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Fiscal Sustainability in Aging Societies: Evidence from Euro Area Countries

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Abstract: Fiscal sustainability remains a paramount challenge in the Euro Area (EA) countries after the sharp rise in public debt-to-GDP ratios in the aftermath of the financial crisis of 2008. Using data from 11 EA countries over the period 1980–2019, we apply panel data techniques to examine the effects of population aging on fiscal sustainability, controlling for key macroeconomic variables. Our results suggest that the discretionary fiscal policy is strongly persistent, not being consistent with long-term fiscal solvency. Moreover, our results indicate that the fiscal stance is countercyclical for the countries under study and that population aging poses a major challenge for fiscal sustainability. The findings are robust to a different grouping of countries within the sample (core and peripheral countries, relatively old and young countries, and relatively more and less indebted countries). We consider that our results may have some practical meaning for national policymakers and international organizations responsible for regional and global fiscal surveillance and might shed some light on the possible effects that population aging could have on the effort of EA countries to restore public finances on a sustainable basis.

Keywords: fiscal sustainability; fiscal policy; population aging; fiscal solvency; Euro Area countries

1. Introduction

The prompt response of fiscal spending is crucial to face and counteract adverse shocks in scenarios characterized by unfavorable macroeconomic conditions (Chalk and Hemming [1]; Aldama and Creel [2]). Advanced countries have encountered greater fiscal pressure in recent years as expansionary fiscal policies have been used to combat economic weakness, generating larger levels of public debt and threatening long-term fiscal sustainability.

In this respect, Fatas and Mihov [3] and Claey's [4] warn that if the deterioration of the fiscal policy is not addressed in the short or the medium term, this situation can provoke a fiscal crisis. There have been several authors who have analyzed whether the fiscal policy can generate enough net revenues in the future to compensate for the accumulated debt and the corresponding interests. This condition is known as the Intertemporal Budget Constraint (IBC), and it has been studied for numerous countries and periods with different methodologies (see, for instance, Wilcox [5], Gerson and Nellor [6], Tanner and Li [7], Quintos [8], Uctum and Wickens [9], Cipollini [10], Auerbach et al. [11], Jha and Sharma [12], Bajo-Rubio et al. [13], Lima et al. [14], Gabriel and Sangduan [15], to name a few) (Moody's suggests an alternative measurement: the ratio of annual interest payments required to maintain a government's debt to its annual tax revenues. Moody's argues that "debt affordability" is a better measure because of how much flexibility a government has for other spending is determined by its past debt accumulation

(Moody's Investors Service [16]). We are very grateful to an anonymous referee for suggesting this alternative approach, which we will explore in a future paper).

Ensuring the long-term sustainability of public finances in the Euro Area (EA) and its member countries is a prerequisite for the smooth functioning of the European Economic and Monetary Union (EMU) (the Maastricht Treaty Article 109j(1) establishes the fiscal sustainability as one main criterion for a country to join EMU). EA countries face historically unprecedented public debt burdens (for some countries, like Greece and Italy, the precrisis level of debt was too high (see Gómez-Puig and Sosvilla-Rivero [17]). European Commission [18] contends that fiscal solvency is not sustainable in the long run, stressing that government primary deficits must be adjusted by around 6 percentage points of GDP) that have been aggravated by the COVID-19 pandemic as budget balances further deteriorate because of the severe economic downturn, reducing fiscal space and resurfacing the possibility of a new European sovereign debt crisis. Attaining long-term debt sustainability will require sustained fiscal consolidation over the next one or two decades that will be conditioned by extremely high old-age dependency ratios.

Indeed, aging is a significant economic, fiscal, and social challenge, having a dramatic impact on labor markets, economic growth, social structures, and government budgets. Yoshino et al. [19] highlight the multifaceted impact of population aging not only on savings and investment but also in terms of productivity and ineffectiveness of macroeconomic policies. They emphasize the lower productivity and henceforth lower economic growth, because elderlies have a lower capacity in comparative terms adopting new technologies and innovation. Furthermore, to exert downward pressure on all components of potential growth, population aging increases aging-related public expenditures (pensions, health care, and long-term care) (for the period 2016–2070, European Commission [20] projects that the total cost of aging in the Euro Area as a whole is going to rise from 26% of GDP in 2016 by 1.1 percentage points in the baseline scenario up to 2070), compromising fiscal policy sustainability (see for instance Corsetti and Roubini [21], Alesina [22], Adema et al. [23], among others). In this respect, the United Nations [24] projections indicate that the population aged 60 or above in the world is expected to be 1.4 billion in 2030 and 2.1 billion in 2050. Moreover, according to the European Commission [25], from about 29% in 2010, the demographic old-age dependency ratio has risen to 34% in 2019 and is projected to rise further, to 59% in 2070 across the European Union (EU) countries due to a vital reduction in fertility rates, low immigration flows, and higher life expectancy. Even though it is a global concern, this pattern is particularly important for EA countries because public spending on pension and healthcare represent almost 20% of GDP currently in the EU (Arévalo et al. [26]).

