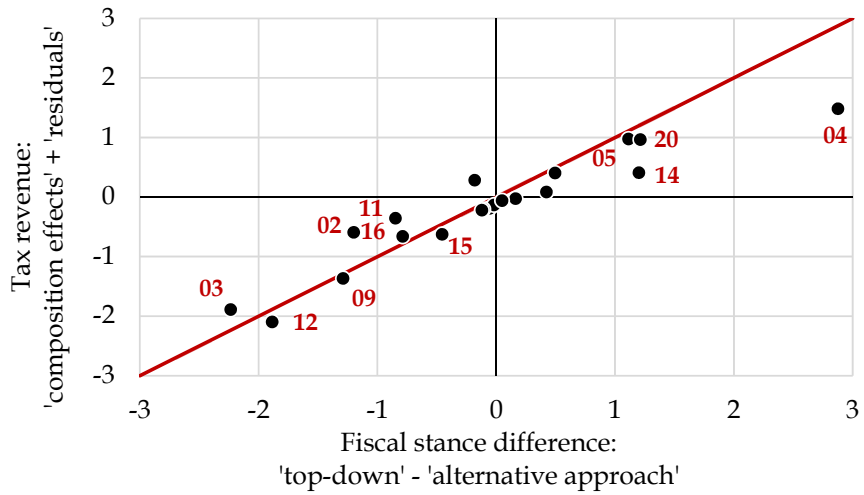

FIGURE 7: Difference in indicators of the fiscal stance and revenue developments | Percentage points of GDP and potential GDP

Sources: Own representation based on authors' calculations.

other two approaches, particularly up to 2014. The identification of the underlying causes is difficult given the complexity of the computation formula. In particular, the flattening of the investment expenditure not co-financed by EU funds is a motive for deviations, especially in periods of higher spending volatility. The rationale for a fiscal stance indicator based on a net-expenditure aggregate is not so different from that underlying other mixed approaches, in particular that proposed in this article. However, the current degree of complexity in the calculation of the expenditure benchmark eliminates, in our view, any advantages it might have over the other two approaches as an indicator of the fiscal policy stance.

4. The impact of the government balance on GDP: the fiscal impulse

The definition of fiscal impulse is not consensual among academics nor practitioners. For some authors (e.g. Alesina and Perotti, 1995) the fiscal impulse corresponds to the previously defined fiscal stance concept. In this article, the fiscal stance corresponds to the discretionary component of the budget balance, while the fiscal impulse measures the impact of fiscal policy on economic activity. Along the lines developed in Braz and Carnot (2019), this article also explores a broader definition of this impact, encompassing also the effect of automatic stabilisers on aggregate demand.

While the fiscal stance can be measured without resort to a macroeconomic model, as shown in the previous section, the same does not happen with the determination of the fiscal impulse. The latter is usually measured on the basis of statistical models (such as VARs) or structural macroeconomic models, with shocks capturing the effects of fiscal policy in economic activity. As these models necessarily entail working assumptions and subjective judgement about the structure of the economy, the measurement of the fiscal impulse is model-dependent.

The ratio between the impact on economic activity and the size of the fiscal policy shock is the so-called fiscal multiplier. The literature on fiscal multipliers is very extensive and gained traction in the aftermath of the Great Financial Crisis. In comprehensive surveys, Castelnuovo and Lim (2019) and Ramey (2019) highlight that estimates vary considerably depending on the computation method (e.g. tax multipliers are found to be larger when based on narrative methods instead of DSGE models), relevant time horizon (short versus medium-to-long term), or the persistence of the shock and whether it was expected or unanticipated. Moreover, the size of fiscal multipliers is a function of country-specific characteristics (such as the exchange rate regime or the degree of openness) and the type of fiscal instruments at play. It is also very much state-contingent: there is some evidence, albeit somewhat fragile, that spending multipliers are larger in periods of slack, while it is consensual that frictions and non-linearities - prominently when interest rates are at the Zero Lower Bound - are associated with higher spending multipliers. In general, the latter exceed multipliers derived from tax cuts, which are found to be procyclical in the sense that they tend to be larger in expansions.

Despite the relevance of composition of fiscal shocks, aggregate fiscal multipliers are often used in practice. These indicate the short term impact on real GDP growth stemming from a 1 per cent of GDP 'balanced' fiscal shock. For example, the European Commission, in its public debt sustainability analysis (DSA), assumes a fixed short-term fiscal multiplier of 0.75, in line with past estimates (Carnot and de Castro, 2015).The Eurosystem DSA considers a 0.55 fiscal multiplier, in line with simulation results obtained with the ECB's New Area Wide Model for a balanced-composition of fiscal consolidation packages.

This article focuses on the short-term impulse of fiscal policy on economic activity. This is proxied on the basis of multipliers specific to key fiscal instruments, as per Table 1. In particular, for each instrument, the relevant multiplier was derived as the average in a sample of empirical studies underlying Gechert (2015)'s meta-analysis. The resulting

figures are very much aligned with Gechert (2015)'s multipliers referring to broader categories of fiscal instruments.

Direct taxes on households	0.31
Direct taxes on corporations	0.12
Social security contributions	0.34
Indirect taxes	0.44
Government consumption	0.98
Government investment	1.07
Social transfers	0.54
Subsidies	0.62
Other net expenditure	0.12

TABLE 1. Fiscal multipliers by instrument: short term impact on real GDP

Source: Authors' calculations based on Gechert (2015) and references therein.
Note: Figures represent the short term impact on real GDP growth of a 1 per cent of GDP shock in each fiscal variable.

After having set the fiscal multipliers, the short-term impulse on GDP growth stemming from the discretionary action of governments is given by the sum, over all instruments, of the product between the multiplier and the respective fiscal shock, as follows:

$$\Delta y_t = \sum_{i=1}^{n} m_i s_{i,t} \tag{6}$$

where y_t is real GDP growth in year t, i is the fiscal instrument, m_i stands for the fiscal multiplier referring to instrument i and $s_{i,t}$ represents the shock on instrument i in period t.

For the identification of the fiscal shocks it is necessary to breakdown the stance by instrument. Out of the three approaches used to derive the fiscal stance in Portugal in the last couple of decades, only two of them allow for this splitting: the top-down approach and the alternative mixed approach proposed in this article. The fact that such breakdown is not possible when measuring the stance with the expenditure benchmark adds to the disadvantages highlighted before. In the case of the top-down approach, the splitting by instrument follows the Disaggregated Framework developed in the context of the Eurosystem for the detailed analysis of fiscal developments (Bouabdallah *et al.*, 2019 and Morris and Reiss, 2020; for an illustration for the Portuguese case, refer to Braz *et al.*, 2019). For the alternative mixed approach the breakdown by instrument follows directly.

The definition of fiscal shock can be broadened to encompass also the impact of automatic stabilisers. However, as discretionary policy action and automatic stabilisers are not independent, an adjustment is required to avoid double accounting. Braz and Carnot (2019) show that this adjustment corresponds to subtracting the product of the output effect of discretionary fiscal policy by the semi-elasticity of the budget balance and the (overall) tax multiplier.

Several obvious caveats apply to the measurement of the fiscal impulse using this approach. Firstly, it is a mechanical partial equilibrium analysis that does not take into account each years' specificities. Secondly, it only allows the assessment of the impact on GDP growth and not on other relevant economic variables. As such, it does not provide a complete counterfactual scenario. Thirdly, it is highly dependent on the choice of multipliers and it cannot grasp the exact specifications of the measures and the prevailing circumstances. Fourthly, it is not capturing possible lags between the materialisation of public revenue or expenditure and the respective macroeconomic impact, like for example those resulting from agents' reactions to government announcements. Lastly, it provides only a short-term/one year assessment, while the dynamics in the following years are also of utmost importance. However, some merits can also be pointed out. The measurement of the fiscal shocks is well founded, increasing the robustness of results. Multipliers were chosen on the basis of averages and a meta study which, given the huge diversity of estimates, is in itself a major advantage. Finally, without having the ambition of providing a counterfactual scenario, which would be in any case impossible to accurately design, the approach renders a rough approximation for the impact on GDP of active fiscal policy in a given year.

5. The 2020 case-study

As highlighted before, and similarly to what happened in almost all countries across the world, the budgetary situation in Portugal deteriorated significantly in 2020 as a result of the Covid-19 pandemic. The deficit reached 5.7 per cent of GDP, deteriorating 5.8 pp relative to the previous year. This resulted from both the working of automatic stabilisers, currently estimated at 3.6 pp, and the adoption of fiscal policy measures to address the emergency health situation and support firms and households. The exact quantification of this expansionary stance hinges on the approaches considered.

Figure 8 quantifies the 2020 fiscal stance broken down by instrument and computed in accordance with the top-down, the mixed alternative and the pure narrative approaches. The use of the latter approach is only made possible due to the atypical nature of 2020 which allows the derivation of the fiscal stance on the basis of a quantification of Covid-related measures on both the revenue and expenditure sides of the budget balance. The categorisation by budgetary instrument is compatible with the multipliers listed in Table 1.[9]

Results shown in Figure 8 place the pure narrative fiscal stance measure (3.1 per cent of GDP) in between the top-down (2.5 per cent) and alternative approach (3.7 per cent) estimates. For the main categories contributing to the stance - subsidies, other net expenditure and public consumption - results are very much aligned. Although pinpointing subsidies is not common in the literature, it was deemed necessary

9. The *proxy* for public consumption encompasses compensation of employees, intermediate consumption, social transfers in kind, all netted out of the proceeds from the sale of goods and services. The residual item net expenditure refers to other current and capital expenditure net of other current and capital receipts.

for 2020 as several firms' support measures are captured in this item in national accounts (including furlough schemes like '*layoff simplificado*'). Net expenditure captures essentially loans granted to air transport companies (*TAP* and *SATA*) and reclassified as capital transfers. The smaller contribution of this category in the purely narrative approach stems from the fact that it is not affected by other transitory transactions (such as the conversion of DTAs, which is not Covid-related), as opposed to the top-down and alternative approaches. Public consumption is capturing the bulk of additional health expenditure related to the pandemic. The slightly higher magnitude of this category in the top-down and alternative approaches is explained by the deduction of sales. The latter declined significantly during the pandemic due to lower demand and restrictions in the access of public services. Since this decline did not stem from the enactment of discretionary measures, it is not captured in the narrative approach. It is also noticeable that developments in other components of social transfers in cash are offsetting the impact of Covid-related measures, while for investment the evolution goes beyond the measures. Finally, regarding taxes and social contributions, the top-down approach captures, in addition to a small impact of measures, composition effects. These were particularly significant in direct taxes paid by households and social contributions. Indeed, in 2020 the wage bill has evolved more favourably than would result from historical elasticities vis-à-vis GDP, reflecting measures that mitigated the impact of the pandemic on the labour market.[10] As such, in the specific case of 2020, the top-down approach may provide a more accurate quantification of active fiscal policy in Portugal.

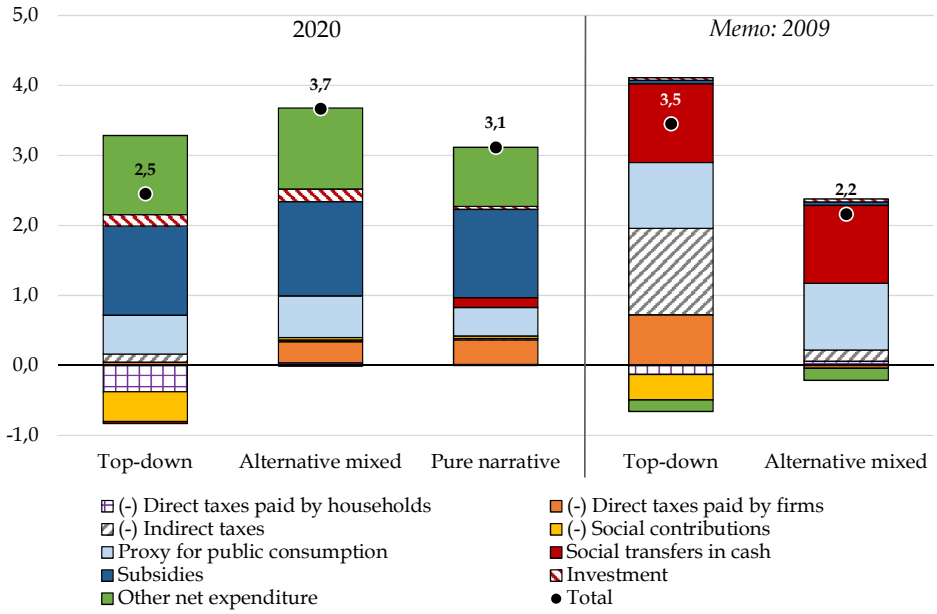

FIGURE 8: Breakdown of the fiscal stance by instrument in 2020 | Percentage of GDP

Sources: Own representation based on authors' calculations.

10. For further details, refer to Box 3 in Banco de Portugal May 2021 Economic Bulletin.

The computation of the fiscal stance with the alternative approach and the breakdown by instrument facilitates a better understanding of the differences between government active fiscal policies in 2020 and in the 2009 crisis. As referred to above, the 2020 fiscal stimulus calculated in accordance to the top-down approach was smaller than that in 2009, which is at odds with the perception that the fiscal packages adopted in response to the Covid pandemic were unprecedented. However, this does not hold when the alternative approach is used (Figure 8). Indeed, the 2009 fiscal outturn was marked by a behaviour of tax revenue much worse than anticipated by average elasticities and the evolution of the macroeconomic bases, particularly as regards direct taxes paid by firms and indirect taxes. These shortfalls are only captured in the top-down approach and may partly have a cyclical nature. In this case, as opposed to 2020, considering these shortfalls as part of active fiscal policy is less accurate. The alternative approach also highlights the different instruments used for the stimulus: although public consumption played a significant role in both cases, the other main explanatory item in 2009 is social transfers in cash, which have an almost nil contribution in 2020.

The fiscal impulse in 2020 can be computed on the basis of the framework described in the previous section. The impact of discretionary fiscal policy on the 2020 GDP growth is calculated as the product of the identified fiscal shocks, according to the three approaches, by the fiscal multipliers. The overall impact on GDP growth reaches 1.4 pp in the top-down approach, 1.5 pp in the pure narrative and 1.8 pp in the alternative approach (Figure 9). The corresponding average multipliers are 0.58, 0.47 and 0.49, respectively, close to the aforementioned 0.55 estimate used in the context of the Eurosystem DSA methodology. The results imply that, in the absence of active fiscal policy, the drop in GDP in 2020 could have reached around 9 per cent (or slightly worse), instead of the observed 7.6 per cent decline.

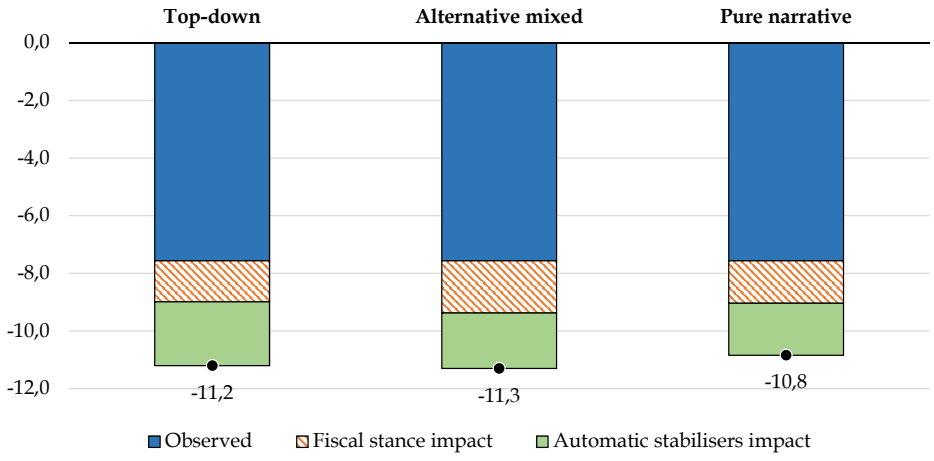

FIGURE 9: Real GDP growth rates: observed and excluding fiscal effects | Percentage
Sources: Own representation based on authors' calculations.

As explained in the previous section, the impact of automatic stabilisers on GDP growth can also be included. The adjustment to eliminate the double accounting between discretionary policy action and automatic stabilisers transforms the 3.6 pp of

GDP estimate for the change in the cyclical component of the deficit in 2020 to around 4 pp.[11] The joint consideration of the two effects, discretionary plus adjusted automatic stabilisers, shows that in their absence GDP would have fallen by around 11 per cent in 2020. Results are also illustrated in Figure 9.[12] Taking into account that the effect of other measures without a direct budgetary impact, like the granting of government guarantees on loans, is not considered, the obtained overall impact may well represent a lower bound for the fiscal impulse.

6. Concluding remarks

The assessment of the magnitude of active government policies - the so-called fiscal stance - is important for the analysis of public finances, providing a base for policy recommendations. In this article, it is argued that the top-down approach, i.e. the change in the structural primary balance ratio to (potential) GDP, is the most comprehensive measure for the fiscal stance. Although structural balances have been subject to heightened criticism in the recent years, due to their unobservable nature and the frequent revisions, this occurs in the context of the multilateral fiscal surveillance framework at the EU level. Outside this scope, structural balances remain a very relevant analytical tool.

There are other approaches for measuring the fiscal stance. On the other extreme of the spectrum, one can find the pure narrative approach which has the advantage of not requiring any estimate of potential output. However, it can also become unstable as the quantification of adopted measures, particularly on the expenditure side, proves extremely difficult. Mixed approaches, like the expenditure benchmark used in the context of the SGP, may provide an alternative. However, in this specific case, the data requirements and the complexity of its computation outweigh the benefits, the latter much reliant on the utilisation of a ten-year average of potential GDP growth. As a result, an alternative mixed approach is proposed in the article, inspired by the work developed by other authors.

In normal times, the computation of the fiscal stance on the basis of the proposed alternative approach is very reliable. First, it builds on a narrative approach for taxes and social contributions. In the presence of significant composition effects or unexplained developments (residuals) in the tax burden, the use of the top-down approach may be, otherwise, commendable. Second, it requires an estimate for potential GDP growth as a benchmark for the non-discretionary evolution of net expenditure. This estimate is easier to obtain in normal times. Lastly, it should be adjusted by the cyclical component of unemployment benefits, which, with the exception of years with pronounced macroeconomic developments, is usually negligible. Under these

11. For the adjustment it was assumed a 0.49 budgetary semi-elasticity, in line with the contemporaneous estimate obtained for Portugal in the context of the Eurosystem methodology. Regarding the overall tax multiplier, the weighted average (taking 2019 weights) of the considered multipliers (0.36) was used.

12. The same exercise applied to 2009 would generate an average overall impact on GDP growth of 3.25 pp, to be compared with 3.5pp in 2020.

conditions, the calculation of the fiscal stance is quite straightforward. It requires, essentially, estimates for changes in tax legislation and temporary measures (in the last years in Portugal, very much concentrated in fiscal support to the banking sector), which are usually publicly available, and for potential output growth, without the need for having estimates in levels.