It is well known that pension systems within the EU member states differ from each other concerning pension schemes, eligibility requirements, demographic structures, among other factors (Bayar [27] and Herce [28]). Nevertheless, they all share three common pillars: public pensions, funded occupational pensions, and personal pension plans. The evolution of the old-age dependency ratio has significantly increased for the advanced countries due to increases in the life expectancy and therefore the expected projection continues growing. Moreover, in conjunction with the low fertility rates, this leads to a serious concern in the pay-as-you-go (PAYG) pension system given that pension benefits are paid with the contribution of the active population. Therefore, the situation highlights higher pressure from the expenses of old-age public pension schemes and therefore to the government primary balance (Auerbach [29]). To enhance fiscal sustainability, while maintaining adequate pension income, most EU Member States have carried out gradual and substantial pension reforms over the last decades (see, e.g., Carone et al. [30]) (the intensity of pension reforms has been particularly strong since 2000. These reforms generally comprised a wide range of measures: changes in the number of years used in benefit calculation, changes in the number of years used in benefit calculation, changing indexation of pensions in payment and linking pensions to higher life expectancy, among others (Carone et al. [30])).

The central point of this study is to evaluate whether or not government behavior is consistent with the government's IBC by assessing fiscal sustainability of the 11 EA countries over the period

1980–2019 with panel data techniques. To that end, in addition to macroeconomic variables that have been consistently associated with fiscal sustainability, considering the projections of European Commission [20] about old-age dependency ratio, we focus especially on the impact of aging in the government's IBC. Additionally, we also explore whether the determinants on the fiscal reaction functions are dissimilar for a different grouping of countries within the sample (core and peripheral countries, relatively old and young countries, and relatively more and less indebted countries).

The remainder of the paper is structured as follows. Section 2 provides a literature review. Section 3 analyses with detail the most important definitions of the fiscal sustainability concept. Section 4 describes the data and the explanatory variables used in this study and it assesses its time-series properties. Section 5 introduces the analytical framework and presents the econometric methodology. Empirical results are offered in Section 6. Finally, some concluding remarks and policy implications are provided in Section 7. An online Supplementary Materials provides details of additional analyses.

2. Literature Review

There is a growing strand of literature focused on the analysis of the fiscal sustainability among different countries and periods (see for instance Reinhart et al. [31], Arghyrou and Luintel [32], Byrne et al. [33], Armstrong and Okimoto [34], among others).

According to Wilcox [5], government IBC holds when the present value of public debt asymptotically converges to zero. One of the main accepted sustainability tests is that proposed by Bohn [35,36]. The positive relationship between the debt-GDP ratio and the government primary balance-GDP ratio indicates that public debt policy is sustainable. The economic intuition is that when the government faces a context of increasing debt today, corrective actions will be needed in the future to guarantee a sustainable fiscal policy. In other words, the debt-GDP ratio series should be mean-reverting. This condition holds when the primary surplus strongly reacts to higher levels of debt, implying that the reaction parameter is adequately high. Another possible instrument to determine the soundness of fiscal policies is the fiscal policy reaction functions in which the requirement to guarantee the fiscal deficit sustainability is that the government primary balance should increase at least linearly with public debt.

There is no consensus on which is the optimal response of the fiscal policy. On the one hand, Bohn [36] considers that fiscal consolidation (i.e., minimizing deficits) is the best option to restore fiscal solvency when the public debt reaches high levels. In the same line, Auerbach et al. [11] computing a required tax hike, conclude that a spending cut is required to satisfy the present-value borrowing constraint in the United States (the present-value borrowing constraint holds when the fiscal policy is expected to generate sufficient net revenues on the future to repay the accumulated debt and interest payments (Hamilton and Flavin [37])). Primary surpluses are also essential for Giannitsarou and Scott [38] to achieve IBC. Nevertheless, authors such as Ghosh et al. [39] or Eichengreen and Panizza [40] stress the so-called fiscal fatigue standing out the risks of dampening the economy (a government displays fiscal fatigue when its ability to increase primary balances cannot keep pace with rising debt (Ghosh et al. [39])). When examining this issue for the EA countries during the 1980–2013 period, Echevarria-Icaza [41] shows that the reaction of the primary balance to rising debt depends on the underlying growth and institutional dynamics. He also finds that rising debt, when accompanied by growth and a favorable political context, may lead to an improvement in the primary balance).

The theoretical literature has proposed several conditions to obtain fiscal solvency, although the analytical definition is not straightforward (Balassone and Franco [42]). The empirical literature of fiscal reaction functions proposed by Bohn [36] has been developed and extended by other authors (Greiner et al. [43], Checherita-Westphal and Zdarek [44], Eichengreen and Panizza [40], Burger et al. [45], Celasun et al. [46], among others). Linear specifications have been commonly implemented in the study of the relationship between sovereign debt and the primary balance (see, for instance, Bohn [47], Celasun et al. [46], Giannitsarou and Scott [38], Medeiros [48], among others). Furthermore, nonlinear specifications have been tested to analyze fiscal sustainability (Legrenzi and Milas [49] and Fournier and

Fall [50]). In particular, a cubic relationship is detected by Ghosh et al. [39] for 23 advanced economies: at low debt levels, there is no significant link, as public debt rises the primary balance reacts in the same direction, and finally for very high levels of debt, the primary balance decreases.

Recent studies have introduced more factors to assess how fiscal policy increases the government debt to GDP ratio. This approach called “the stock-flow adjustment” (Camarero et al. [51]). In the same line, Mauro et al. [52] study the main determinants on the primary fiscal balance behavior for 55 countries for up to 200 years. In particular, they found that when inflation is high, or the potential economic performance deteriorates unexpectedly, the policy response is significantly weaker. This finding means that the increment in primary fiscal balance in response to rising debt is not so high. However, when the sovereign borrowing costs increase, a stronger policy is detected to guarantee fiscal sustainability.

To assess whether the government debt of the G-7 and some European countries is sustainable, Chen [53] adopts the threshold autoregressive (TAR) and the momentum threshold autoregressive (MTAR) to include the possibility of an asymmetric adjustment of the government deficits. Additionally, he implements the LSTR-TAR and LSTR-MTAR unit root tests to identify the nonlinear relationship without specifying the threshold in advance. In this case, some countries are characterized by supporting a violation of fiscal sustainability using the standard unit root tests. Nevertheless, Canada, Germany, Italy, and the US show that the IBC is sustainable. These results are in line with the findings of, to name a few, Sarno [54], Arestis et al. [55], Bajo-Rubio et al. [13] and [56] and Payne and Mohammadi [57]. Considering cointegration analysis based on the fully modified OLS panel estimation method, Afonso and Jalles [58] cannot confirm that some of the European countries during 1970–2010 show a sustainable fiscal policy, given that the average marginal long-run impact is zero. Paniagua et al. [59] estimate a time-varying fiscal reaction function for EA countries during the 1970–2014 period using the Kalman filter, observing differences among countries on the way and timing they manage their public finances and concluding that temporary deviation to fiscal commitment due to the moral hazard associated with bailouts. Fincke and Greiner [60] apply alternative tests to analyze the reaction of the primary surplus to debt variation to determine whether some EA countries pursue sustainable debt policies, obtaining that Italy, France, Austria, Germany, and Portugal experienced sustainable policies under the 1979–2009 period. Even though for some European countries the fiscal policy is not sustainable during 1970–2006, Afonso and Rault [61] claim that the first difference of the stock of real government debt series is integrated of order zero for the EU-15 panel set, meaning that solvency condition holds and therefore the necessary condition for fiscal policy sustainability is satisfied.

Moreover, Stoian et al. [62] develop a new methodology (V-L-D) to assess the vulnerability of fiscal policy for 28 EU countries during 1990–2013 period. This approach is based on two measures: the vulnerabilities indicated by the level of the cyclically adjusted government balance and the distance to stability; and the vulnerabilities detected through changes in sovereign debt and cyclically adjusted budget balance. They detect 310 episodes of fiscal vulnerability, out of which 128 episodes of low vulnerability, 94 of moderate, 62 of strong, and 26 of extreme fiscal vulnerability.