A comparison between the automatic reaction of public finances - the so-called automatic stabilisers - and the fiscal stance shows no clear pattern in Portugal in the last two decades. In the 2000-2020 period, the average absolute change and the volatility of the fiscal stance is only slightly higher than that of the automatic stabilisers. This holds both in terms of relative size and regarding the combination of active fiscal policy and cyclical conditions. The stronger discretionary reactions of fiscal policy occurred in crisis years: 2003, 2009 and 2020 as far as a stimulus is concerned, and 2011 and 2012, Programme years, in case of a tightening. At times of cyclical improvement, active fiscal policy was more nuanced. In most years results obtained with the alternative approach are qualitatively similar, even if the magnitudes involved might differ somewhat.

The fiscal stance can be used as an input to measure the impact of discretionary policies on economic activity, i.e. the fiscal impulse. As the measurement of the fiscal impulse is model-dependent, in this article its computation relies on a selection from the literature of short-term fiscal multipliers by instrument. These, multiplied by the fiscal shocks obtained from the breakdown of the stance by instrument, allow to compute the short-term impulse on economic activity. The fiscal shocks can be broadened to encompass in addition the effect of automatic stabilisers. Many caveats obviously underlie this very stylised and simplified framework.

The atypical nature of the year 2020 provides an excellent case study for the framework described in this article. In a first step, the 2020 fiscal stance is quantified and disentangled on the basis of three approaches: top-down, alternative mixed and pure narrative. The latter corresponds to the actual magnitude of the measures adopted in response to the Covid-19 pandemic. Results show the pure narrative fiscal stance measure (3.1 per cent of GDP) in between the top-down (2.5 per cent of GDP) and alternative approach (3.7 per cent of GDP) estimates. For the main categories contributing to the stance - subsidies, other net expenditure and public consumption - results are very much aligned. In a second step, the short-term impulse on economic activity is computed. It shows that in the absence of active fiscal policy and the working of automatic stabilisers, GDP drop in 2020 could have reached around 11 per cent, instead of the observed 7.6 per cent decline.

The pandemic crisis and the ensuing strong response by governments created a natural experiment for the application of fiscal analysis tools. Moving forward, the measurement of the fiscal stance and fiscal impulse will most likely be adapted to circumstances and evolve, as it has been the case over the last decades. In the EU countries, interest in these measures will probably not subside in the coming years as, among others, a good understanding of the Next Generation EU fiscal effects and its impact on economic activity will be of utmost importance.

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Non-technical summary

July 2021

Unveiling the real contribution of final demand to GDP growth

Fátima Cardoso and António Rua

Typically, the contributions of the final demand components to real GDP growth are presented as the growth of that component weighted by its share in GDP, without taking into account that part of this expenditure has been met resorting to imports. This article proposes a methodology for calculating the contributions of final demand components (private consumption, public consumption, investment and exports) to real GDP growth adjusting for the corresponding imports. In this way, the contribution of each component is adjusted according to its import intensity, reflecting the import content heterogeneity across the final demand components. Thus, the contribution of each demand component net of imports corresponds to the domestic contribution and is obtained by removing from that demand aggregate the associated direct imports (final demand of goods and services imported directly) and indirect imports (imports used as intermediate consumption in the domestic production of goods and services).

The exact calculation of the import content, in volume terms, by demand component for each time period is not possible, as this would require granular base information (in particular, input-output matrices, including the import matrix), which is only available at current prices and for some years. This study presents and compares some possible alternatives to overcome those issues, suggesting the computation of contributions net of imports based on the estimation of annual import contents at constant prices.

Figure 1 presents for 2019 and 2020, based on preliminary data, the results of the proposed methodology vis-à-vis the traditional methodology for the Portuguese economy. The first column for each year presents the gross contributions of the demand components to GDP growth. As each final demand component includes imports, the corresponding contributions are overestimated. In order to obtain GDP growth, it is necessary to subtract from the sum of the contributions of these components the total contribution of imports. In the column on the right for each year, the contributions of the components are already net of imports and therefore they measure the actual domestic contribution (in terms of value added) of that component to GDP. This exercise shows that the contributions net of imports of each demand component to output growth are, in general, significantly different from those calculated in the traditional way. In particular, there is an overestimation of the real contribution of the final demand components when the corresponding import intensity is not taken into account.

In 2020, given the changes recorded, the quantitative difference between gross contributions and net contributions is quite substantial. In both cases, the negative

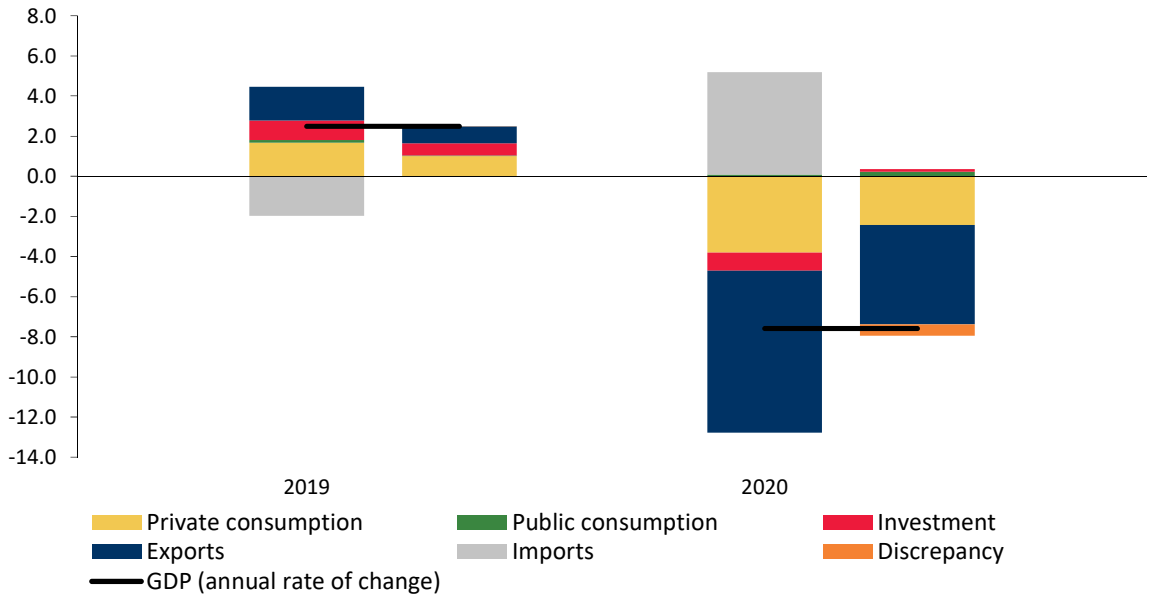

FIGURE 1: Decomposition of the real GDP growth rate

Note: For each year, the left-hand bar refers to gross contributions from each GDP component and the right-hand bar to the corresponding contributions net of imports (in percentage points).

contributions of private consumption and mainly exports are remarkable, but are clearly attenuated when the contributions net of imports are used. In the case of exports, which present the largest contribution to the 7.6 percent drop in GDP in 2020, the contribution is -8.1 pp without adjusting for imports and -5 pp in net terms. In the case of investment, if it is considered in gross terms, its contribution is negative, while if it is considered net of imports, the contribution is marginally positive. This difference reflects the different dynamics within investment, as the investment components that fell the most are those with higher import content (machinery and equipment and transport equipment) while investment in construction, which has a low import content, increased in 2020.

The fact that the sum of the contributions proposed here results approximately in the real rate of change of GDP allows to assess directly the contribution of each component and its relative importance as a driver of the evolution of economic activity. Additionally, the annual volume estimates obtained for the import content allow us to obtain an indicator of final demand weighted by import content that enhances the predictive ability of the models commonly used for macroeconomic projections.

Unveiling the real contribution of final demand to GDP growth

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July 2021

Abstract
This article focuses on the decomposition of real GDP growth in Portugal by components of final demand. Typically, the analysis of expenditure contributions to the real GDP growth does not take into account that part of the final demand is directly or indirectly satisfied by imports. This can lead to an overstatement of the real contribution of the components of final demand. Therefore, several methodological alternatives are considered aiming to remove the imports associated with each component of final demand from the corresponding contribution. In particular, a new approach is proposed that involves the annual estimation of the import content which in turn reflects expenditure structure and the respective evolution in volume over time, leading to more accurate results than the other alternatives considered. (JEL: C67, D57, F43)

1. Introduction

The analysis of the contributions of the different components of final demand to the evolution of GDP is important as it allows us to assess which expenditure items (private consumption, public consumption, investment or exports) are more determinant for the real change in GDP. The decomposition of real GDP growth can be presented in different ways, depending on the treatment given to imports that are associated with each demand component. In this article, we intend to present a procedure for estimating the contribution of each component of the final demand taking into account the corresponding import content.

In the more traditional economic analysis, the contributions of final demand components to real GDP growth presented are not adjusted from associated imports, which makes it difficult to interpret the real contribution of each component. Typically, imports are taken as an aggregate and its total amount is deducted, having associated a negative contribution to GDP. However, this approach overestimates the contribution of each component of domestic demand (private consumption, public consumption, investment) and exports, not allowing to evaluate or compare the real contribution of each component. In some cases, the contribution of imports is subtracted from that of

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exports, being presented in an aggregate named net external demand or net exports. This practice is commonly used, for example, in official publications by the OECD, the European Commission and the European Central Bank. In this case, the contribution of the external component to GDP appears underestimated, and the overestimation of the contribution of domestic demand remains. A possible reason for these forms of presentation is the lack of data on the import content of the final demand, mainly in real terms. Indeed, even in nominal terms this information is not available on a regular basis, given the detail required for its calculation. Some examples of analyzes and uses of import content in nominal terms can be seen in Bravo and Álvarez (2012) for Spain, Cardoso *et al.* (2013) for Portugal, Bussière *et al.* (2013) for a panel of OECD countries and Mikulic and Lovrincevic (2018) for the case of Croatia.

As an alternative to the so-called traditional presentations mentioned above, a few institutions present the contributions of demand components to real GDP growth net of the imports associated with each component of final demand. In this regard, it is worth mentioning the case of the central bank of the Netherlands, De Nederlandsche Bank, as well as the Portuguese case, in which both the Banco de Portugal in its analyzes and forecasts and Statistics Portugal, when publishing the annual national accounts, have been presenting demand contributions in this alternative form (see, for example, Banco de Portugal (2021) and Statistics Portugal (2020)). For a discussion of the differences between the so-called traditional contributions of expenditure components to the GDP growth and those adjusted for imports, see, for example, Kranendonk and Verbruggen (2008) for the United States and some European countries and Grech and Rapa (2019) for Malta. More recently, Andersson *et al.* (2021) emphasize the importance of using import intensity-adjusted final demand components for a better understanding of the impact of the COVID-19 pandemic on euro area economic growth.

Compiling these contributions requires the determination of imports (direct and indirect) associated with each aggregate of demand, which in turn is only possible with the use of input-output matrices of national accounts and the respective import matrices. Since these matrices are generally not available on a regular basis (in many cases only on a five-year basis), decomposing GDP growth over time entails estimating or making assumptions for these import contents. Typically, import contents calculated for a given year are used, namely the most recent year for which this information is available.

Additionally, this information is compiled only at current prices, meaning that import contents at constant prices for a given year are not available. In fact, effectively obtaining contributions net of imports to the real GDP change involves estimating or making assumptions for the evolution of import contents in volume. This article presents some alternative strategies for calculating the annual import contents and shows the impact of the assumptions on the contributions to real GDP growth. Among the procedures considered, the approach with the best results is based on the methodology used by Cardoso and Rua (2019) to obtain the import contents at constant prices, which are used to calculate the contributions net of imports of the different components of final demand to real GDP growth.

The article is organized as follows. In section 2 the different alternatives considered for import contents are discussed and in section 3 the respective total values for the

final demand weighted by import contents are compared with the observed imports, as a measure of the error of each approach. Section 4 assesses the decomposition of real GDP growth by final demand components in light of the different alternatives discussed previously. This also makes it possible to assess the reliability of the different approaches based on the discrepancy between the sum of the contributions obtained for the demand components and the actual GDP growth. Section 5 illustrates the use of final demand weighted by import contents resulting from the selected approach in estimating a function for imports. Finally, section 6 concludes.

2. Import content of final demand components

This section briefly describes the methodology for estimating the import contents of final demand and its components, which will be used both to obtain the net contributions of the demand components to the real change in GDP and for the volume indicator of final demand weighted by import content presented in the following sections. The objective is to estimate for each year the import content since 1999 implicit in the various components of the final demand.

The available import contents are based on the input-output symmetric matrices system, which are only available at current prices. In the period under study, the symmetric input-output matrices are available for the following years: 1999, 2005, 2008, 2013, 2015 and 2017. These matrices present information on intermediate consumption and final uses by product in the economic territory, coming from both imports and domestic production. Given the different nomenclatures of national accounts on the basis of the various matrices used, these matrices were aggregated considering the highest possible detail by product in order to ensure comparability over time, resulting in 49 products/branches of activity. From this information disaggregated by product, it is possible to calculate the import content per unit of final demand by product and for each component of final demand (see Cardoso and Rua (2019) for a detailed methodological explanation). Considering the structure of the respective expenditure, it is possible to calculate the import content implicit in the various components of final demand.[1] It should be noted that the non-imported content corresponds to the impact on GDP.

Since there is no official import content at constant prices, the aim is to obtain an annual estimate of these import contents by taking advantage of the more detailed information available for each year. Based on that, it is possible to calculate the import content implicit in other aggregates, for example, for the breakdown of expenditure usually published in quarterly national accounts. For this purpose, three alternatives are considered.

1. It should be noted that the import contents are from the perspective of the economic territory, reflecting the fact that the information by product contained in the input-output matrices is presented from the perspective of the territory. Therefore, and in the absence of additional information, it is implicitly assumed that the import contents from residents correspond to those determined for the territory.

The first alternative considered is simply to use, for the entire period under analysis, the import contents (calculated at current prices) for the most recent year available, which currently corresponds to 2017. At the level of detail we need to calculate the contributions (see section 3) the import contents are thus taken as fixed over time and those implicit in the various final demand aggregates result only from changes in the corresponding expenditure composition.

Alternatively, we used all the information available over time, from annual national accounts and from input-output matrices and respective import contents (available only for the above mentioned years) to obtain an annual series of import contents calculated at current prices since 1999. Conceptually, the import content for any desired aggregate results from the weighting of the import content per unit of final demand of each product by the expenditure structure per product of that aggregate. In the years mentioned above where there is information about the input-output matrices, this calculation is immediate. For the remaining years, the expenditure structure is available with the corresponding detail in the annual national accounts, but for the import contents by product we need to make assumptions. Therefore, for these years, a linear interpolation between the closest years available for import contents was considered for the import contents at the elementary level (in particular, 49 products for each demand component). For example, the import contents by product for 2006 and 2007 result from a linear interpolation between the 2005 and 2008 values and were weighted by the 2006 and 2007 annual national accounts structure (at current prices) of each type of expenditure to obtain the final demand aggregates. Since the last year for which there are import contents is 2017, the import content, at the most elementary level, for 2018 was obtained by linearly extrapolation based on the trend observed in the most recent period.[2]

Since the focus of the following analysis is the evolution in real terms, a third alternative is considered, which corresponds to the estimation of annual import contents at constant prices. The methodology used to obtain the import contents at constant prices is identical to the one used to calculate the import contents at current prices, although the basic information, namely that of the input-output matrices (available at current prices) is previously deflated and converted to constant prices of the reference year. For this purpose, detailed information on national accounts deflators was used, as proposed in Cardoso and Rua (2019). For the remaining years, the interpolation of import contents at the elementary level was carried out, similarly to what was done at current prices, and taking into account the annual structure of expenditure by product in volume terms. The reference year for constant prices was 2016, as it is the base year and also the reference year for the chained linked volume series of the current national accounts. Thus, we calculate the import contents annually by product and by component of final demand from 1999 to 2018 at constant 2016 prices.

2. In particular, it was assumed for 2018 the average change observed in the previous decade, from 2008 to 2017.

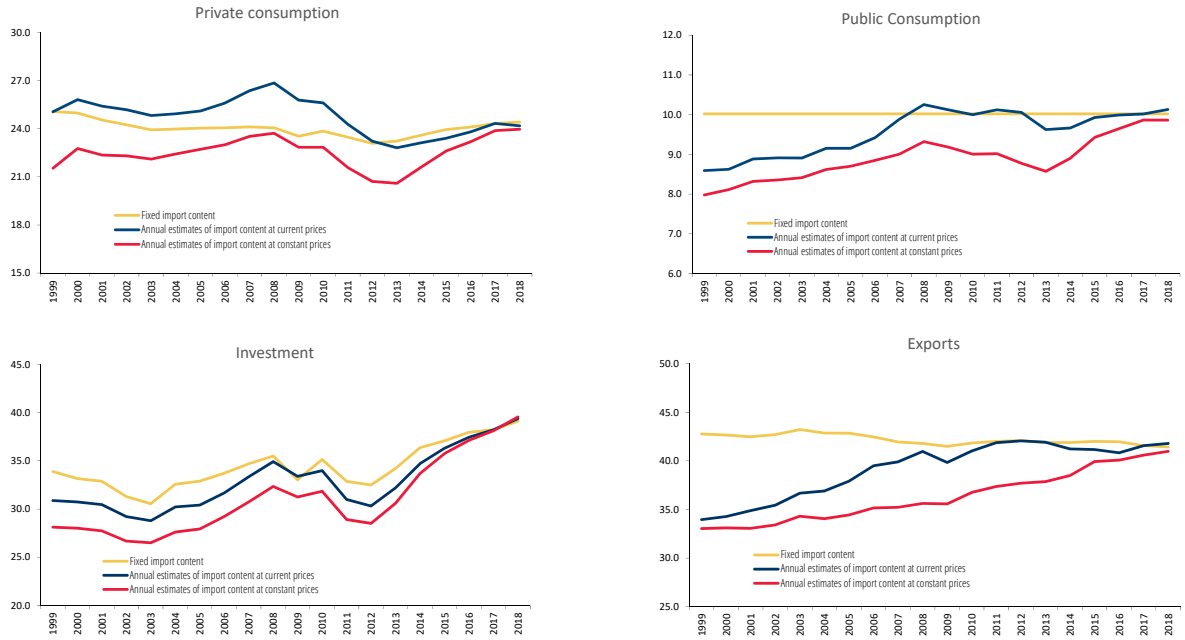

FIGURE 1: Import content of the main components of final demand (in percentage)

In Figure 1, the resulting import content is presented for the main aggregates of final demand. Analyzing the results of the various alternatives, it is possible to see, as discussed in detail by Cardoso and Rua (2019), an increase in the import content in volume, namely in investment and exports and, to a lesser extent, in private consumption. This growth profile is only partially captured with the import content compiled in nominal terms.