Another strand of papers examines the impact of the population aging on fiscal sustainability. Some authors (Howse [63], Martin and Whitehouse [64], Schneider [65], Zaidi [66], Grech [67], among others) have examined the medium and long-term sustainability of public pension expenditures. Given that the government’s ability to collect tax revenues is jeopardized and simultaneously the healthcare spending is becoming more and more important, these facts can generate a serious burden on public finance. As it is well known, the lower productivity leads to a decrease in economic growth, henceforth this implies a crucial reduction in revenues and savings threaten economic and financial sustainability. For instance, Van Der Gaag and de Beer [68] emphasize that the Europe 2020 employment targets would be not sufficient to compensate for the demographic burden on economic growth for the EU countries. Additionally, the decline in savings motivated by the aging trend in the European countries not only imposes a limitation in the potential output growth but also it implies imbalances in

social security that will threaten debt sustainability (Castro et al. [69]). Afonso and Rault [61] warn that the combination of population aging and insufficient funded public pension schemes will endanger solvency condition for the European countries.

For their part, Yoshino and Miyamoto [70] also underline the ineffectiveness of the monetary policy, since the effect of an expansionary policy on consumption is smaller in aging economies as elderlies are more inelastic because of the restricted income and fixed spending pattern.

Following Hauner et al. [71], IMF [72], Auerbach [73], among others, reforms should go in line with the consolidation of public finances, trying to reduce public debt levels to accommodate future deficits. Behind this statement is the tax smoothing argument developed by Barro [74] in which tax distortions are minimized. It means that taxes should be determined at a level consistent with long-run revenue requirements according to political decided expenditures. Based on this argument, these authors emphasize that this consolidation is crucial to be ensured prior to the demographic changes taking full effect. Flodén [75] also stands out the prefunding to ensure fiscal sustainability given changes in the dependency ratio. This author underscores the consolidation of public finances as the best option based on the consumption smoothing since the burden is almost shared across different generations. One of the main results of Andersen [76] is that changes in longevity have a direct utility effect, which provokes different implications for fiscal sustainability in comparison to changes in dependency ratios via fertility. For this reason, Andersen [76] highlights that instead of consolidation, an increase in the retirement age is the policy recommendation more appropriated.

Decoster et al. [77], interested by the sustainability of Belgian public finances, not only study the explicit debt in the behavior of primary balance but also incorporate other factors. They identify aging and the related increase in age-related government expenditures as the main drivers in the long-term fiscal imbalance. Generational accounting concept was introduced by Auerbach et al. [78] as a possible way to explain the shortcomings of deficit accounting, since one of the crucial criticisms is that increases on the future pensions would not affect current deficit but would impact on long-run fiscal prospects. Decoster et al. [77] emphasize generational accounts as a better option to analyze repercussion not only on current but also future generations. Cooley et al. [79] quantify the growth effects from aging and from the financing of public pensions and estimate the welfare gains from pension reforms, while Emerson et al. [80] examine the potential crowding-out effect of productive investment of funding additional transfers to the elderly. Rouzet et al. [81] assess the implications of population aging across G20 economies on the sustainability of public finances, providing recommendations on policy responses to address aging-related challenges and highlights good practices. Finally, Honda and Miyamoto [82] find that, as population ages, the output effects of fiscal spending shocks are weakened and that, while high-debt countries generally face weaker fiscal multipliers, high-debt aging economies face even weaker multipliers.

For the EA, Nerlich and Schroth [83], using model simulations, find that population aging will have major macroeconomic and fiscal implications, as aging will lead to a decline in the labor supply and is likely to have adverse effects on productivity, while the implications for savings and investment will vary over time, depending on the relative size of the various cohorts and behavioral changes. Population aging will also entail changes to relative prices, mainly owing to shifts in demand, with demand for services rising, as well as adding upward pressure on public spending on pensions, health care, and long-term care.

There have been considerable studies analyzing the fiscal sustainability for the European countries based on the PAYG pension systems (see, for instance, Rother et al. [84], Angrisani et al. [85], Fehr and Habermann [86], Blake and Mayhew [87], Nannestad [88], Pianese et al. [89], Nerlich and Schroth [83], among others), with the inverse old-age dependency ratio the most common indicator used to measure the demographic sustainability.

Regarding the effects of changing age structure on the demand for health and long-term care services, Lindgren [90] reviews the large body of literature discussing this issue. A general conclusion of the empirical literature seems to be that expenditures will not be lower over remaining life-years,

but they will be distributed over a longer period. Indeed, aging leads to postponement of some costs to a later time, rather than to increases in per capita expenditure (see, e.g., Propper [91], or Wong et al. [92]).

Dolls et al. [93] evaluate the effect of demographic changes between 2010 and 2030 on labor force participation and government budgets in the EU-27. Basso and Rachedi [94] document that fiscal multipliers depend on the age structure of the population, decreasing with the share of old people in the total population.

Using a panel analysis for eighteen European countries, Afflatet [95] concludes that public debt is going to rise sharply as a consequence of the impact of population aging. Applying a DSGE model with overlapping generations in a small EA economy with the PAYG pension system, Castro et al. [69] obtain a crucial negative impact of aging on the GDP and private consumption. They emphasize that this effect would be large if the government increases the social security premium on both employers and employees. The demographic structure of the population is one of the main factors in the ability of a country to sustain its pension system detected by Heer et al. [96] using an overlapping generations life-cycle model to some European countries considering distortionary taxation on labor and capital to derive a threshold dependency ratio. In particular, their model is calibrated to quantify the level of the threshold dependency ratio and the distance of the economy from its threshold for 14 European countries, which have the highest dependency ratios in the world, to analyze the effects on the fiscal sustainability. In this analysis, they consider three possible reforms: a reduction in pension contributions, an increase in the retirement age, and partial financing using consumption taxes. These authors conclude the necessity of paying attention to the provision of public pensions with urgency, and finally, they consider that a more complete analysis considering the implications of population aging should be taken into account.

Based on a dynamic computable general equilibrium model, in a more recent study, Costantini and Sforza [97] maintain that aging trends will reduce the EU capacity to guarantee the Stability and Growth Pact disturbing the fiscal sustainability.

Arévalo et al. [26] explore the intergenerational dimension of fiscal sustainability in the EU Member States using generational accounting techniques, concluding that public finances in the EU face long-term fiscal sustainability challenges based on current policies and that there are intergenerational issues, entailing a larger adjustment for future generations.

In contrast, Hughes Hallett et al. [98] contend that fiscal sustainability is not a matter of long-term debt but is an issue of changes in taxes and spending in transition. In a more recent study, Hughes Hallett et al. [99] contend that even deteriorating population parameters, a relatively benign steady state is possible. Nevertheless, they emphasize that probably it will achieve with some fiscal and financial breakdowns along the way. In other words, they postulate that demographic change (understood as aging and social change) is not necessarily a problem as trusted fiscal rules or credible fiscal constraints are set up in advance, meaning that the golden rule of public finance is enough to guarantee fiscal sustainability. Therefore, durable dynamic adjustment paths are needed to reach a steady state.

3. Fiscal Sustainability

The most usual approach to evaluating fiscal policy sustainability is to use the nonincreasing debt to GDP ratio as a benchmark (Chalk and Hemming [1]). However, there have been other approaches. Kremers [100] outlined that if the government leads to a public debt in real terms that asymptotically grows at an average rate smaller than the interest rate, this corresponds to a situation of fiscal sustainability. Bohn [36] emphasizes that the government can achieve long-term sustainability whether primary surplus positively reacts implementing corrective actions to increases in debt–income ratio (note that Bohn [35]’s model takes into account the potential omitted variables problems, as it is based on an explicit theoretical model of fiscal policy (i.e., Barro [74]’s tax-smoothing model). For that reason, we use Bohn [35]’s model instead of those proposed by Chalk and Hemming [1] and Kremers [100]).