An initial assessment of these alternatives can be made by comparing the resulting import content for the final demand with the one implicit in the most recent version of the national accounts (see Figure 2). In fact, based on the latter information, it is possible to assess the import content for the final demand as a whole (but not for its decomposition by components or by products) by simply computing the ratio between imports and final demand in volume.

Figure 2 shows that the evolution of the total import content is significantly conditioned by the approach considered in its calculation. In the case where import content is considered fixed, it is assumed that the import intensity of both intermediate consumption and final uses at the elementary level did not vary over time. However, import content, although relatively stable, varies over time, which is not captured with this approach. In turn, using annual estimates obtained at current prices allows for a closer approximation to the intended result. However, the evolution in volume showed an ascending profile over the period, more marked than that observed at current prices as referred to in Cardoso and Rua (2019) and as corroborated by Figure 2. This difference essentially reflects the evolution of relative prices, that is, the increase in volume of import content is somewhat mitigated in nominal terms, by the fact that import prices on average have grown less than those of final demand in the period under analysis.

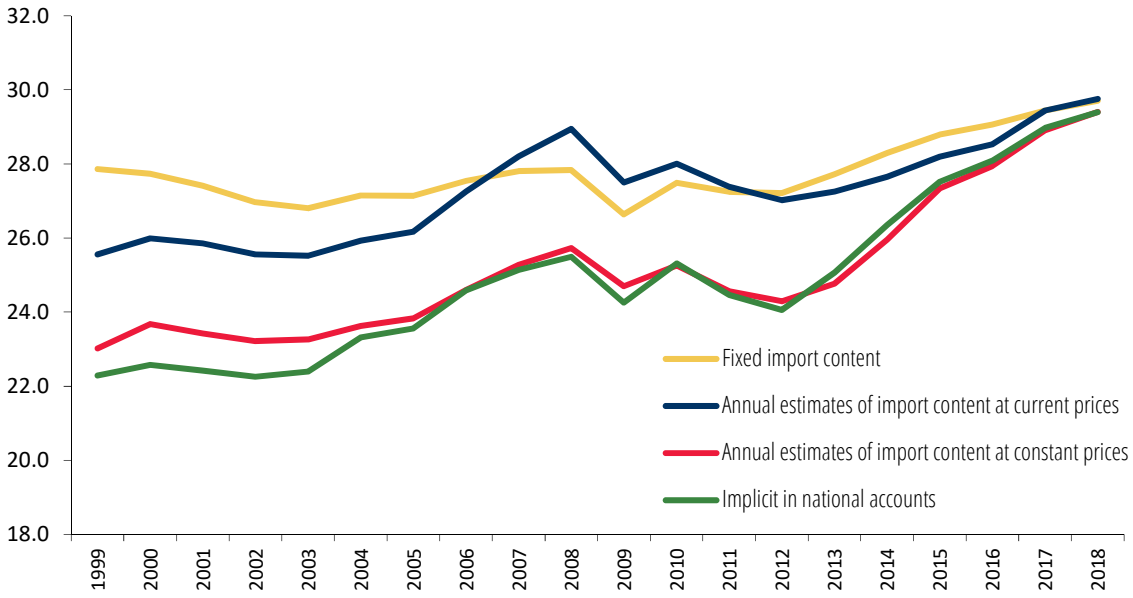

FIGURE 2: Import content of final demand in volume.

Note: Import content per unit of total final demand (in percentage), resulting from the aggregation of the demand components in volume with the import content of each component obtained according to each approach.

In fact, the figure shows that resorting to the import content estimated at constant prices is what allows for a closer approximation (both in terms of level and in terms of evolution) to the import content implicit in total final demand in volume. In the earlier period, especially from 1999 to 2005, the differences are a little larger, which must be related, on the one hand, to the longer time interval in which input-output matrices were not compiled (there are matrices in 1999 and 2005 but not between these two years) and, on the other hand, to the revisions to the series that have meanwhile been incorporated in the national accounts but were not followed by an update of the corresponding input-output matrices. In the following sections, we compare the results arising from the use of these alternatives as an approximation to the observed imports (weighted final demand indicators) and for computing the contributions (net of imports) of the different components of final demand to the real GDP rate of change.

3. Weighted final demand and imports

Based on the import contents discussed in the previous section, it is possible to estimate a proxy for imports, called the final demand weighted by import contents, and compare with the actual observed imports. This indicator results from the weighting of the different components of demand by the respective import content, the total being obtained by aggregation. Multiplying the import contents previously obtained for each component of final demand by the respective expenditure level of each component (in volume), we obtain the imports in volume necessary to satisfy that component of final demand. By aggregating all these imports, it is possible to compare the total with

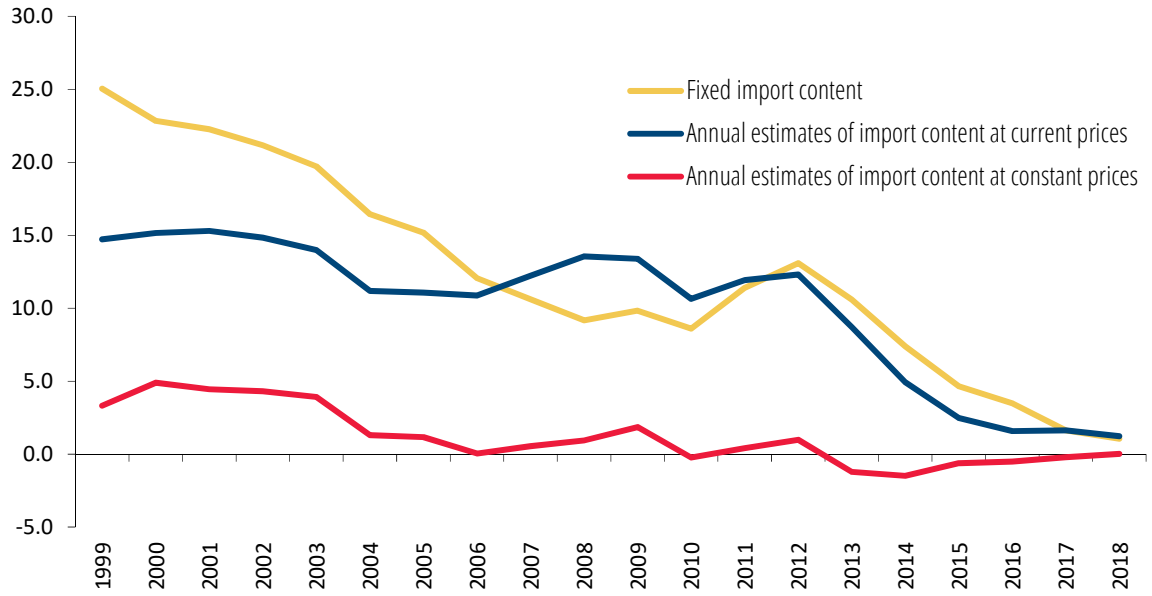

FIGURE 3: Discrepancy between weighted final demand and imports (in percentage of imports)

actually observed imports and assess the respective discrepancy. It should be noted that the results depend on the level of detail considered for the final demand, being the closer the higher the disaggregation used.

This exercise was done for the different import content alternatives defined above. With this aim, the most recent version of the national accounts was used, considering the level of disaggregation of the demand components currently released by Statistics Portugal in its quarterly publication. In particular, private consumption is broken down into durable goods, food and beverages and other non-durable consumption, GFCF is divided into construction, transport equipment, machinery and equipment and other GFCF and exports are separated into goods and services.

	Level (in percentage of imports)		Annual rate of change (in percentage points)	
	Average (abs)	Average	Average (abs)	Average
Fixed import content	12.3	12.3	1.7	-1.2
Annual estimates of import content at current prices	10.1	10.1	1.2	-0.7
Annual estimates of import content at constant prices	1.6	1.2	0.8	-0.2

TABLE 1. Discrepancy between weighted final demand and imports

Note: The average (abs) corresponds to the average of the absolute values of the discrepancies.

Figure 3 shows the discrepancies, as a percentage of imports, for the three alternatives considered for import content. As time goes back, the discrepancy clearly tends to increase, as one would expect. In fact, revisions to the national accounts have taken place over time, either through the incorporation of new basic information or due to methodological changes, which were not reflected in the input-output matrices (including the import matrices) previously published. It should be noted that this increase in discrepancy is very significant in the case of the use of import content at current prices. The use of annual estimates between the years for which it is actually

possible to calculate import contents makes it possible to mitigate the discrepancy. However, it is the use of annual estimates of import contents at constant prices that allows for the smallest discrepancy over the entire period (see Table 1). This approach allows us to obtain an average discrepancy of 1.2 percent, which compares with 10.1 and 12.3 percent, respectively, in the case of import contents calculated at current prices, depending on whether or not there are annual estimates. The findings are very similar considering the average of the discrepancies in absolute terms. Furthermore, the use of calculation at constant prices also presents a smaller discrepancy when evaluated in terms of the annual rate of change of imports, recording an average discrepancy of -0.2 p.p. and 0.8 p.p. in absolute terms. Therefore, both the average discrepancy and the average absolute discrepancy are clearly lower than that observed for any of the alternatives in which import contents obtained at current prices are used.

4. Decomposition of real GDP growth

Once the imports necessary to satisfy each of the final demand components have been determined, it is possible to determine the contribution, net of imports, of each demand component to real GDP growth. This contribution seeks to assess the extent to which each of the final demand components effectively contributes to the growth of the national economy once the imports generated directly or indirectly by each of these expenditure components are adjusted. The contribution of each component to GDP growth reflects the change in that aggregate weighted by its non-imported content, which corresponds to its domestic content.

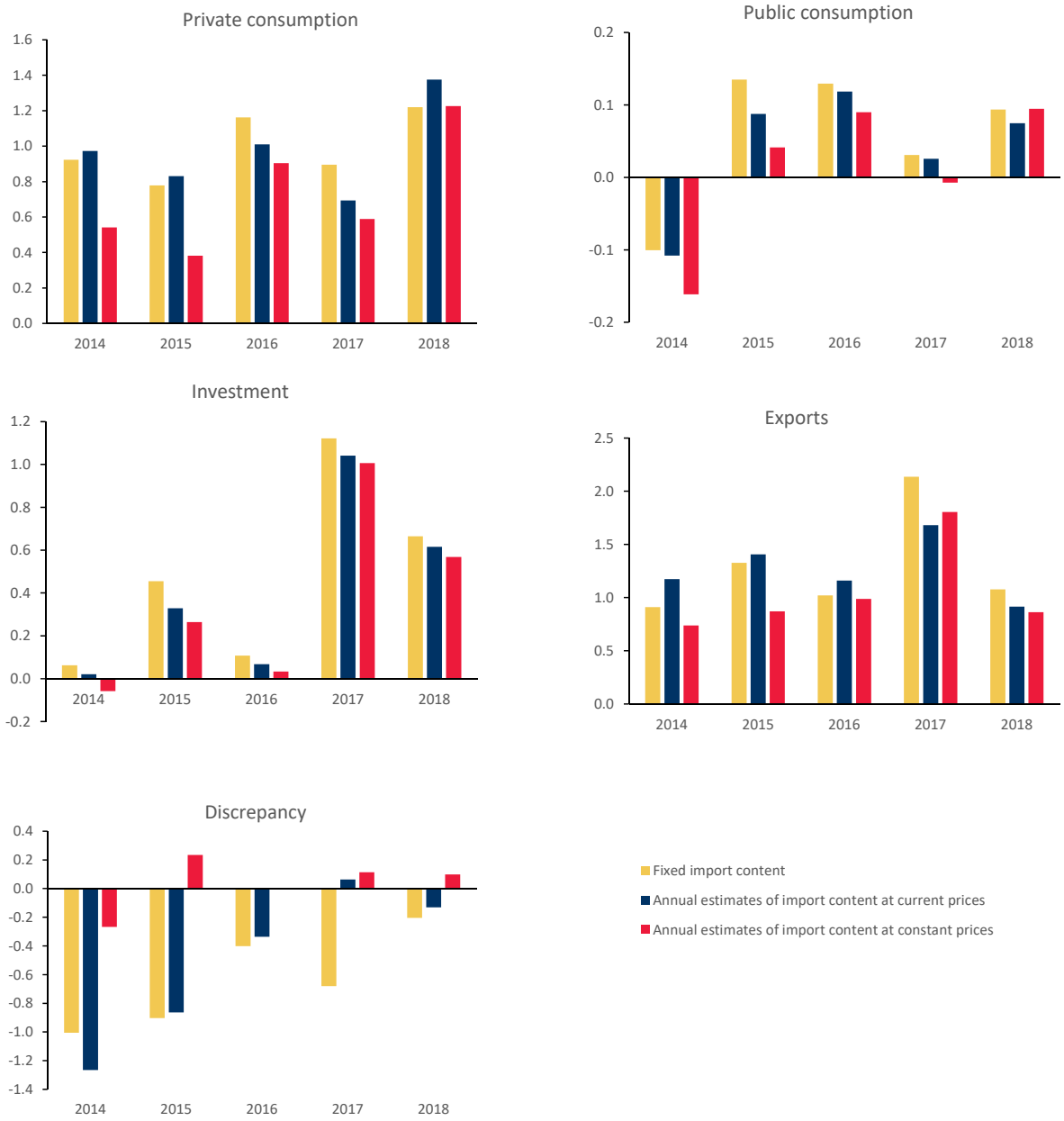

FIGURE 4: Contributions to the real GDP rate of change (in percentage points)

Note: The discrepancy shown in the last figure corresponds to the difference between the real rate of change of GDP and the sum of the contributions (net of imports) of the different components of final demand presented in the remaining figures.

The net contributions of the main components of final demand to real GDP growth were computed considering either the import contents at current prices, fixed in a year or with annual estimates, or the annual estimates of the import contents at constant prices. Thus, a comparative analysis of the real GDP breakdown by components is carried out, conditional on the alternative used for import contents.

It can be seen that the assumption made for import contents has a substantial impact on the result obtained for each component of the final demand. In the case of private

consumption, the use of annual estimates for the case of import content at current prices would lead to higher contributions in the years 2014, 2015 and 2018 and lower in 2016 and 2017 compared to the case of fixed import contents. In turn, the use of import contents at constant prices would lead to a lower contribution from that component, particularly in 2014 and 2015. For public consumption, the differences are much smaller, also reflecting the reduced import content that this item tends to present. In the case of investment, the contribution calculated with import contents at constant prices is always lower than that obtained with import contents at current prices with annual estimates, which in turn is lower than that obtained from fixed import content. Regarding exports, the respective contribution calculated with annual import content at current prices is higher than that obtained with fixed import content in 2014, 2015 and 2016, but lower in 2017 and 2018. In turn, the contribution of exports using import content at prices constants is lower in most years.

Calculating the sum of the aforementioned net contributions of the different components of final demand, it is possible to assess the difference in relation to the real growth actually observed for GDP. Figure 4 also presents the discrepancies obtained for the different alternatives. It should be noted that any of the alternatives based on import content at current prices (with fixed coefficients or with an annual estimate) has an underlying significant discrepancy. On the contrary, the use of import content at constant prices generates a relatively small discrepancy. It should be noted that in all alternatives, the discrepancies also reflect, in addition to the need to estimate import content, small differences resulting from the non-additivity of chain-linked volume data of national accounts, that is, the fact that the sum of the expenditure components do not exactly match GDP.[3]

In accumulated terms, in the period from 2013 to 2018, the importance of using import content at constant prices becomes even more evident (see Figure 5). In fact, with import contents at constant prices, the resulting discrepancy is very small (0.2 p.p.) when compared to the use of import content at current prices, whose discrepancy amounts to -2.6 p.p. and -3.3 p.p. with annual estimate or fixed in 2017, respectively. From the above, the approach based on import content at constant prices is therefore the most accurate, as in this case the sum of the contributions is much closer to the real evolution of GDP.

	In percentage points	
	Average (abs)	Average
Fixed import content	0.5	-0.3
Annual estimates of import content at current prices	0.4	-0.2
Annual estimates of import content at constant prices	0.3	0.0

TABLE 2. Discrepancy between the sum of contributions and the real rate of change of GDP (from 2000 to 2018)

Note: The average (abs) corresponds to the average of the absolute value of the discrepancies.

3. Note that the remaining discrepancy could be eliminated, for example, by proportionally distributing the imports differential over the final demand components.

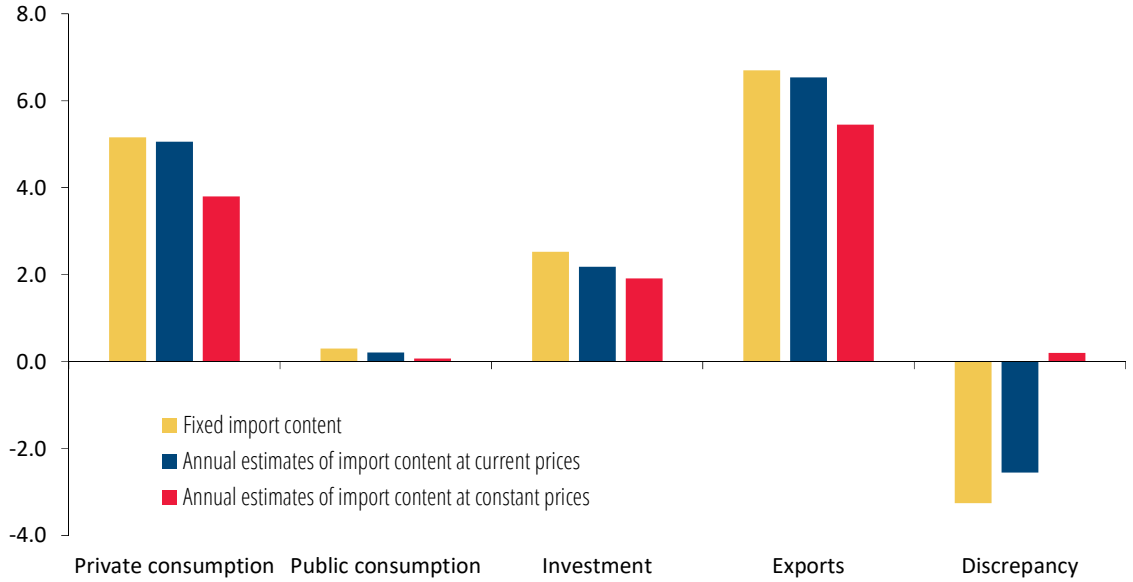

FIGURE 5: Contribution to the accumulated real change in GDP, in percentage points (from 2013 to 2018)

Table 2 presents some summary statistics about the discrepancies between the sum of the contributions of the final demand components and the real rate of change of GDP for the period as a whole. Similar to the previous results, it is the approach based on annual import content at constant prices that generates a smaller discrepancy for the decomposition of real GDP change.

In order to illustrate the relevance of considering contributions net of imports, in Figure 6, the net contributions obtained with import contents at constant prices are compared with the contributions usually used to break down real GDP growth by final demand components.[4] For each year, two vertical columns are presented whose sum corresponds to the rate of change of GDP for that year. The first column represents the traditional contributions (which we call gross contributions) while the second corresponds to the contributions of final demand components net of the respective imports. It can be seen that the non-adjustment of the contributions from imports leads to an overestimation of the real contribution of each component of final demand to real GDP growth. This difference in assessment depends on the magnitude of the import content but also on the weight of that component. In fact, the most significant quantitative differences are registered in private consumption and exports.

For the most recent years, namely 2019 and 2020, it is not possible to proceed as described in section 2 given the absence of detailed annual national accounts. Therefore, the available breakdown published in the scope of quarterly national accounts (and mentioned in section 2) was considered and the variation observed for the import content of final demand as a whole was assumed for the evolution of the import content

4. The Appendix presents the import contents of the final demand components at constant 2016 prices, implicit in the calculation of the contributions net of imports.

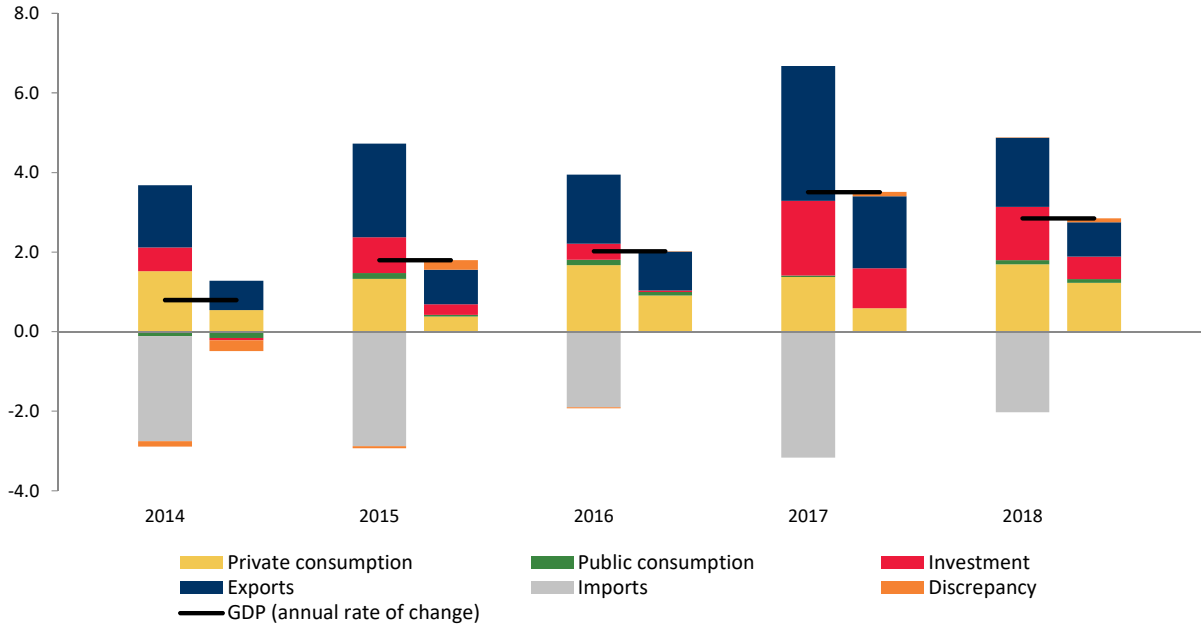

FIGURE 6: Contributions to the real GDP growth rate

For each year, the left-hand bar refers to the gross contributions of each component to GDP and the right-hand bar to the corresponding net contributions (percentage points).

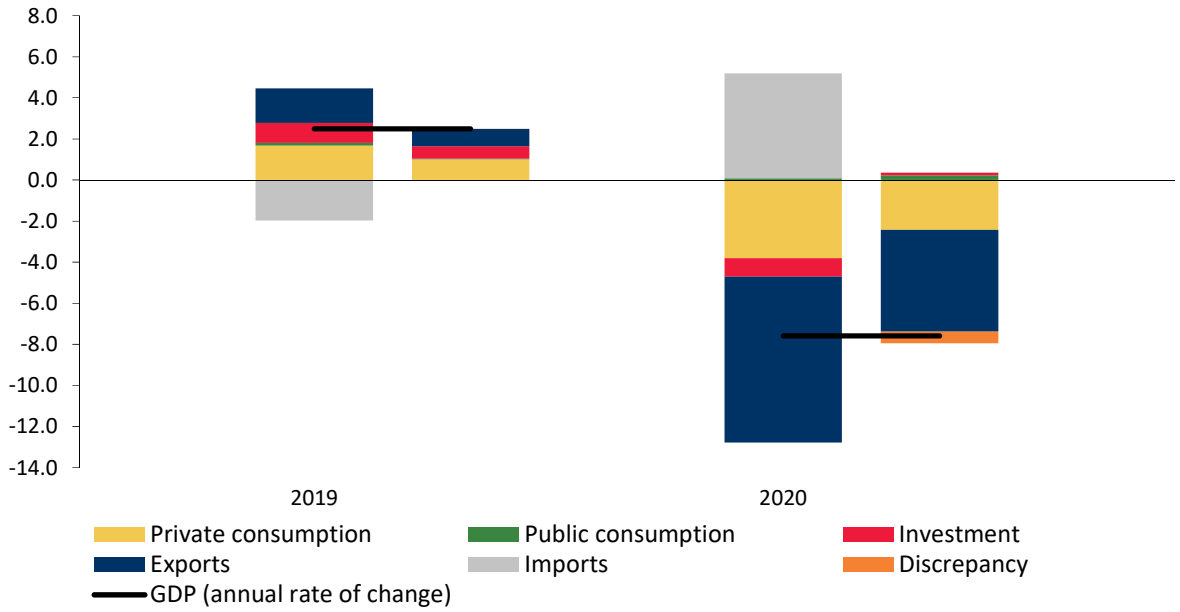

FIGURE 7: Contributions to the real GDP growth rate in 2019 and 2020

For each year, the left-hand bar refers to the gross contributions of each component to GDP and the right-hand bar to the corresponding net contributions (percentage points).

of each component. Figure 7 shows the resulting contributions to the GDP rate of change in 2019 and 2020. Note the very substantial quantitative difference, in particular in 2020, between gross contributions and contributions net from imports. In 2019, the component that registered the greatest positive contribution was private consumption, followed by exports and then investment. In 2020, it is worth mentioning the subtantially negative contributions of private consumption and mainly exports, which are clearly mitigated when the net contributions are used.

5. Estimation of the imports function

In addition to the contribution analysis carried out previously, the import contents also allow the calculation of the weighted final demand, an indicator typically used in macroeconometric modeling of the imports evolution (see, for example, Laxton *et al.* (1998), Herzberg *et al.* (2002), Bussière *et al.* (2013) and Cardoso *et al.* (2013)). Using quarterly national accounts data for the demand components and assuming for all quarters of a given year the import contents corresponding to the respective year (calculated at constant prices as described in section 2), we calculated the indicator of quarterly final demand weighted by import content. Figure 8 suggests that this indicator is a good proxy for the evolution of imports, in particular when compared to unweighted final demand.

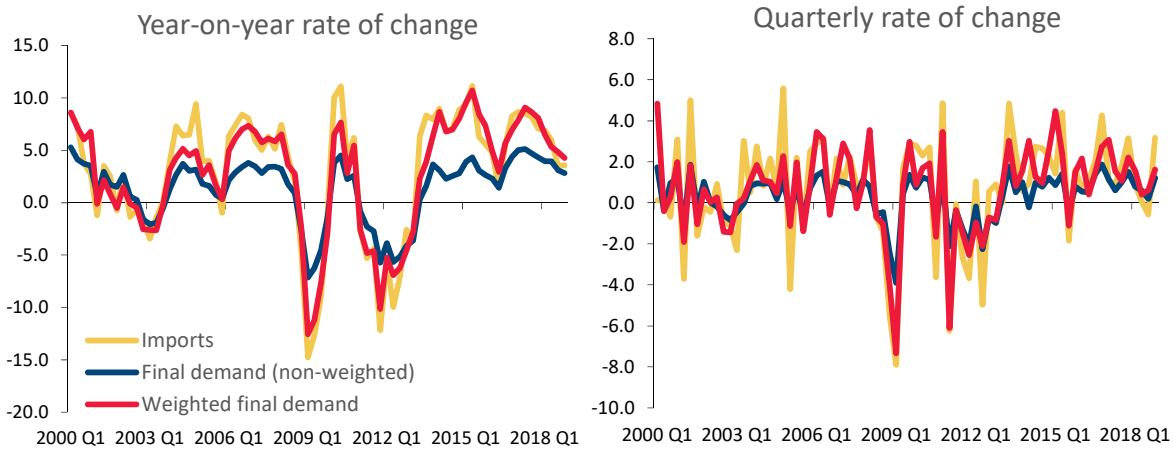

FIGURE 8: Imports and weighted final demand, in volume (in percentage)

Based on this proxy, a model for volume imports was estimated for the last two decades. As usual in the literature, we considered a macroeconometric model of the error-correction mechanism type. The estimated model for the period between the first quarter of 1999 and the fourth quarter of 2018 was as follows: [5]

5. The years 2019 and 2020 were excluded from the sample period given their preliminary nature as discussed in the previous section.

$$\Delta \ln M_t = \underset{(-1.76)}{-0.003} + \underset{(14.6)}{1.11}\,\Delta \ln FD_t^* \underset{(-3.71)}{-0.27}\left(\ln M_{t-1} - \ln FD_{t-1}^*\right)$$

$$\widehat{\sigma} = 0.014 \qquad R^2 = 0.74 \qquad F\,(2, 76) = 106.7\,[0.000]$$

where M are the imports of goods and services, at constant prices, and FD^* corresponds to the final demand weighted by the annual import contents at constant prices. We report the usual t-ratios for the estimated coefficients in parentheses, the standard deviation of the error, the R^2 and the F statistic of global adherence of the model with the respective *p-value*.

In what regards the specified model, the following should be noted. As expected, the restriction commonly imposed in the literature of a unitary elasticity in the long run between imports and weighted final demand is not rejected statistically, and is therefore assumed in the estimation of the model. Regarding the coefficient associated with short-term dynamics, the value estimated is only slightly above 1. In fact, and contrary to what has been found empirically in previous works, a unitary elasticity in the short term is not rejected.[6] Naturally, an exact unitary coefficient is not obtained in the short run, given the lack of import matrices for all time periods (and at constant prices) so that measurement errors persist in practice. In other words, with the aforementioned measure of final demand weighted by import contents at constant prices, an approximately unitary elasticity is obtained, both in the short and in the long run. Note that, if there were no measurement errors in the calculation of import contents, this elasticity, by construction, would be exactly unitary.

In addition, the statistical significance of an import price competitiveness indicator was also assessed, defined as the ratio between the deflator of imports of goods and services and the deflator of GDP (see, for example, Fagan and Mestre (2005)). However, this additional regressor was not relevant in the estimated model. This result reflects the fact that the impact of changes in relative prices is already largely reflected in the evolution of import content at constant prices and in the composition of weighted final demand, therefore, the inclusion of that regressor is not necessary.

These results reinforce the validity of this approach as a way to obtain an informative indicator for the evolution of imports.

6. Concluding remarks

Within the scope of economic analysis, it is usual to assess the importance of the different components of final demand for the real evolution of GDP. This allows identifying, for example, whether real growth is sustained by the external component, namely exports, or whether it is the components of domestic demand, such as private consumption or investment, that are being more decisive for the activity developments.

6. For a discussion of the elasticity of imports to final demand, weighted or unweighted, see, for example, Bussière *et al.* (2013).

However, typically, the analysis of contributions to GDP growth does not take into account that part of the final demand is satisfied directly or indirectly by imports, with this proportion being very heterogeneous across demand components. This fact, in general, leads to a significant overstatement of the real contribution of each expenditure item to the GDP rate of change. Therefore, it is crucial to adjust for the effect of imports associated with each component of final demand in order to allow a more accurate assessment of its real contribution.

In this article, several alternatives were considered regarding the estimation of import content on an annual basis in order to obtain the net contribution of imports of each component of final demand. Among the alternatives considered, the one based on the estimation of annual import contents at constant prices was the most informative. This approach makes it possible to get closer to actually observed imports and generates a relatively small discrepancy in terms of contributions. It is therefore important to point out that, for the purpose of decomposing the real change in GDP, it is crucial to consider the evolution of import contents in volume terms.

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Appendix

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Private consumption	21.5	22.8	22.4	22.3	22.1	22.4	22.7	23.0	23.5	23.7	22.8
Durable goods	56.2	55.8	55.7	55.6	55.5	55.3	55.2	55.8	56.5	57.0	56.5
Non-durable goods and services	16.9	18.4	18.4	18.7	18.9	19.2	19.4	19.7	20.1	20.3	20.0
Food and beverage	30.3	31.4	30.9	31.3	31.7	32.1	32.4	33.5	34.4	35.5	35.0
Other non-durable goods and services	13.7	15.4	15.5	15.8	15.9	16.2	16.4	16.5	16.8	16.8	16.5
Public consumption	8.0	8.1	8.3	8.4	8.4	8.6	8.7	8.8	9.0	9.3	9.2
GFCF	27.1	27.6	27.2	26.5	26.8	27.4	27.8	29.1	30.6	32.3	31.3
Transport equipment	64.3	64.0	64.6	65.1	65.3	66.6	67.7	69.7	73.3	76.9	78.6
Other machinery and equipment	66.4	66.9	67.2	67.4	67.3	67.4	67.4	68.1	67.1	67.7	68.4
Construction	15.2	15.4	15.5	15.5	15.5	15.7	15.6	16.0	16.3	16.7	16.4
Other	13.7	16.6	16.4	16.1	15.2	14.9	13.2	14.7	18.5	21.3	20.6
Exports	33.0	33.1	33.1	33.4	34.3	34.1	34.4	35.2	35.2	35.6	35.6
Goods	40.1	40.0	39.9	40.2	40.6	40.6	40.8	42.0	42.3	42.8	43.1
Services	13.8	14.9	15.3	15.2	15.8	16.1	16.8	17.7	18.7	19.2	19.2
Final demand	23.0	23.7	23.4	23.2	23.3	23.6	23.8	24.6	25.3	25.7	24.7

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Private consumption	22.8	21.6	20.7	20.6	21.6	22.6	23.2	23.9	24.0	24.4	23.6
Durable goods	56.0	55.1	54.4	53.5	54.1	54.7	55.7	56.8	56.6	57.0	56.0
Non-durable goods and services	19.7	18.9	18.5	18.4	19.0	19.7	20.1	20.5	20.5	20.9	20.3
Food and beverage	34.4	34.0	33.5	32.8	33.3	33.7	33.8	34.0	33.8	34.3	33.3
Other non-durable goods and services	16.3	15.3	14.9	14.7	15.4	16.2	16.6	17.1	17.1	17.6	16.6
Public consumption	9.0	9.0	8.8	8.6	8.9	9.4	9.6	9.9	9.9	10.3	9.3
GFCF	31.6	28.7	28.4	30.3	33.2	35.2	36.6	37.4	38.4	38.4	35.3
Transport equipment	73.9	72.0	71.0	74.1	71.3	72.9	72.6	74.4	75.9	76.3	75.3
Other machinery and equipment	69.3	69.9	70.8	71.9	72.7	73.4	73.2	73.2	73.8	74.3	73.2
Construction	15.9	15.5	14.9	14.2	15.7	17.1	18.1	19.3	19.8	20.3	19.3
Other	20.2	14.9	14.9	14.9	16.9	18.5	18.3	18.0	18.2	18.6	17.6
Exports	36.8	37.4	37.7	37.9	38.5	39.9	40.1	40.6	41.0	41.3	42.0
Goods	44.5	45.4	45.9	46.9	46.8	48.0	48.2	49.0	49.7	50.2	49.2
Services	19.0	18.5	17.9	17.0	19.2	20.8	21.0	22.0	22.2	22.6	21.6
Final demand	25.3	24.6	24.3	24.8	26.0	27.3	27.9	28.9	29.4	29.9	28.4

TABLE A.1. Estimates of import contents of GDP components at 2016 constant prices (in percentage).

Note: For the years 2019 and 2020, the available information has a lower level of detail than for previous years (as described in section 4), so the respective import contents should be read with additional caution.

Non-technical summary

July 2021

Heterogeneity in loan pricing: the role of bank capital

Diana Bonfim, Luísa Farinha, Leonor Queiró

The risk of the borrower and the loan attributes, such as amount, maturity and collateral, should essentially determine the price of a loan. However, interest rates applied by different banks on loans with similar characteristics, granted to similar borrowers, often exhibit considerable dispersion. What else can explain differences in loan pricing across banks?

To better understand this, we use detailed loan level data since mid-2012, merged with firm-level risk indicators and bank-level detailed financial data. The analysis

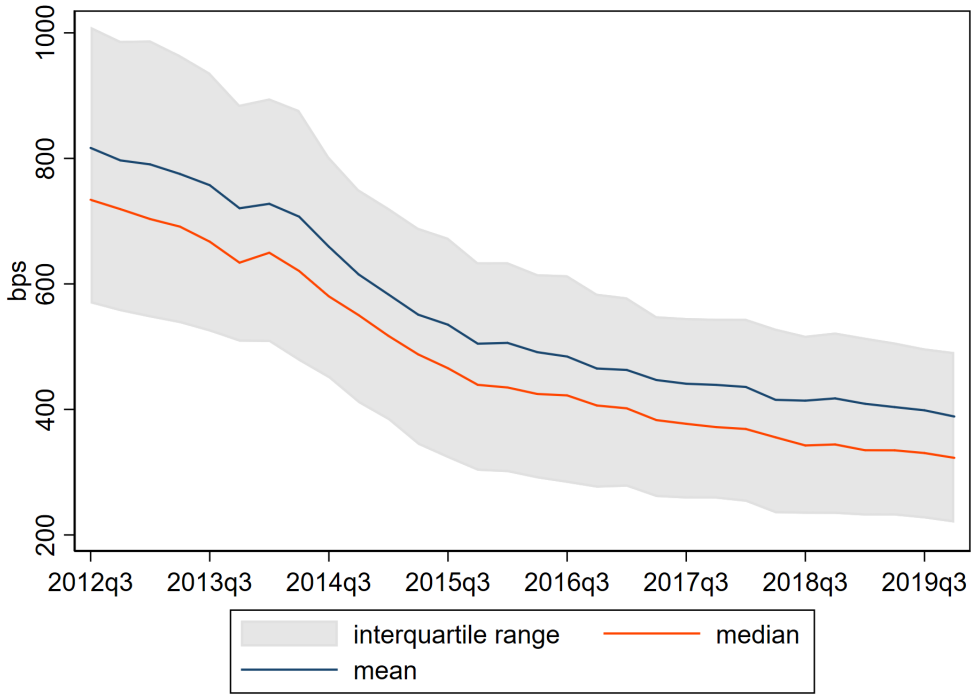

FIGURE 1: Dispersion in loan spreads

Source: Banco de Portugal and authors' estimates. Notes: The figure depicts the simple average of loan spreads, for all loans granted to firms in each quarter. The spread on a loan is the difference between the interest rate charged on the loan and the 3-month Euribor. The figure depicts the mean and median of the loan spread distribution, as well as the interquartile range. The sample begins in the 3rd quarter of 2012 and ends in the last quarter of 2019.

focuses on the differential between the spread that a bank charges to a given borrower and the average spread charged by all banks lending to the same borrower.