According to Bohn [101]'s recommendation, the government's intertemporal budget constraint expressed as percentage of GDP percentage is given by the following equation:

$$D_t = \sum_{j=0}^{\infty} \left(\frac{1+g}{1+r} \right)^{j+1} E_t GPB_{t+j+1} + \lim_{j \rightarrow \infty} \left(\frac{1+g}{1+r} \right)^{j+1} E_t D_{t+j+1} \quad (1)$$

where D_t and GPB_t represent the public debt and the government primary balance as a percentage of GDP, respectively, and E_t is the expectation operator conditional on the information available at time t . Moreover, g and r capture the real GDP growth rate and the real interest rate, respectively. The transversality of the so-called no Ponzi games condition (see for instance Arghyrou and Luintel [32], Mendoza and Ostry [102]) can be postulated as follows assuming last parameters as constant (hitherto, it has always been assumed that $r > g$, but Barrett [103] finds that for several advanced economies, $r < g$ over the very long run. Moreover, Mauro and Zhou [104] contend that this has been the norm rather than the exception during the past two centuries, not necessarily implying sovereign defaults):

$$\lim_{j \rightarrow \infty} \left(\frac{1+g}{1+r} \right)^{j+1} E_t D_{t+j+1} = 0 \quad (2)$$

In this setting, we can say that when the expected future budget surpluses, measured as present-value, are equal to its outstanding public debt, the fiscal policy is sustainable.

We test fiscal sustainability by applying a modified version of the model-based fiscal reaction function approach proposed by Bohn [36]:

$$CAGPB_{it}^* = \alpha_i + \beta debt_{i,t-1}^* + X_{i,t} + \epsilon_{i,t} \quad (3)$$

in which $CAGPB_{it}^*$ is the cyclically-adjusted government primary balance as a percentage of the potential GDP (Beqiraj et al. [105]), $debt_{i,t-1}^*$ is the (lagged) debt-potential GDP ratio and $X_{i,t}$ is a set of control variables (even though potential output is not observable and must be estimated, as suggested by Giavazzi et al. [106], dividing by actual rather than potential output would introduce a likely endogeneity bias due to the correlation between the error term and the right-hand side variables). According to Bohn [36], if β is positive, we would claim that fiscal policy is solvent in the long run. The economic intuition behind this statement is that increases in public debt must be counterbalanced with higher revenues meaning more government primary surplus. Economies may undergo stages characterized by unfavorable macroeconomic scenarios and higher government spending is needed during some periods. Nonetheless, what is remarkable is that this path cannot disrupt the long-run fiscal sustainability meaning that corrective actions are crucial.

Regarding $X_{i,t}$, in addition to a set of explanatory variables that have been consistently associated with fiscal sustainability in the empirical literature (real economic growth, financial development, output gap, and inflation rate) (as a robustness check, we also include the real effective exchange rate as a measure of competitiveness and the trade balance as it is posited to boost productivity through transfers of knowledge and efficiency gains (Seghezza and Baldwin [107])). These variables were not significant, and their inclusion did not affect the results reported in Empirical Results's section, we consider the old-dependency ratio to capture the role potential of population aging (note that our demographic component does not include pension reform aspects like the increase of the retirement age. By changing eligibility criteria and retirement incentives, reforms will affect the behavior of older workers in the coming decades. For instance, the European Commission [25] projects that effective labor market exit ages for men and women will increase by 0.9 and 1.3 years, respectively, on average in the EU by 2070. We will explore in a future paper the effects of incorporating these issues).

The rate of real growth (g) reflects the fact that in a growing economy, the debt-to-GDP ratio would fall even if the level of debt were constant.

As for the role of the development of local financial markets (*findev*), it facilitates domestic public debt and may lower the cost of government borrowing (Ismihan and Özkan [108]) (while progress has been made since 2015, after launching the European Commission an economic policy initiative for a Capital Markets Union, EU capital markets remain fragmented. An integrated and well-functioning financial system is essential for an effective and stable EMU (European Commission [109])).

Concerning the output gap (*outputgap*), it is included to identify and isolate the impact of cyclical factors not captured by the general government debt-to-potential GDP ratio (note that short-term improvements in GDP growth rate may be reversed as activity slows down, and should, therefore, not be seen as an underlying structural improvement).

Finally, the inclusion of the inflation rate (*inf*) reflects the fact inflation erodes the face value of nominal debt, creating a capital loss for investors and a capital gain for the government. Furthermore, inflation can be taken as a proxy for macroeconomic instability.

4. Data and Time-Series Properties

4.1. Data

We use annual data for 11 EA countries over the period 1980–2019. The sample selection has been conditioned by the availability of data and the requirement of employing balanced panels for some estimation commands.