Focusing on firms that simultaneously borrow from several banks, we find a positive relationship between bank capital and the pricing of loans. In our preferred specification, which includes both bank and firm-quarter fixed effects, we regress spread differentials vis à vis the average spread charged by all banks lending to the same borrower on the banks' capital ratios. In this specification we rely on multiple levels of fixed effects, which mitigate endogeneity issues.

The positive relation between bank capital and spreads only holds for firms with a rating better than the median, for firms in all size classes except the very small ones, and those with more than two relationships. This implies that bank capital does not seem to exert a screening incentive in the case of loans to riskier, smaller or firms with only two relationships.

Our main result holds mainly in the post-crisis period. Until 2014, when banks were still recovering from the severe consequences of the euro area sovereign debt crisis, an increase in their capital ratios was associated with lower interest rates, for the same level of risk. From 2016 onwards, the relationship reversed.

Overall, our results show that bank capital plays an important role in shaping the pricing of loans. Banks that are better capitalized compared to their historical average seem to be more conservative in loan pricing, offering higher loan spreads than the other banks lending to the same firm.

Heterogeneity in loan pricing: the role of bank capital

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Abstract
In this article, we examine the role of bank characteristics in shaping loan pricing decisions. We evaluate the pricing differentials across banks lending to the same firm and find that lower levels of bank capital are associated with lower interest rates. Banks that are better capitalized compared to their historical average seem to be more conservative in loan pricing, offering higher loan spreads than the other banks lending to the same firm. However, bank capital does not seem to exert a screening incentive in the case of loans to riskier, smaller firms or firms with only two relationships. The results are stronger in the aftermath of the euro area sovereign debt crisis. (JEL: G21, G28, G32)

1. Introduction

Loan pricing should reflect the default risk of a loan. The characteristics of the borrower and loan attributes crucially influence the risk that a borrower might fail to repay the loan. However, interest rates applied by different banks on loans with similar characteristics to similar borrowers often exhibit a substantial dispersion. What else can explain differences in loan pricing across banks? The knowledge about the determinants of loan pricing is relevant in understanding the relation between bank behaviour and the economy and can help policy making in shaping bank regulation and supervision.

The goal of this article is to contribute to the understanding of the dispersion of loan spreads across banks. We use detailed loan level data that we can merge with firm-level indicators of risk and bank-level financial data to examine the role of bank characteristics in loan pricing decisions. This allows us to understand how different banks price risk. Directly comparing interest rates or loan spreads across banks is not enough, as banks may lend to borrowers with different characteristics. A bank may offer lower interest rates, on average, because it caters to a less risky pool of corporate borrowers. To make

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sure we are truly capturing differences across banks, we focus on firms that borrow from more than one bank in the same quarter. By comparing loan spreads offered by different banks to the same firm, we are evaluating how each bank prices the same level of risk.

The main focus of our analysis is the effect of bank capital on spread differentials across banks. Financial intermediation theories suggest that bank capital strengthens the screening and monitoring incentives of banks. Holmstrom and Tirole (1997) and Dell' Ariccia and Marquez (2006) argue that more capitalised banks screen and monitor more intensively their borrowers. Other papers document that due to agency costs, risk-shifting incentives arise for undercapitalized banks (Acharya and Steffen, 2015, Drechsler et al., 2016, Crosignani, 2017, Bonaccorsi and Kashyap, 2017). The bank-fragility theory of Diamond and Rajan (2000) posits that, relative to high-capital banks, low-capital banks should charge higher rates to borrowers that have low cash flows. Santos and Winton (2019) examine the effect of bank characteristics on loan spreads and find a significant negative relationship between bank capital and loan spreads. This relationship can change through the cycle, as shown by Gambacorta and Mistrulli (2014), who find that the effects of the financial crisis on interest rate spreads were lower for borrowers of well-capitalized banks.

Even though the literature emphasizes the role of bank capital in loan pricing decisions, borrower characteristics might also be relevant and even shape the relationship between bank capital and interest rates. To examine this, we evaluate this relationship for borrowers of different size, risk and with different relationships with their lenders. Throughout the analysis, we control for loan characteristics, such as amount, maturity, and collateral, as all these ingredients are part of the loan approval process and determine the ultimate level of risk of the exposure. The effect of these variables on spreads is not consensual. Larger and longer loans may be riskier, but they are also more likely to be granted to more creditworthy firms. Collateral should protect banks against the risk of a loan. Bester (1985) and Besanko and Thakor (1987) argue that the willingness to provide collateral serves as a credible signal of borrower quality and predict that low credit risk borrowers post collateral and obtain lower spreads. Nevertheless, collateral may itself be a proxy for a negative assessment of borrowers' risk and go hand in hand with higher spreads (Boot et al., 1991).

Our article adds to the empirical literature on this topic by focusing on the differential between the spread that a bank charges to a given borrower and the average spread charged by all banks lending to the same borrower. We find that the lower banks' capital ratios are compared to their historical averages, the more they tend to underprice the risk of a borrower relative to the other banks that lend to the same borrower. Focusing on loans to firms that borrow from more than one bank in each period ensures that the differences in interest rates across banks derive from banks' characteristics and are not driven by selection. This could be an important concern if, for example, less capitalized banks specialize in riskier borrowers. We deal with endogeneity issues arising from potential reverse causality between spreads charged and bank capital by relying on multiple levels of fixed effects. In our preferred specification, which includes both bank and firm-quarter fixed effects, we regress spread differentials vis à vis the average spread charged by all banks lending to the same borrower on banks' capital ratios. We

then claim that our main result is consistent with the hypothesis that capital exerts a monitoring incentive upon banks.

Section 2 describes the data and presents the empirical strategy. Section 3 analyzes the results and section 4 concludes.

2. Data and empirical strategy

2.1. Data

To evaluate loan pricing differentials we use a loan-level dataset, internally labeled as *New operations dataset*. This dataset includes information on all the new loans granted to firms by Portuguese banks since mid-2012 (Santos, 2013). Until end-2014, only banks with an annual volume of new loans larger than EUR 50 million had to report this information. From 2015 onwards, all resident banks reported to this dataset. For each loan we are able to observe the date of origination, the loan amount, the interest rate, the maturity and whether or not the loan is collateralized. We use data up to the last quarter of 2019. We only include loans with fixed maturity to make sure that the results are anchored on comparable observations, and firms that borrow from more than one bank in the same quarter, to make sure that differences in interest rates across banks derive from bank characteristics. We exclude renegotiations in which the customer is involved, automatic renovations and restructurings. Given that we want to examine the role of bank capital on loan pricing decisions, we exclude branches from foreign banks operating in Portugal, as these institutions are not subject to regulatory capital requirements in the host country. This sample represents on average 12% of the total amount lent by banks each quarter.

To account for the effect of relationship lending on loan pricing, we use the Central Credit Registry to compute the number of bank relationships held by each firm in each quarter. Further, we also use this dataset to identify the formation of new bank relationships.

To understand how bank characteristics might be relevant in shaping loan pricing decisions, we merge the loan-level information with quarterly bank-level data. We use the Historical Series on the Portuguese Banking Sector (Esteves, 2020), which include detailed financial statements on all the banks reporting interest rate data.[1]

Finally, given the role played by risk on loan pricing, we merge our data with internal credit ratings and default probabilities estimated in an in-house credit risk model developed at Banco de Portugal (Antunes et al., 2016). These risk indicators are available at an yearly frequency.

We winsorize interest rates with unreasonably low or high values (below the 5th percentile and above the 95th percentile). Loan maturity is winsorized at the 95th percentile.

1. More details on this dataset may be found here.

The loan-level data is aggregated at the firm-bank-quarter level. Whenever one bank grants more than one loan to a given firm in a quarter, loan characteristics are aggregated using weighted averages (with the weight being the loan amount).

2.2. *Summary statistics*

Figure 1 shows the evolution of the average loan spread over time in Portugal. For each new loan that is granted, we compute the spread as the difference between the interest rate charged on the loan and the 3-month Euribor. The average corporate loan spread depicted in the figure is the simple mean of loan spreads in each quarter.

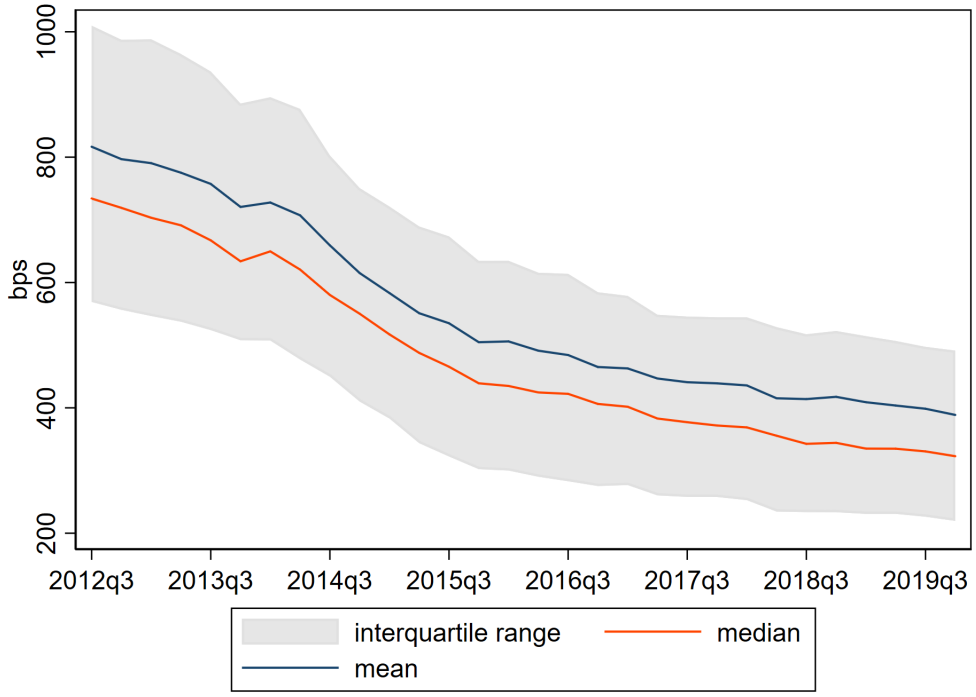

FIGURE 1: Dispersion in loan spreads

Source: Banco de Portugal and authors' estimates. Notes: The figure depicts the simple average of loan spreads, for all loans granted to firms in each quarter. The spread on a loan is the difference between the interest rate charged on the loan and the 3-month Euribor. The figure depicts the mean and median of the loan spread distribution, as well as the interquartile range. The sample begins in the 3rd quarter of 2012 and ends in the last quarter of 2019.

The average loan spread has been declining steeply since 2012. It stabilized around 400 basis points (bps) after 2017. The overall decrease in loan spreads occurs in a period of historically low interest rates and of increasing pressure on net interest margins. After the surge in loan spreads during the financial and sovereign debt crises, spreads gradually decreased as a result of lower funding costs but also of increasing competition. Given the fragile economic recovery, both internally and externally, this heightened competition was especially targeted at low-risk firms. Since 2012 banks have been increasing the share of new loans granted to lower-risk firms, which has improved the risk profile of the loan book.

The decrease in loan premia was accompanied by a smaller variation across banks, as shown by the interquantile range also depicted in Figure 1. A better understanding of this dispersion is precisely the focus of this article. At the core of our analysis will be the $weighted\ deviation$ in interest rate spreads, that is, the difference between the spread charged by bank i to firm j in quarter t and the weighted average of the spreads charged by all banks lending to firm j in quarter t. The weights are the shares of each bank lending to the firm in that quarter:

$$Deviation_{ijt} = Spread_{ijt} - \sum_{i} w_{ijt} Spread_{ijt} \tag{1}$$

We want to understand how different banks price risk. Simply comparing interest rates or loan spreads across banks would not yield the desired results, as banks may lend to borrowers with different risk levels. To make sure we are truly capturing differences across banks, we focus on firms that borrow from more than one bank in the same quarter. By comparing loan spreads offered by different banks to the same firm ($deviation$), we are evaluating how each bank prices the same level of risk. That said, the loans may differ in terms of amounts, maturities or collateral, what would also affect pricing. We control for these dimensions in the regressions.

The simple mean of the weighted deviation is 17 bps (Table 1). This figure is positive as the average does not weigh each weighted deviation by its loan amount. The weighted mean of the weighted deviation is, by definition, 0 bps. The average pricing differential across banks is not very large. That said, there is a lot of dispersion in this variable. The average interest rate is 5.4% in our sample. This compares with an average interest rate of 5.86% in loans where the firm borrows from only one bank in the quarter. The firms included in the sample belong mainly to the services and industry sectors and have a higher share of firms in the industry sector and a smaller share of firms in services than firms which, in each quarter, only borrow term loans from one bank. The majority of firms analyzed are micro and small firms and are, on average, larger than the firms which borrow term loans from only one bank in each quarter.

In Table 1 we also report summary statistics for other variables used in our analysis. The median loan is 50 thousand euros, reflecting the fact that most of the firms in the economy are small and medium enterprises (SME). The median maturity for a loan is 104 days. Slightly more than half (54%) have collateral.

The average default probability for each firm is 4.6% and it has been declining throughout the last decade. The average share of each bank in the total amount of loans granted to a firm in each quarter is 40%. On average, each firm borrows from 7 different banks (the median is 6). More than half of the firms have established a new relationship in the previous 12 months.

Our main hypothesis is that banks' loan pricing decisions may be strongly affected by how well capitalized banks are. On average, banks' Tier 1 capital ratio was 13%. Banks became better capitalized over time, as they emerged from the pressures felt during the euro area sovereign debt crisis and responded to tighter capital requirements regulation. The average total capital ratio was slightly higher (14%). There are 31 different banks in

	N	mean	std. dev	p5	p25	median	p75	p95
Interest rate and deviations:								
Interest rate (bps)	371,188	540	300	151	302	490	713	1167
Weighted deviation (bps)	371,188	17.40	204	-267	-65	-0.45	78	365
Simple mean deviation (bps)	371,188	0.00	180	-284	-88	-4.12	81	301
Loan characteristics:								
Loan amount (th euros)	371,188	262	5170.00	4	20	50	150	743
Maturity (in days)	371,188	352	545	32	76	104	183	1812
Collateral (0/1)	371,188	0.54	0.50	0.00	0.00	1.00	1.00	1.00
Firm variables:								
Rating	364,565	14.68	2.99	9	13	15	17	19
Default probability (%)	364,565	4.63	5.9	0.2	1.1	2.6	5.8	15.8
Share in firm financing (%)	371,188	40.43	27.4	3.2	16.7	36.5	61.3	90.5
Nr of relationships (quarter)	281,068	7.05	3.6	2.0	4.0	6.0	9.0	14.0
New rel. past 12 months (0/1)	281,068	0.54	0.5	0.0	0.0	1.0	1.0	1.0
Firm size	370,320	2.00	0.8	1.0	1.0	2.0	3.0	3.0
Bank variables:								
Tier 1 capital ratio (%)	371,188	12.83	3.02	9.34	10.93	12.32	13.98	18.47
Total capital ratio (%)	371,188	13.73	2.86	9.69	12.20	13.48	15.02	18.81
Loan loss charge (%)	371,188	1.02	0.85	-0.09	0.42	0.94	1.41	2.44
Funding cost (%)	371,188	1.66	0.99	0.47	0.84	1.44	2.27	3.46
RWA density (%)	371,188	58.05	10.76	40.82	53.25	57.65	64.85	77.70

TABLE 1. Summary statistics

Note: The weighted deviation is the difference between the spread charged by a bank on a loan to a given firm and the weighted average spread charged by all banks on loans to that firm in the same quarter. The simple mean deviation is the difference between the spread charged by a bank on a loan to a given firm and the simple average spread charged by all banks on loans to that firm in the same quarter. The rating and default probability are based on an internal credit scoring model used by Banco de Portugal (details may be found in Antunes et al., 2016). The share in firm financing is the ratio between the loan amount granted by a bank to a firm in a given quarter and the total loan amount granted by all banks to that firm in the same quarter. The number of banking relationships is defined quarterly. We consider that a firm has a new relationship if it obtains loans from at least one new bank in the previous 12 months. Firm size is defined using the Commission recommendation 2003/361/EC (micro firms take the value 1, small firms 2, medium firms 3 and large firms 4). The loan loss charge is the ratio between the annualized flow of loan impairments in the quarter and the (annual average) loan stock. The funding cost is the ratio between the annualized flow of interest paid in the quarter and the (annual average) stock of debt. The RWA density is the ratio between risk-weighted assets (RWA) and total assets. The data span from the 3rd quarter of 2012 until the last quarter of 2019.

the sample. On average, in each quarter, there are 20 different banks. However, in each regression, only banks lending to the same firm are compared. On average, firms obtain new loans from 3 different banks in a quarter.

Even though the literature on risk pricing suggests that bank capital plays a predominant role (Boot et al. 1993, Diamond and Rajan, 2000), there are other bank characteristics that might also be relevant in shaping banks' heterogeneous loan pricing decisions. During the euro area sovereign debt crisis, Portuguese banks accumulated loan losses, that had to be managed in the following years (Marques et al., 2020). To understand if loan losses change banks' pricing decisions, we consider the role of the loan loss charge, defined as the ratio between the annualized flow of loan impairments in each quarter and the (annual average) loan stock.

A critical aspect in shaping loan pricing decisions is of course the cost at which banks are financed. We consider the role of banks' funding costs, defined as the ratio between the annualized flow of interest paid in each quarter and the (annual average) stock of debt. Banks' funding costs stood at 1.66%, on average, reflecting the low rate environment prevailing throughout the sample period.

Finally, we consider the role of global riskiness embedded in banks' balance sheets by examining the role of the RWA density, which is defined as the ratio between risk-weighted assets (RWA) and total assets. Banks with higher RWA density have riskier assets. The risk profile of banks varies considerably in the sample.

2.3. Empirical strategy

Our empirical analysis is focused on understanding what explains the heterogeneity in loan pricing across banks. Our dependent variable is the (weighted) $deviation$ in interest rate spreads. To make sure that the differences derive from banks' characteristics but not from compositional effects arising from heterogeneity in the pool of borrowers that each bank caters to, we focus on firms that obtain loans from at least two banks in the same quarter. There is a trade-off in this choice: on one hand it allows us to understand how different banks price the exact same level of (observational) risk; on the other hand, this will bias the analysis towards larger firms, that are more likely to borrow simultaneously from several banks (Bonfim et al., 2018). That said, this latter point can actually be helpful to make sure we are capturing the role of bank characteristics on loan pricing, given that smaller firms are more informationally opaque. This implies that there is substantially more discretion in the pricing of smaller loans (Cerqueiro et al., 2011). By focusing on larger firms, we can be more certain that the heterogeneity in loan pricing can be attributed to bank capital (or other characteristics), rather than issues related with asymmetric information and rent extraction (Bonfim et al., 2021).

To examine the role of bank characteristics on loan pricing decisions we estimate the following specification:

$$Deviation_{ijt} = \beta BankVariables_{it} + \gamma LoanControls_{ijt} + \eta_i + \theta_{jt} + \varepsilon_{ijt} \quad (2)$$

The coefficient β will capture the importance of bank variables on loan pricing heterogeneity, captured by the deviation on loan spreads obtained by firm j from banks i in quarter t. In our preferred specification we estimate the effect of bank capital. We control for loan characteristics that may be important to explain pricing deviations. These include the loan amount, the maturity, the share of financing that the firm obtains from each bank in each quarter and the existence of collateral. In some specifications we estimate the effect of other time-varying bank characteristics besides bank capital, such as the loan loss charge, funding costs or RWA density. We control for unobserved time-invariant bank heterogeneity (η_i). This allows to capture time-invariant bank-specific characteristics, such as business models or risk aversion preferences. In the most demanding specifications in terms of identification we also control for $firm \times quarter$ fixed effects (θ_{jt}). This means that the results identified in these specifications will

rely on the comparison of banks lending to the same firm during a given quarter. By relying on multiple levels of fixed effects we are able to limit endogeneity issues due to potential reverse causality between spreads charged and bank capital. In our preferred specification, which includes both bank and firm-quarter fixed effects, we regress spread differentials vis à vis the average spread charged by all banks lending to the same borrower on banks' capital ratios.

3. Results

In Table 2 we present our main estimation results. In column (1) we consider the role of the Tier 1 capital ratio in explaining loan pricing heterogeneity. In this first estimation we control for firm, quarter, and bank fixed effects. The dependent variable is the weighted interest rate spread deviation. We find that banks' deviation in terms of loan pricing is larger the higher their capital ratios are compared to their historical average.[2] Conversely, this means that when banks' capital constraints become more binding, they might underprice the risks they are assuming, when compared to other banks simultaneously lending to the same firm.

This main result holds in all other specifications reported in this table. In column (2) we control for $bank$ and $firm \times quarter$ fixed effects. Banks whose capital ratios are high compared to their historical average seem to offer to the same firm higher rates than their peers, thus becoming more prudent in their pricing decisions. In columns (3) and (4) we repeat these first two estimations, but adding variables that capture loan characteristics that might be important to capture heterogeneity in loan pricing. After we control for loan amount, maturity, the share of financing granted by the bank and the existence of collateral, the coefficient on bank capital remains positive and statistically significant.

We observe that larger loans have smaller spread deviations. The same is true for loans with longer maturities. When banks are responsible for a larger share of financing to a given firm in a given quarter, they also charge lower spreads (Petersen and Rajan, 1994). Taken together, this suggests that banks that are more involved with a given firm offer generally better financing conditions. Given the high number of bank relationships and the frequency with which firms establish new ones, these results are consistent with a broadly competitive environment where hold-up costs are not large.

Finally, loans with collateral are associated with higher spreads. Even though collateral mitigates the risk incurred by the lender, there is evidence that the presence of collateral may in itself be a proxy for a negative assessment of borrowers' risk, also reflected in higher spreads (Boot et al., 1991, Berger and Udell, 1990, Cerqueiro et al., 2016). In an environment with information asymmetries, by requiring collateral the bank increases the level of effort adopted by the debtor to successfully carry out his projects, thereby better aligning the incentives between the two parties (Boot et al., 1991). The

2. Given that bank fixed effects are being used to control for time-invariant bank heterogeneity, identification comes from within bank variation.

Dep. variable: deviation				
	(1)	(2)	(3)	(4)
Tier 1 capital ratio	3.729***	4.760***	2.434***	2.760***
	(0.324)	(0.406)	(0.314)	(0.383)
Log amount			-0.366	-11.62***
			(0.684)	(1.489)
Log maturity			-39.63***	-61.68***
			(0.521)	(0.733)
Share financing			-1.040***	-0.540***
			(0.026)	(0.052)
Collateral (1/0)			4.599***	5.286***
			(1.573)	(2.022)
Constant	-30.45***	-43.68***	223.2***	275.8***
	(4.164)	(5.207)	(5.613)	(8.631)
Observations	371,186	371,186	371,186	371,186
R2	0.200	0.346	0.259	0.426
Firm fixed effects	Y	N	Y	N
Quarter fixed effects	Y	N	Y	N
Bank fixed effects	Y	Y	Y	Y
Firm*quarter fixed effects	N	Y	N	Y

TABLE 2. Loan pricing deviations and bank capital

Notes: The dependent variable in all regressions is the weighted deviation, defined as the difference between the spread charged by a bank on a loan to a given firm and the weighted average spread charged by all banks on loans to that firm in the same quarter. Other variables defined in Table 1. Data used in these regressions span from the 3rd quarter of 2012 until the 4th quarter of 2019. Robust standard errors in parentheses (clustered at the firm level). *** significant at 1%, ** significant at 5%, * significant at 10%

results remain entirely consistent if we use an unweighted version of the dependent variable or if we exclude collateral.[3]

Figure 1 shows that loan spreads decreased considerably during our sample period and that dispersion across banks also decreased. Further, Ordoñez (2013) shows that monitoring efforts change as the economy moves into and out of financial crises. To examine if the positive relationship between bank capital and deviations in loan pricing also changed during this period, we estimate a dynamic version of equation 2, such that:

$$Deviation_{ijt} = \beta_y BankCapital_{it} + \gamma LoanControls_{ijt} + \eta_i + \theta_{jt} + \varepsilon_{ijt} \tag{3}$$

The difference is that now β_y will take a different value for each year in the sample. The results for this coefficient are reported in Figure 2. Interestingly, we find that even

3. When splitting the sample by firm risk, firm size and loan maturity, alternatively, we verify that collateral is statistically significant and has a positive coefficient only in the case of firms in the top risk quartile (with risk measured by firms' credit ratings), micro firms and loans with longer maturities (over 2 years), respectively. Given that smaller firms are usually riskier, more opaque and expected to have a higher marginal return on the entrepreneur's effort, these results are consistent with the role of collateral in correcting borrowers' incentives. We also estimated several versions of column (4) with lags on the capital variable. While the results do not hold for all lag combinations, the main conclusion still holds.

though the deviations in loan pricing decreased throughout the sample, the role of bank capital in shaping those deviations actually increased. In the first two years of the sample, 2013 and 2014, the effect of bank capital on interest rate spread deviations was actually negative. Banks with more capital granted lower interest rates, for the same level of risk, when the country was emerging from the financial assistance program. In 2015 the coefficient was not statistically significant. After that, the coefficient became positive and increased until 2018. The results that we obtain for the entire sample, reported in Table 2, mainly reflect the period 2016-2019. This dynamic analysis shows that the effect of capital ratios on loan pricing differentials can change through time.

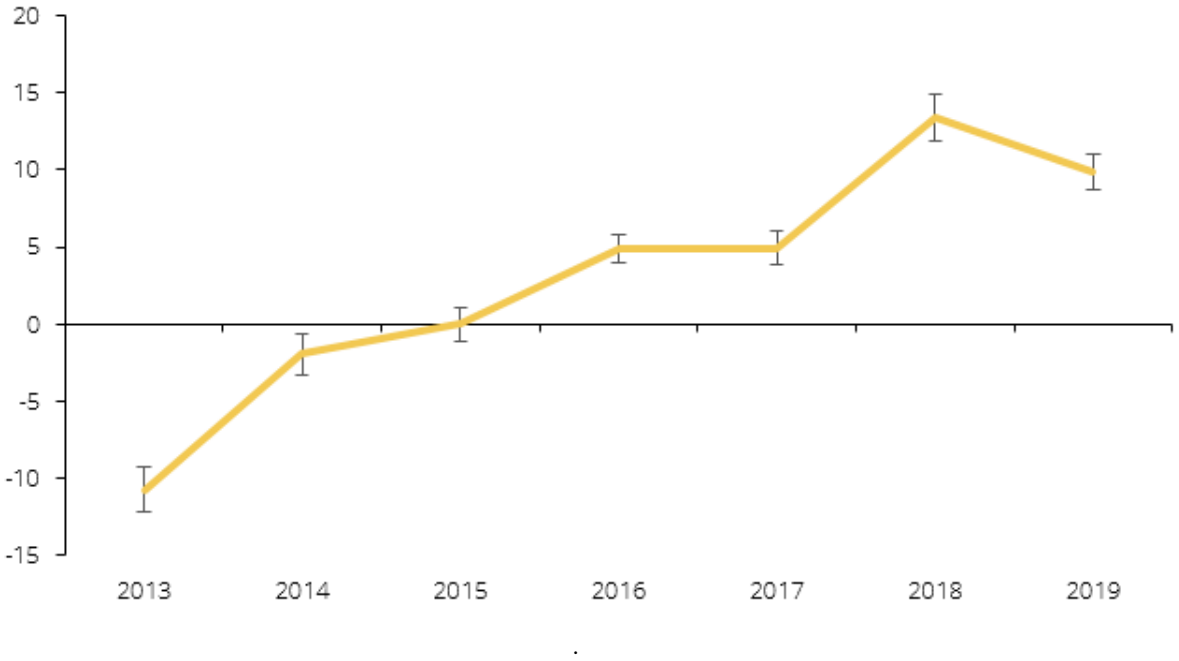

FIGURE 2: Effect of bank capital on pricing deviations

Source: Banco de Portugal and authors' estimates. Notes: This figure depicts the coefficients of a dynamic specification of equation 2. Each point in the graph is the estimated coefficient on the Tier 1 capital ratio interacted with year dummies, as defined in equation 3. Thin bars indicate 95% confidence intervals. Loan controls (loan log-amount, loan log-maturity, share in firm financing and a collateral dummy) are included in the regression. Data used in the regression span from the 3rd quarter of 2012 until the 4th quarter of 2019.

Bank capital clearly plays a role in shaping banks' loan pricing decisions. However, other bank characteristics might also be relevant. In Table 3 we estimate equation 2 using other potentially relevant bank variables. In the first column we repeat the results reported in column (4) of Table 2. This can be considered our baseline specification and it includes loan controls, $bank$ fixed effects and $firm \times quarter$ fixed effects. The dependent variable is the weighted deviation of interest rate spreads.

In the following columns we repeat this estimation using alternative bank variables. We do not consider simultaneously the role of several variables, as that would be excessively demanding in terms of the data structure. Recall that we are exploring differences in interest rate spreads across the set of banks that lend to the same firm in

Dep. variable: deviation					
	(1)	(2)	(3)	(4)	(5)
Tier 1 capital ratio	2.760***				
	(0.383)				
Total capital ratio		4.172***			
		(0.387)			
Loan loss charge			-8.548***		
			(0.924)		
Funding costs				-9.604***	
				(1.781)	
RWA density					-0.297
					(0.208)
Constant	275.8***	253.6***	319.5***	327.8***	329.1***
	(8.631)	(8.809)	(7.351)	(7.884)	(14.160)
Observations	371,186	371,186	371,186	371,186	371,186
R2	0.426	0.426	0.426	0.426	0.426
Firm fixed effects	N	N	N	N	N
Quarter fixed effects	N	N	N	N	N
Bank fixed effects	Y	Y	Y	Y	Y
Firm*quarter fixed effects	Y	Y	Y	Y	Y
Loan controls	Y	Y	Y	Y	Y

TABLE 3. Loan pricing deviations and other bank characteristics

Notes: The dependent variable in all regressions is the weighted deviation. Variables defined in Table 1. Loan controls (loan log-amount, loan log-maturity, share in firm financing and a collateral dummy) are included in all regressions. Data used in these regressions span from the 3rd quarter of 2012 until the 4th quarter of 2019. Robust standard errors in parentheses (clustered at the firm level). *** significant at 1%, ** significant at 5%, * significant at 10%

a given quarter. By including more bank characteristics at the same time, we would be exploring differences in variables that are highly correlated within small sets of banks.

In column (2) we consider the role of the total capital ratio, instead of the Tier 1 capital ratio. The two ratios are highly correlated and, as expected, the results are broadly consistent.

When banks record higher loan loss charges, they seem to underprice their loans, for the same level of risk. When banks are facing increasing losses, their franchise value is being eroded and they may have weaker incentives to adequately screen borrowers. They might even attract riskier borrowers as an attempt to boost their weakened profitability. This underscores the importance of a prompt recognition of loan losses (Ari et al., 2020, Bonfim et al., 2020).

When banks' financing costs increase, they actually charge lower interest rates for the same level of risk.[4] Higher funding costs possibly reflect higher risk for a given bank, what is often related with low capital ratios (Gambacorta and Shin, 2018). This negative

4. If we include both the Tier 1 capital ratio and the funding cost in the same regression, the Tier 1 capital ratio remains statistically significant and positive and the funding cost remains statistically significant and negative.

coefficient can thus be seen as the reverse of the positive coefficient on bank capital. Finally, RWA density is not significantly related with loan pricing deviations.

3.1. Loan pricing and firm characteristics

The pricing of loans is not necessarily a linear function of risk. That should be especially true for smaller and more opaque firms, where the information conveyed within a firm-bank relationship can mitigate information asymmetries and improve financing conditions (Bonfim et al., 2018). At the same time, firms may also become locked in a relationship, allowing banks to extract rents (Sharpe, 1990, Schenone, 2010).

To better understand the role played by firm heterogeneity and firm-bank relationships, we interact bank capital with several variables (Table 4). The first step we take is to try to understand if there are non-linearities between the level of risk and the heterogeneity in loan pricing. It is possible that the relationship between banks' capital and deviations in loan pricing is not the same for firms with different degrees of risk. To test this hypothesis, we classify firms as high or low risk, depending on whether firms have credit ratings above or below the median. We find that the relationship between bank capital and interest rate deviations is positive only for the low-risk firms. For high-risk firms, banks' capital ratios become less relevant in explaining pricing differentials.

Another important dimension shaping loan pricing is the number of bank relationships. Firms are able to obtain better financing conditions when they borrow from more banks, as this mitigates information asymmetries (Farinha and Santos, 2002, Bonfim et al., 2018). When we interact bank capital with a variable that captures whether firms have more than two bank relationships, we find that the relationship between bank capital and more prudent risk pricing is negative for firms with one or two banking relationships and becomes positive for these multiple loans firms.This result is consistent with the idea that information is more asymmetric for firms with fewer bank relationships and thus banks may rely on collateral requirements to correct borrower moral hazard, with capital exerting fewer monitoring incentives. It should be said that loans to firms with up to two bank relationships represent only 5% of our sample.

Next, we examine if there are significant differences between firms that establish new relationships and others. We consider that a new relationship is established when a firm obtains loans from at least one new bank in the previous 12 months. The relationship between bank capital and interest rate deviations is positive as in the baseline specification and the effect is stronger for firms that recently established new relationships. This should reflect more heterogeneity in loan pricing for firms with new relationships, which are differentially assessed by banks with different levels of capitalization.

Another hypothesis that can be examined is whether the heterogeneity in risk pricing for banks with different capital ratios holds regardless of firm size or if there are differences, which may be attributable to information asymmetries. In column (4) we consider the interaction between bank capital and firm size. In this case, the coefficient of bank capital becomes negative, capturing the effect of the omitted size category (micro

Dep. variable: deviation				
	(1)	(2)	(3)	(4)
Tier 1 capital ratio	5.991***	-4.845***	1.144**	-3.894***
	(0.466)	(1.097)	(0.499)	(0.603)
Tier 1 * High risk firms	-7.538***			
	(0.575)			
Tier 1 * More than 2		7.563***		
		(1.058)		
Tier 1 * New relationships			2.054***	
			(0.476)	
Tier 1 capital * small				6.403***
				(0.666)
Tier 1 capital * medium				13.43***
				(0.781)
Tier 1 capital * large				15.11***
				(1.340)
Constant	276.7***	287.9***	286.0***	345.2***
	(8.668)	(9.477)	(9.471)	(12.410)
Observations	364,561	281,067	281,067	369,751
R2	0.428	0.441	0.44	0.429
Firm fixed effects	N	N	N	N
Quarter fixed effects	N	N	N	N
Bank fixed effects	Y	Y	Y	Y
Firm*quarter fixed effects	Y	Y	Y	Y
Loan controls	Y	Y	Y	Y

TABLE 4. Loan pricing deviations, bank capital and firm characteristics

Notes: The dependent variable in all regressions is the weighted deviation. A high (low) risk firm is a firm with a credit rating above (below) the median credit rating of all firms that received loans in the same quarter. The number of banking relationships is defined quarterly. We consider that a firm has a new relationship if it obtains loans from at least one new bank in the previous 12 months. Firm size is defined using the Commission recommendation 2003/361/EC. Other variables defined in Table 1. Loan controls (loan log-amount, loan log-maturity, share in firm financing and a collateral dummy) are included in all regressions. Data used in these regressions span from the 3rd quarter of 2012 until the 4th quarter of 2019. Robust standard errors in parentheses (clustered at the firm level). *** significant at 1%, ** significant at 5%, * significant at 10%

firm). The interactions are positive and increasing with firm size, suggesting that there is more dispersion on loan pricing for larger firms, for the same level of bank capital.

4. Concluding remarks

In this article we examine the role of bank capital in shaping loan pricing decisions. The results were obtained taking into account the entire set of new term loans granted to non-financial corporations by Portuguese banks.

Focusing on firms that simultaneously borrow from several banks, our results show that bank capital plays an important positive role on shaping the pricing of loans. We deal with endogeneity issues due to potential reverse causality between spreads charged and bank capital by relying on multiple levels of fixed effects in our main empirical specification.

The positive relation between bank capital and spreads only holds for firms with a rating better than the median, for firms in all size classes except the very small ones, and those with more than two relationships. Bank capital does not seem to be associated with higher interest rates for the same level of risk in the case of loans to riskier, smaller or firms with only two relationships.

Between 2012 and 2019, loan spreads gradually decreased. The relationship between bank capital and loan pricing also changed. Until 2014, this relationship was actually negative. When banks were still recovering from the severe consequences of the euro area sovereign debt crisis, banks with more capital granted lower interest rates, for the same level of risk. From 2016 onwards, the coefficient becomes positive. Our main result thus holds mainly in the post-crisis period.

Our results show that bank capital plays an important role on shaping the pricing of loans. Banks that are better capitalized compared to their historical average seem to be more conservative in loan pricing, offering higher loan spreads than the other banks lending to the same firm.