In particular, our sample considers ten of the eleven EU members that launched the euro on 1 January 1999 (Austria, Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, Portugal, and Spain), plus Greece, which was admitted on 1 January 2001. Following Beqiraj et al. [105] and Bohn [101], we consider cyclically adjusted general government primary balance and the public debt as a percentage of potential GDP (as explained in OECD [110], cyclically adjusted general government primary balances are obtained from the underlying fiscal position when cyclical or automatic movements are removed from the fiscal components. Beqiraj et al. [105] contend that this variable is the correct measure of the public finance stance, providing useful information to assess whether the fiscal policy of a country is expansionary, neutral, or restrictive for a given period). Furthermore, and as mentioned above, we estimate our model controlling several macroeconomic variables to analyze the fiscal sustainability: real economic growth, real effective exchange rate, financial development, trade balance, output gap, inflation rate, and old-dependency ratio. The precise definitions and sources of the variables are presented in Appendix A.

The data have been extracted from the OECD Statistics, the World Development Indicators Database, AMECO database, and the Bank for International Settlements.

4.2. Time Series Properties

Taking into account that when the explanatory variables in the regression model are not stationary the standard assumptions for asymptotic analysis are not reliable and we cannot apply the hypothesis tests, the panel unit root tests are crucial to be applied. Sustainability is achieved regardless of the order of integration on the variables involved (Bohn [101]).

The application of the first-generation panel unit root tests is very common. However, given the interactions across countries and over time, the second-generation panel unit root tests are crucial. As Breitung and Pesaran [111] highlighted, the problem of cross-section dependence is complex to deal with since it can emerge due to several reasons such as common unobserved shocks, spillover effects, social relationships, or a combination of these features. In particular, since EMU countries are committed to consolidating their public finances according to the EU Treaty in Maastricht, we consider it more suitable to not only implement the first-generation tests taking on the cross-section independence but also the second-generation tests.

Specifically, we employ two approaches for unit root testing. First, we use the called first-generation panel unit root tests (Harris and Tzavalis [112], Choi [113], Levin et al. [114], Im et al. [115]), which assume

cross-sectional independence across countries (except for the same time effect). Second, we additionally implement the second-generation panel unit root tests (Hadri [116]; Breitung and Das [117]; Choi [118]), which are more flexible because they permit dependency across the panel.

The results of these tests (which are reported in Section S1 of the Supplementary Materials to save space), decisively reject the null hypothesis of a unit root for $CAGPB_{it}$, $outputgap_{it}$, g_{it} and inf_{it} ; indicating that they are stationary in levels (i.e., $I(0)$ variables), while they do not reject the null for $debt_{it}$, $findev_{it}$, and old_{it} , suggesting that these variables can be treated as first-difference stationary variables (i.e., $I(1)$ variables).

5. Analytical Framework and Econometric Methodology

Given that our dependent variable (cyclically adjusted primary balance) is stationary (i.e., its statistical properties such as mean, variance, autocorrelation, etc., remain constant over time), we cannot explain it with nonstationary variables (whose statistical properties change over time). Additionally, if the variables in the regression model are not stationary, then the standard assumptions for asymptotic analysis will not be valid and we cannot undertake hypothesis tests about the regression parameters. Therefore, by differentiating the nonstationary variables, we transform them into stationary variables.

As a result of the time-series properties of our data, the baseline empirical model is as follows:

$$CAGPB_{it} = \alpha_i + \delta_1 CAGPB_{it-1} + \delta_2 g_{it} + \delta_3 \Delta findev_{it} + \delta_4 outputgap_{it} + \delta_5 inf_{it} + \delta_6 \Delta debt_{it} + \delta_7 \Delta old_{it} + \varepsilon_{it} \quad (4)$$

where Δ denotes the first difference operator.

We consider three basic panel regression methods: the fixed-effects (FE) method, the random effects (RE) model, and the pooled ordinary least square (POLS) method. To determine the empirical relevance of each of the potential methods for our panel data, we make use of several statistic tests. In particular, we test FE versus RE using the Hausman test statistic to test for noncorrelation between the unobserved effect and the regressors. To choose between POLS and RE, we use Breusch and Pagan [119]'s Lagrange multiplier test to test for the presence of an unobserved effect. Finally, we use the F test for fixed effects to test whether all unobservable individual effects are zero, to discriminate between POLS and FE.