That said, there are further limitations in the analysis that should be acknowledged. These relate to the relatively small dimension of the sample, as the identification strategy requires exploring differences across firms that borrow from several banks simultaneously. The evaluation of banks' capitalization is also partial, due to the lack of data on effective capital requirements (i.e., pillar 2 requirements). Furthermore, 2015-2019 is a period characterized by the recovery from one of the largest crises in the history of the Portuguese financial system, which might challenge the external validity of the results.

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Non-technical summary

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Simple guidelines for the taxation of housing

Pedro Teles

How should housing be taxed? Should housing be treated like capital or like a consumption good? Housing can be taxed in many different ways. How can those taxes be combined to improve welfare? In this note we develop simple guidelines for the optimal taxation of housing. In order to do this, we first review the principles of optimal taxation of capital, and explain how housing differs from other capital.

The main take away from the results on the taxation of capital is that investment should not be distorted. The reason for this is that distortions on capital accumulation introduce wedges between consumption in different periods (as well as labor in different periods). For standard preferences used in macroeconomics, it is best to tax goods in different periods at the same rate, rather than at different rates. This means that capital accumulation should not be distorted.

The result that capital accumulation should not be distorted does not mean that capital cannot be taxed. It is possible to design a tax on capital income that taxes the preexistent capital stock without distorting the accumulation of capital. A full deduction of investment, rather than the deduction of depreciation, accomplishes this. By allowing for the full deduction of investment in the tax basis of capital income, investment is not distorted, but the pre-existent capital is taxed. Recently, the US Tax Cuts and Jobs Act of 2017 allowed for an immediate full deduction of the cost of short-lived investments, even if as a temporary measure.

Does the same principle, that the accumulation of capital should not be distorted, apply to housing? Yes, in the sense that the only reason to distort the accumulation of housing is to be able to tax housing services. We show that a labor income tax together with a value added tax on both investment in housing and consumption goods is all that is needed in order to tax efficiently. All other taxes on housing should be avoided, including taxes on property, on the income from rents or other distortionary taxes on the investment in housing.

Economic synopsis
Simple guidelines for the taxation of housing

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1. Introduction

The purpose of this note is to develop simple guidelines for the optimal taxation of housing. In order to do this, we need to first review the principles of optimal taxation of capital, and understand how housing differs from other capital. The analysis is based on two papers, Chari, Nicolini and Teles (2020) on the optimal taxation of capital income and Correia, Reis and Teles (2017) on the optimal taxation of housing. The models used in those papers, and in this note, are simple models that abstract from many important features of actual economies including the extreme complexity of the tax codes. The policy exercise is useful because of the clarity with which the main principles of optimal taxation can be derived. The underlying assumption is that Ramsey (1927) distortionary taxation is necessary in order to finance government consumption, transfers and outstanding debt in the most efficient way. The available taxes resemble the ones that can be found in actual economies.

The main take away from the results on the taxation of capital is that capital accumulation should not be distorted. The reason for this is that distortions on capital accumulation introduce wedges between consumption in different periods and between labor in different periods. Such distortions are not second-best efficient for preferences that are standard in macro models. This means that they are not desirable even when other distortions must be imposed. This result can be seen as an application of the classical Diamond and Mirrlees (1971) principle of production efficiency.

Abstaining from distorting capital accumulation does not mean that capital cannot be taxed. It does mean, though, that taxation of capital has to be redesigned so that the preexistent capital can be taxed, while future capital is exempted. A full deduction of investment accomplishes this. Abel (2007) made this important point in an unpublished manuscript. Recently, the US Tax Cuts and Jobs Act of 2017 allowed for an immediate full deduction of the cost of short-lived investments. This was however a temporary measure, to be in full effect for only five years, expiring in 2026 after a transition period.

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Does the same principle, that the accumulation of capital should not be distorted, apply to housing? Yes, in the sense that the only reason to distort the accumulation of housing is to be able to tax housing services. A labor income tax or a value added tax (VAT) on both investment in housing and consumption goods is all that is needed in order to tax efficiently.

In what follows, we are going to go through the derivations of optimal policy, first in a model with capital only, and then in a model with capital and housing. In the model with capital only, we start by assuming that taxes on capital income resemble corporate income taxes with an allowance for depreciation. An alternative tax structure allows for the deduction of investment, so that the tax resembles a dividend tax. The implementations assume that households carry the capital stock, but an alternative implementation in which the firms accumulate capital is also described. In the model with both capital and housing, we also allow for a tax on investment in housing that resembles a value-added tax on housing. The analysis gets into unavoidable technical detail, so that the principles of optimal taxation of capital and housing may be derived clearly.

2. A model with capital only

In this section, we review the main principles of optimal taxation of capital. The main take aways are: (1) Capital accumulation should not be distorted. (2) Taxation of capital income with or without an allowance for depreciation should be zero, meaning that corporate income taxes as they are usually designed should be zero. (3) Taxes on capital income with an investment deduction can be positive since there are no efficiency losses from dividend taxes, other than reputational costs associated with confiscatory taxation.

To keep the analysis simple, we are going to model taxation in a representative agent model where the household accumulates the capital stock. The household is taxed on the labor income, consumption, and capital income. The taxes on capital income resemble either a corporate income tax, with a deduction for depreciation, or a dividend tax with full investment expensing.

The preferences of a representative household, over consumption c_t, and labor n_t, are described by $\sum_{t=0}^{\infty} \beta^t u\left(c_t, n_t\right)$ where the period utility function has the familiar isoelastic form:

$$u\left(c_t, n_t\right) = \frac{c_t^{1-\sigma^c} - 1}{1-\sigma^c} - \eta n_t^{1+\psi}. \tag{1}$$

with $\sigma^c > 0$ and $\psi > 0$.

The production technology is described by

$$c_t + g_t + k_{t+1} - \left(1 - \delta^k\right) k_t \leq F\left(k_t, n_t\right) \tag{2}$$

where k_t is capital, g_t is exogenous government consumption, and δ^k is the depreciation rate of capital. The production function F is constant returns to scale.

The household owns the capital stock and rents it to a representative firm every period at rate u_t^k. The household accumulates real public debt, b_{t+1}, in units of goods at

$t+1$, that cost $\frac{b_{t+1}}{1+r_{t+1}}$ units of goods at t. The household pays taxes on capital income, τ_t^k, and on labor income, τ_t^n. There is also a consumption tax τ_t^c. The flow of funds constraint is

$$\begin{aligned}\frac{1}{1+r_{t+1}}b_{t+1}+k_{t+1} \quad &\leq \quad b_t+\left[1-\delta^k+\left(1-\tau_t^k\right)u_t^k\right]k_t \\ &\quad +\left(1-\tau_t^n\right)w_t n_t-\left(1+\tau_t^c\right)c_t, \text{ for } t\geq 0.\end{aligned} \tag{3}$$

The household maximizes utility (1), subject to the budget constraint obtained from these flow of funds constraints, (3), together with a no-Ponzi games condition that ensures solvency.

The choices of the household over consumption, labor, and capital accumulation must satisfy the following marginal conditions

$$\frac{u_{c,t}}{-u_{n,t}}=\frac{1+\tau_t^c}{\left(1-\tau_t^n\right)w_t}, \tag{4}$$

$$\frac{u_{c,t}}{\beta u_{c,t+1}}=\frac{1+\tau_t^c}{1+\tau_{t+1}^c}\left(1+r_{t+1}\right), \tag{5}$$

and

$$1+r_{t+1}=1-\delta^k+\left(1-\tau_{t+1}^k\right)u_{t+1}^k, \tag{6}$$

where $u_{c,t}$ and $u_{n,t}$ are the marginal utility of consumption and labor, respectively.

The flow of funds conditions for the household together with the no-Ponzi games condition can be written, using (6), as a single budget constraint which, written with equality, is

$$\sum_{t=0}^{\infty}q_t\left[\left(1+\tau_t^c\right)c_t-\left(1-\tau_t^n\right)w_t n_t\right]=b_0+\left(1-\delta^k\right)k_0+\left(1-\tau_0^k\right)u_0 k_0 \tag{7}$$

where $q_t=\frac{1}{(1+r_1)\ldots(1+r_t)}$ for $t\geq 1$, with $q_0=1$.

A representative firm produces output that can be used as consumption, capital, or government consumption. The first order conditions for the firm are

$$1=\frac{w_t}{F_{n,t}}=\frac{u_t^k}{F_{k,t}}, \tag{8}$$

where $F_{n,t}$ and $F_{k,t}$ are the marginal productivity of labor and capital, respectively.

It follows from the marginal conditions of both household and firm that, in a competitive equilibrium, it must be that

$$\frac{u_{c,t}}{-u_{n,t}}=\frac{1+\tau_t^c}{\left(1-\tau_t^n\right)F_{n,t}}, \tag{9}$$

and

$$\frac{u_{c,t}}{\beta u_{c,t+1}}=\frac{1+\tau_t^c}{1+\tau_{t+1}^c}\left[1-\delta^k+\left(1-\tau_{t+1}^k\right)F_{k,t+1}\right]. \tag{10}$$

This shows how taxes create wedges in both within period and across period margins. In particular, time varying consumption or labor income taxes and a tax on capital income introduce intertemporal distortions.

The first best allocation can be described by the marginal conditions above, with the tax rates set to zero,

$$-\frac{u_{c,t}}{u_{n,t}} = \frac{1}{F_{n,t}}, t \geq 0,$$

$$\frac{u_{c,t}}{\beta u_{c,t+1}} = 1 - \delta^k + F_{k,t+1}, t \geq 0,$$

together with the resource constraints, (2) , with equality. This first-best solution solution cannot be implemented because there are limitations on the capacity of the government to tax lump sum, without imposing distortions. The optimal solution with distortionary taxes is obtained by solving a Ramsey problem that we analyze next.

The Ramsey optimal solution The competitive equilibrium conditions can be summarized by a small set of conditions. The Ramsey problem in this economy is to maximize utility subject to those conditions, namely, the implementability condition

$$\sum_{t=0}^{\infty} \beta^t \left[u_{c,t} c_t + u_{n,t} n_t\right] = W_0 \tag{11}$$

where $W_0 = \frac{u_{c,0}}{1+\tau_0^c}\left[b_0 + \left[1 - \delta^k + \left(1 - \tau_0^k\right) F_{k,0}\right] k_0\right]$ and the resource constraints, (2).

The first order conditions of the Ramsey problem, assuming W_0 is exogenous, can be written as:

$$\frac{u_{c,t}}{-u_{n,t}} = \frac{1 + \varphi\left(1 + \psi\right)}{\left[1 + \varphi\left(1 - \sigma^c\right)\right] F_{n,t}} \tag{12}$$

and

$$\frac{u_{c,t}}{\beta u_{c,t+1}} = 1 - \delta^k + F_{k,t+1}, t \geq 0, \tag{13}$$

for $t \geq 0$, where φ is the multiplier of the implementability condition, (11). The parameters ψ and σ^c are the labor and consumption elasticities. If lump-sum taxes could fully fund the government, the multiplier would be zero and the solution would be the first best.

From (12) and (13), it follows that intratemporal distortions are constant over time, and there are no intertemporal distortions at the optimal solution. The comparison of these conditions for the optimal wedges with the competitive equilibrium conditions above, (9) and (10), tells us how the optimal allocations can be implemented with the available tax instruments. A simple way to implement the optimal solution is to set the tax on capital income to zero, starting in period one, $\tau_{t+1}^k = 0$, $t \geq 0$, and to keep both consumption and labor income taxes constant over time.

If W_0 was not assumed to be exogenous, but rather b_0 and k_0 were the exogenous variables, then the optimal initial distortion on capital accumulation would be non-zero, meaning that $\tau_1^k > 0$. From period one onward, intertemporal distortions and taxes on

capital income should be zero.

Taxing capital with an allowance for depreciation We have seen, so far, that consumption and/or labor income taxes are all the taxes that are needed for implementation of the Ramsey allocation. There is no need for other taxes. Furthermore, except for the initial distortion, consumption and labor tax rates should be constant, avoiding intertemporal distortions.

Is there any way of taxing capital that avoids intertemporal distortions? What if the capital income tax includes a depreciation allowance? With a depreciation allowance, $\delta^{k\prime}$, that does not have to coincide with the actual economic depreciation, the flow of funds constraint of the representative household can be written as

$$\begin{aligned}\frac{1}{1+r_{t+1}}b_{t+1}+k_{t+1}-\left(1-\delta^{k}\right)k_{t} &\leq b_{t}+\left(1-\tau_{t}^{k}\right)u_{t}^{k}k_{t}+\tau_{t}^{k}\delta^{k\prime}k_{t}+\\ \left(1-\tau_{t}^{n}\right)w_{t}n_{t}-\left(1+\tau_{t}^{c}\right)c_{t}\text{, for } t &\geq 0.\end{aligned}$$

The non-arbitrage condition between bonds and capital is now

$$1+r_{t+1}=1-\delta^{k}+\left(1-\tau_{t+1}^{k}\right)u_{t+1}^{k}+\tau_{t+1}^{k}\delta^{k\prime}.$$

Since $u_{t+1}^{k}=F_{k,t+1}$, we have that the two gross returns are equal if

$$1+r_{t+1}=1-\delta^{k}+F_{k,t+1}-\tau_{t+1}^{k}\left(F_{k,t+1}-\delta^{k\prime}\right).$$

As long as the fiscal depreciation is less that the total user cost of capital, $F_{k}\left(t+1\right)>\delta^{k\prime}$, so that the tax is effective, there is a distortionary burden on capital accumulation. If the fiscal depreciation coincides with the economic one, $\delta^{k\prime}=\delta^{k}$, then

$$1+r_{t+1}=1+\left(1-\tau_{t+1}^{k}\right)\left(F_{k,t+1}-\delta^{k}\right).$$

In this case, the intertemporal marginal condition is

$$\frac{u_{c,t}}{\beta u_{c,t+1}}=\frac{1+\tau_{t}^{c}}{1+\tau_{t+1}^{c}}\left[1-\delta^{k}+\left(1-\tau_{t+1}^{k}\right)\left(F_{k,t+1}-\delta^{k}\right)\right]. \tag{14}$$

The Ramsey problem is exactly the same as before, and therefore the optimal solution eliminates the intertemporal distortion. The only way this can be accomplished with a depreciation allowance is if the allowance for depreciation is $\delta^{k\prime}=F_{k}\left(t+1\right)=\delta^{k}+r_{t+1}$, eliminating all capital income tax revenues.

In sum, the depreciation allowance is a tax break but does not solve the distortion, except by eliminating the tax altogether. The initial tax τ_{0}^{k} does not distort. If bounded above by 100%, all it taxes is the capital income in period zero, as is clear from (7).

Taxing capital with an allowance for investment: The Abel tax If instead of an allowance for depreciation, the tax base of capital income allowed for the deduction

of investment, with full investment expensing, the flow of funds constraint of the representative household would then be written as

$$\begin{aligned}\frac{1}{1+r_{t+1}}b_{t+1}+k_{t+1}-\left(1-\delta^{k}\right)k_{t} &\leq b_{t}+\left(1-\tau_{t}^{d}\right)u_{t}^{k}k_{t}+\tau_{t}^{d}\left[k_{t+1}-\left(1-\delta^{k}\right)k_{t}\right]\\ +\left(1-\tau_{t}^{n}\right)w_{t}n_{t}-\left(1+\tau_{t}^{c}\right)c_{t}, \text{ for } t &\geq 0,\end{aligned}$$

where we now call this tax τ_t^d, since it resembles more a dividend tax, rather than a capital income tax or profit tax. This tax includes a positive deduction as long as investment is positive, $k_{t+1}-\left(1-\delta^{k}\right)k_{t}\geq 0$. The deduction would be negative otherwise.

The returns on bonds and capital are equated if

$$1+r_{t+1}=\frac{1-\tau_{t+1}^{d}}{1-\tau_{t}^{d}}\left(1-\delta^{k}+u_{t+1}^{k}\right),$$

so that the intertemporal wedge is now described by

$$\frac{u_{c,t}}{\beta u_{c,t+1}}=\frac{1+\tau_{t}^{c}}{1+\tau_{t+1}^{c}}\frac{1-\tau_{t+1}^{d}}{1-\tau_{t}^{d}}\left(1-\delta^{k}+F_{k,t+1}\right). \tag{15}$$

which compares to (14). If the tax rate on capital income is constant, $\tau_t^d=\tau^d$, $t\geq 0$, then there is no intertemporal distortion. As the tax rate approaches one, the initial capital is fully taxed. Indeed, the single intertemporal budget constraint can be written as

$$\sum_{t=0}^{\infty}q_{t}\left[\left(1+\tau_{t}^{c}\right)c_{t}-\left(1-\tau_{t}^{n}\right)w_{t}n_{t}\right]=b_{0}+\left(1-\tau_{0}^{d}\right)\left(1-\delta^{k}+u_{0}^{k}\right)k_{0}.$$

If $\tau_0^d=\tau^d\to 1$, no distortions are imposed and all the preexistent capital stock is confiscated.

Ramsey optimal taxation assumes that the government is able to commit to a policy path. A government that is able to commit to future policies is likely to be a government that must honor previous commitments. That may rule out unanticipated confiscatory taxation, preventing the welfare gains from non-distortionary taxes on both capital or housing income.

An alternative decentralization with capital accumulation by the firm Suppose now that a representative firm produces and invests in order to maximize the present value of dividends, net of taxes, $\sum_{t=0}^{\infty}q_t\left(1-\tau_t^d\right)d_t$, where τ_t^d are dividend taxes. The tax τ_t^k is now a profit tax with an allowance for depreciation at fiscal rate $\delta^{k\prime}$. The present value of dividends is

$$\sum_{t=0}^{\infty}q_{t}\left(1-\tau_{t}^{d}\right)\left\{\left(1-\tau_{t}^{k}\right)\left[F(k_{t},n_{t})-w_{t}n_{t}\right]+\tau_{t}^{k}\delta^{k\prime}k_{t}-k_{t+1}+(1-\delta^{k})k_{t}\right\}.$$

The firm chooses labor and capital to maximize the value of dividends according to $F_{n,t}=w_t$, and

$$\frac{q_{t}}{q_{t+1}}=\frac{1-\tau_{t+1}^{d}}{1-\tau_{t}^{d}}\left[1+\left(1-\tau_{t+1}^{k}\right)\left(F_{k,t+1}-\delta^{k}\right)+\tau_{t+1}^{k}\left(\delta^{k\prime}-\delta^{k}\right)\right]. \tag{16}$$

The household owns the firm and receives the dividends. The present value budget constraint of the household is

$$\sum_{t=0}^{\infty} q_t \left[\left(1+\tau_t^c\right) c_t - \left(1-\tau_t^n\right) w_t n_t \right] \leq \sum_{t=0}^{\infty} q_t \left(1-\tau_t^d\right) d_t + b_0.$$

The household marginal conditions are the same as before, (4) and (5), except for the arbitrage condition on bonds and capital, (6), that was replaced by the analog condition for the firm (16) since here it is the firm that makes those choices.

The competitive equilibrium wedges are now

$$\frac{u_{c,t}}{-u_{n,t}} = \frac{1+\tau_t^c}{\left(1-\tau_t^n\right) F_{n,t}}, \tag{17}$$

$$\frac{u_{c,t}}{\beta u_{c,t+1}} = \frac{1+\tau_t^c}{1+\tau_{t+1}^c} \frac{1-\tau_{t+1}^d}{1-\tau_t^d} \left[1 + \left(1-\tau_{t+1}^k\right) \left(F_{k,t+1} - \delta^k\right) + \tau_{t+1}^k \left(\delta^{k\prime} - \delta^k\right) \right]. \tag{18}$$

The present value of dividends can be written as

$$\sum_{t=0}^{\infty} q_t \left(1-\tau_t^d\right) d_t = \left(1-\tau_0^d\right) \left[F_{k,0} + 1 - \delta - \tau_0^k \left(F_{k,0} - \delta^{k\prime}\right) \right] k_0$$

so, as long as the dividend tax is constant over time, $\tau_t^d = \tau^d, t \geq 0$, the tax causes no intertemporal distortions.

The dividend tax on the firm is equivalent to the Abel (2007) tax on capital income with a full investment deduction. Both the Ramsey optimal solution and the decentralization coincide in the two economies. This alternative decentralization makes it apparent that capital income should be taxed as dividends at a non-distortionary constant rate while the profits of the firm should not be taxed.

Heterogeneity and distribution Would the Ramsey optimal solution be any different if the economy had heterogeneous agents with different initial wealth levels? In this economy, if we were to consider heterogeneous agents sharing the same isoelastic preferences but with different levels of initial wealth, the optimal tax on the accumulation of capital is zero, as in the case with the representative agent. This is again an application of the Diamond and Mirrlees (1971) result of production efficiency. See Chari, Nicolini and Teles (2020) for a formal discussion of the argument. Depending on the distribution of wealth and on the welfare weights of the different agents, the constant tax on dividends could be used as a redistributive tool.

3. A model with capital and housing

We now turn our attention to the optimal taxation of housing which is the main focus of this article. The analyzes follows closely Correia, Reis and Teles (2020). Should housing be treated like capital, so that no distortions should be imposed on the accumulation of housing? On the other hand, people get utility out of housing services. Services

and goods should, in general, be taxed at comparable rates. Does this mean that accumulation of housing should be distorted?

Consider a model with capital and housing. Housing is an asset that can be accumulated, like capital, but it enters the utility function. The preferences of a representative household, over consumption c_t, housing h_t^u and labor n_t, are described by $\sum_{t=0}^{\infty}\beta^t u\left(c_t, h_t^u, n_t\right)$ where

$$u\left(c_t, h_t^u, n_t\right) = \frac{c_t^{1-\sigma^c}-1}{1-\sigma^c} + \frac{\left(h_t^u\right)^{1-\sigma^h}-1}{1-\sigma^h} - \eta n_t^{1+\psi}. \tag{19}$$

with $\sigma^c > 0$, $\sigma^h > 0$, and $\psi > 0$. We assume, again, separability and constant elasticity. When $\sigma^c = \sigma^h$, the function is separable in leisure and homothetic in the two goods, consumption and housing services.

The production technology is described by

$$c_t + g_t + h_{t+1}^u - \left(1-\delta^h\right)h_t^u + k_{t+1} - \left(1-\delta^k\right)k_t \leq F\left(k_t, n_t\right) \tag{20}$$

where h_t^u is housing, and δ^h is the depreciation rate of housing.

The equilibrium implementation assumes that the household owns the capital stock and rents it out to the representative firm every period at rate u_t^k. We will be distinguishing between the housing in which the household lives, h_t^u, and the housing the household owns, h_t. The household chooses both, even if in equilibrium they must be equal. The household also accumulates real debt, b_t. The household pays taxes on income from rents on houses owned, τ_t^h, on the rent (or imputed rent) on the house that the household lives in (a tax on housing services), $\tau_t^{h^u}$, pays taxes on capital income, τ_t^k, and on labor income, τ_t^n. There is also a consumption tax, τ_t^c, and a tax on the investment in housing, $\tau_t^{h^i}$. The reason we assume that there is a tax on investment in housing and not on investment in capital is that housing in this model is a final good that would be taxed with a value-added tax, while capital is an intermediate good in production. The flow of funds constraint is, for $t \geq 0$,

$$\begin{aligned}
&\frac{1}{1+r_{t+1}}b_{t+1} + k_{t+1} - \left(1-\delta^k\right)k_t + \left(1+\tau_t^{h^i}\right)\left[h_{t+1} - \left(1-\delta^h\right)h_t\right] \\
\leq\ & b_t + \left(1-\tau_t^k\right)u_t^k k_t + \left(1-\tau_t^h\right)u_t^h h_t + \left(1-\tau_t^n\right)w_t n_t - \left(1+\tau_t^c\right)c_t - \left(1+\tau_t^{h^u}\right)u_t^h h_t^u
\end{aligned}$$

The household maximizes utility (19), subject to these constraints, together with a no-Ponzi games condition.

A representative firm produces output that can be used as consumption, capital, housing or government consumption.

The competitive equilibrium In a competitive equilibrium, the returns on bonds, housing and capital must be equal,

$$1 + r_{t+1} = \frac{\left(1+\tau_{t+1}^{h^i}\right)\left(1-\delta^h\right) + \left(1-\tau_{t+1}^h\right)u_{t+1}^h}{1+\tau_t^{h^i}} \tag{21}$$

and

$$1 + r_{t+1} = 1 - \delta^k + \left(1 - \tau_{t+1}^k\right) u_{t+1}^k. \tag{22}$$

Using these arbitrage conditions, the single budget constraint for the household is

$$\begin{aligned} & \sum_{t=0}^{\infty} q_t \left[\left(1 + \tau_t^c\right) c_t - \left(1 - \tau_t^n\right) w_t n_t\right] + \sum_{t=0}^{\infty} q_t \left(1 + \tau_t^{h^u}\right) u_t^h h_t^u + \\ \leq \quad & b_0 + \left[1 - \delta^k + \left(1 - \tau_0^k\right) u_0^k\right] k_0 + \left[\left(1 + \tau_0^{h^i}\right)\left(1 - \delta^h\right) + \left(1 - \tau_0^h\right) u_0^h\right] h_0 \end{aligned}$$

where $q_t = \frac{1}{(1+r_1)...(1+r_t)}$ for $t \geq 1$, with $q_0 = 1$.

The household choices must also satisfy (4), (5) and

$$\frac{u_{h^u,t}}{u_{c,t}} = \frac{\left(1 + \tau_t^{h^u}\right) u_t^h}{1 + \tau_t^c}. \tag{23}$$

The marginal conditions for the firm are (8).

The equilibrium wedges can then be summarized by

$$\frac{u_{c,t}}{-u_{n,t}} = \frac{1 + \tau_t^c}{\left(1 - \tau_t^n\right) F_{n,t}}, \tag{24}$$

$$\frac{u_{c,t}}{\beta u_{c,t+1}} = \frac{1 + \tau_t^c}{1 + \tau_{t+1}^c}\left[1 - \delta^k + \left(1 - \tau_{t+1}^k\right) F_{k,t+1}\right] \tag{25}$$

and

$$\frac{\left(1 + \tau_{t+1}^{h^i}\right)\left(1 - \delta^h\right)}{1 + \tau_t^{h^i}} + \frac{\left(1 - \tau_{t+1}^h\right)\left(1 + \tau_{t+1}^c\right)}{\left(1 + \tau_t^{h^i}\right)\left(1 + \tau_{t+1}^{h^u}\right)} \frac{u_{h^u,t+1}}{u_{c,t+1}} = 1 - \delta^k + \left(1 - \tau_{t+1}^k\right) F_{k,t+1} \tag{26}$$

If the tax rates on capital income were set to zero, $\tau_{t+1}^k = 0$, and if the other taxes were constant over time, $\tau_t^c = \tau^c$, $\tau_{t+1}^h = \tau^h$, $\tau_{t+1}^{h^u} = \tau^{h^u}$, $\tau_t^{h^i} = \tau^{h^i}$, $\tau_t^n = \tau^n$, $t \geq 0$, the distortions would be result of the combined taxes on consumption and labor income on the intratemporal margin,

$$\frac{u_{c,t}}{-u_{n,t}} = \frac{1 + \tau^c}{\left(1 - \tau^n\right) F_{n,t}}, \tag{27}$$

and the distortion resulting from the differential taxation of consumption and housing in

$$1 - \delta^h + \frac{\left(1 + \tau^c\right)\left(1 - \tau^h\right)}{\left(1 + \tau^{h^i}\right)\left(1 + \tau^{h^u}\right)} \frac{u_{h^u,t+1}}{u_{c,t+1}} = 1 - \delta^k + F_{k,t+1}. \tag{28}$$

If the joint tax on housing would be equal to the consumption tax, $1 + \tau^c = \left(1 + \tau^{h^i}\right)\left(1 + \tau^{h^u}\right) / \left(1 - \tau^h\right)$, the only distortion would be in the margin between consumption and leisure (or between housing services and leisure) and it would be a constant distortion over time.

Taxation of capital and housing income with an investment deduction We now consider that the taxes on income from capital and housing allow for an investment

deduction, as in the Abel tax. The deduction of the investment in housing is gross of investment taxes. We call these taxes τ_t^{dh} and τ_t^{dk}, on housing and capital, respectively, where d stands for dividends. The budget constraint of the household is, for $t \geq 0$,

$$\begin{aligned}
&\frac{1}{1+r_{t+1}} b_{t+1} + \left(1-\tau_t^{dk}\right)\left[k_{t+1} - \left(1-\delta^k\right)k_t\right] \\
&+ \left(1-\tau_t^{dh}\right)\left(1+\tau_t^{h^i}\right)\left[h_{t+1} - \left(1-\delta^h\right)h_t\right] \\
\leq\ & b_t + \left(1-\tau_t^{dk}\right)u_t^k k_t + \left(1-\tau_t^{dh}\right)u_t^h h_t + \left(1-\tau_t^n\right)w_t n_t - \left(1+\tau_t^c\right)c_t - \left(1+\tau_t^{h^u}\right)u_t^h h_t^u
\end{aligned}$$

The marginal conditions of the households are (4), (5), (23) together with

$$1 + r_{t+1} = \frac{\left(1-\tau_{t+1}^{dh}\right)\left(1+\tau_{t+1}^{h^i}\right)\left(1-\delta^h\right)}{\left(1-\tau_t^{dh}\right)\left(1+\tau_t^{h^i}\right)} + \frac{\left(1-\tau_{t+1}^{dh}\right)u_{t+1}^h}{\left(1-\tau_t^{dh}\right)\left(1+\tau_t^{h^i}\right)}$$

$$1 + r_{t+1} = \frac{1-\tau_{t+1}^{dk}}{1-\tau_t^{dk}}\left(1-\delta^k + u_{t+1}^k\right)$$

The marginal conditions of the competitive equilibrium can now be summarized as (24),

$$\frac{u_{c,t}}{\beta u_{c,t+1}} = \frac{1+\tau_t^c}{1+\tau_{t+1}^c}\frac{1-\tau_{t+1}^{dk}}{1-\tau_t^{dk}}\left(1-\delta^k + F_{k,t+1}\right) \tag{29}$$

and

$$\begin{aligned}
&\frac{\left(1-\tau_{t+1}^{dh}\right)\left(1+\tau_{t+1}^{h^i}\right)}{\left(1-\tau_t^{dh}\right)\left(1+\tau_t^{h^i}\right)}\left(1-\delta^h\right) + \frac{1-\tau_{t+1}^{dh}}{\left(1-\tau_t^{dh}\right)\left(1+\tau_t^{h^i}\right)}\frac{1+\tau_{t+1}^c}{1+\tau_{t+1}^{h^u}}\frac{u_{h^u,t+1}}{u_{c,t+1}} \\
=\ & \frac{1-\tau_{t+1}^{dk}}{1-\tau_t^{dk}}\left(1-\delta^k + F_{k,t+1}\right).
\end{aligned} \tag{30}$$

As long as the tax rates on capital and housing income are constant over time, $\tau_t^{dk} = \tau^{dk}$ and $\tau_t^{dh} = \tau^{dh}$, those taxes impose no distortions regardless of the levels. If, in addition, the other taxes are also constant over time, then condition (30) becomes

$$1 - \delta^h + \frac{1+\tau^c}{\left(1+\tau^{h^i}\right)\left(1+\tau^{h^u}\right)}\frac{u_{h^u,t+1}}{u_{c,t+1}} = F_{k,t+1} + 1 - \delta^k. \tag{31}$$

There is no wedge on this margin as long as the tax rate on housing services, either through τ^{h^i} or τ^{h^u} is equal to the consumption tax. Only consumption and housing services are distorted relative to leisure at the same constant rate over time. The intratemporal margin, (24), is distorted by $\left(1+\tau^c\right)/\left(1-\tau^n\right)$, and there are no distortions on the other two margins, (29) and (30).

The present value budget constraint in this case is

$$\begin{aligned}
&\sum_{t=0}^{\infty} q_t\left[\left(1+\tau_t^c\right)c_t - \left(1-\tau_t^n\right)w_t n_t\right] + \sum_{t=0}^{\infty} q_{t+1}\left(1+\tau_{t+1}^{h^u}\right)u_{t+1}^h h_{t+1}^u + \\
\leq\ & b_0 + \left(1-\tau_0^{dk}\right)\left[1-\delta^k + u_0^k\right]k_0 + \left(1-\tau_0^{dh}\right)\left[\left(1+\tau_0^{h^i}\right)\left(1-\delta^h\right) - \frac{\tau_0^{dh}+\tau_0^{h^u}}{1-\tau_0^{dh}}u_0^h\right]h_0^u.
\end{aligned}$$

Constant dividend-like taxes on capital and housing income that would be confiscating the pre-existent levels of capital and housing without distorting the accumulation.

The Ramsey problem The Ramsey problem is to maximize utility (19), subject to the resource constraints (2), and the implementability condition

$$\sum_{t=0}^{\infty}\beta^{t}\left[u_{c,t}c_{t}+u_{n,t}n_{t}\right]+\sum_{t=0}^{\infty}\beta^{t+1}u_{h^{u},t+1}h_{t+1}^{u}=W_{0}$$

where

$$\begin{aligned}W_{0} &= \frac{u_{c,0}}{1+\tau_{0}^{c}}\left[b_{0}+\left[1-\delta^{k}+\left(1-\tau_{0}^{k}\right)F_{k,0}\right]k_{0}\right]\\ &\quad+\frac{u_{c,0}}{1+\tau_{0}^{c}}\left[1-\delta^{h}-\left(\tau_{0}^{h}+\tau_{0}^{h^{u}}\right)\frac{u_{h^{u},0}\left(1+\tau_{0}^{c}\right)}{u_{c,0}\left(1+\tau_{0}^{h^{u}}\right)}\right]h_{0}^{u},\end{aligned}$$

when the tax rate on capital and housing income does not allow for any deductions, or

$$\begin{aligned}W_{0} &= \frac{u_{c,0}}{1+\tau_{0}^{c}}\left[b_{0}+\left(1-\tau_{0}^{dk}\right)\left[1-\delta^{k}+F_{k,0}\right]k_{0}\right]\\ &\quad+\frac{u_{c,0}}{1+\tau_{0}^{c}}\left(1-\tau_{0}^{dh}\right)\left(\left(1+\tau_{0}^{h^{i}}\right)\left(1-\delta^{h}\right)-\frac{\tau_{0}^{dh}+\tau_{0}^{h^{u}}}{1-\tau_{0}^{dh}}\frac{u_{h,0}\left(1+\tau_{0}^{c}\right)}{u_{c,0}\left(1+\tau_{0}^{h^{u}}\right)}\right)h_{0}^{u},\end{aligned}$$

when the tax on capital and housing income allows for the deduction of investment.

The first order conditions of the Ramsey problem treating W_0 as exogenous include:

$$\frac{u_{c,t}}{-u_{n,t}}\frac{1+\varphi\left(1-\sigma^{c}\right)}{1+\varphi\left(1+\psi\right)}=\frac{1}{F_{n,t}},\ t\geq 0, \tag{32}$$

$$\frac{u_{c,t}}{\beta u_{c,t+1}}=1-\delta^{k}+F_{k,t+1},\ t\geq 0, \tag{33}$$

$$\frac{1+\varphi\left(1-\sigma^{h}\right)}{1+\varphi\left(1-\sigma^{c}\right)}\frac{u_{h,t+1}}{u_{c,t+1}}-\delta^{h}=F_{k,t+1}-\delta^{k}. \tag{34}$$

With these constant elasticity preferences, intratemporal distortions should be constant. Furthermore if the consumption and housing price elasticities coincide, $\sigma^{c}=\sigma^{h}$, then there should be no distortions on the margin (34).

Preferences with $\sigma^{h}=\sigma^{c}$ are homothetic in consumption and housing services, and separable in leisure, and they are also homothetic over labor in different periods. The optimal solution is to have consumption and housing services taxed at the same constant rate. This is achieved with a constant labor income tax, $\tau_{t}^{n}=\tau^{n}$, $t\geq 0$, a constant consumption tax, $\tau_{t}^{c}=\tau^{c}$, $t\geq 0$, and a constant tax on investment in housing equal to the consumption tax, $\tau_{t}^{h^{i}}=\tau^{h^{i}}=\tau^{c}$, $t\geq 0$. Taxes on housing services would then be set to zero, $\tau_{t+1}^{hu}=0$, $t\geq 0$. The same allocation can be achieved with a zero tax on investment in housing and a tax on rents (actual and imputed) equal to the consumption tax, $\tau_{t+1}^{h^{u}}=\tau^{h^{u}}=\tau^{c}$.

In the economy with investment expensing, the taxes on capital and housing income should be constant.

In sum, if housing investment is taxed with a consumption-type tax, as is the case in most economies with value added taxes, then there is no need to use any other taxes on housing services or income. Furthermore value-added taxes at different rates are able to accommodate differential elasticities between consumption and housing services.

4. Concluding remarks

There are two main lessons from the analysis in this note that follows closely Chari et al. (2020) and Correia et al. (2017). First, taxation of any form of capital or housing income should allow for full investment expensing. Second, there is no need for any other form of taxation of housing services other than labor and/or value added taxes applied to all consumption goods and services including housing.

We have assumed preferences with constant consumption and labor elasticities. If consumption and housing services share the same elasticity, then the solution of the optimal taxation problem is very simple. A constant value-added tax applied to all goods including housing, possibly complemented with a labor income tax, is all that is needed to implement the optimal wedges. Departing from constant-elasticity preferences is going to result in deviations from this simple prescription, but the constant tax result is still a useful benchmark. Finally, constant taxes on capital and housing income, with full investment expensing, can take care of the desired initial confiscation.

In the extreme simplicity of the set up that we use here, the confiscation of the installed capital or housing stock is efficient. This is true because we are abstracting from important features in firm dynamics and also from reputational concerns.

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