6. Empirical Results

Table 1 presents the results for the 11 EA countries under study using FE, RE, and POLS estimation methods, suggesting the specification tests that the FE method is the relevant one for this sample (Additionally, we apply the endogeneity test for all the regressors considering all countries. Our results (not presented here to save space, but available from the authors upon request) suggest that we cannot reject the null hypothesis in which it is considered that all possible endogenous regressors can be treated as exogenous, so, for this reason, we do not estimate the so-called fixed effects instrumental variables (FE-IV) or the random effects instrumental variables (RE-IV). As can be seen, we find that both macroeconomic and financial factors and the aging process influence fiscal reaction functions. Regarding the real growth, the positive and statistically significant coefficient indicates that the $CAGPB$ improves during economic expansive phases. Financial development is found to make a significant negative effect on discretionary fiscal policy, which may reflect the greater financial capacity to enable deficit financing. In respect to the output gap, we find a positive and statistically significant coefficient, suggesting that the fiscal stance is countercyclical (enacting expansionary fiscal policy during recessions and reducing spending during expansions). As for the inflation rate, we find a negative, significant coefficient, indicating that macroeconomic instability erodes fiscal sustainability. Finally, the negative and statistically significant coefficient on our proxy of aging indicates that the

CAGPB deteriorates, on average, by about 21.30 percentage point with each percentage point increase in the old-dependency ratio.

Table 1. Parameter estimates for the empirical model: All Euro Area (EA) countries in the sample.

	FE	RE	POLS
$CAGPB_{it-1}$	0.5964 *** (0.0282)	0.6037 *** (0.0270)	0.6037 *** (0.0441)
$\Delta debt_{it}$	−0.0606 *** (0.0068)	−0.0619 *** (0.0068)	−0.0619 *** (0.0120)
g_{it}	0.0106 *** (0.0014)	0.0091 *** (0.0012)	0.0091 *** (0.0032)
$\Delta findev_{it}$	−0.0109 ** (0.0045)	−0.0094 ** (0.0043)	−0.0094 ** (0.0046)
$outputgap_{it}$	0.1641 *** (0.0151)	0.1487 *** (0.0142)	0.1486 *** (0.0322)
inf_{it}	−0.0289 *** (0.0087)	−0.0102 (0.0075)	−0.0102 (0.0092)
Δold_{it}	−21.3023 * (11.4394)	−0.9419 (10.207)	−0.9419 (10.9140)
Constant	0.1536 ** (0.0703)	0.0293 (0.0619)	0.0293 (0.0842)
Country FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
N	429	429	429
R ² overall	0.8386	0.8418	
R ² within	0.8428	0.8405	0.6213
R ² between	0.9216	0.9435	
BIC	826.18	840.56	849.58
AIC	793.69	820.15	817.09
Endogeneity test of all regressors		2.475 [0.1157]	
Breusch and Pagan test (POLS vs. RE)		0.000 [1.0000]	
F test for fixed effects (POLS vs. FE)		2.30 [0.0000]	
Haussman test (FE vs. RE)		13.44 [0.0366]	

Source: Authors' own elaboration. Notes: In the ordinary brackets below the parameter estimates are the corresponding z-statistics, computed using White (1980)'s heteroskedasticity-robust standard errors. In the square brackets below the specification tests are the associated p-values. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.

As can be also seen in Table 1, the positive and statistically highly significant coefficient on the lagged *CAGPB* suggests that discretionary fiscal policy appears to be strongly persistent. Turning to the sustainability of fiscal policy, we find that the coefficient on $\Delta debt$ is negatively and statistically significant, which is an indication of fiscal behavior that fails to take into account the government IBC and, therefore, is not consistent with long-term fiscal solvency. Our results are consistent with those obtained in Chen [53] for some European countries during the 1980–2012 period using unit root tests with a nonlinear trend and asymmetric adjustment. In Afonso and Rault [61] for EU-15 over the

period 1970–2006 using stationarity and cointegration analysis, and in Afonso and Jalles [58] applying cointegration analysis to European countries during 1970–2010 period.

To assess the robustness of our results, we divide economies under study in six groups of countries: central countries, peripheral countries, relatively old countries, relatively young countries, relatively more indebted countries, and relatively less indebted countries (following the empirical literature, we consider Austria, Belgium, Finland, France, Germany, and the Netherlands as EA central countries and Greece, Ireland, Italy, Portugal, and Spain as EA peripheral countries (see, e.g., Gräbner et al. [120]). Regarding the relative aging and the relative indebted countries classification, we use the sample average to distribute countries below and above it as relatively old and young countries (Austria, Belgium, France, Germany, Greece, Italy, and Portugal, and Finland, Ireland, Netherlands, and Spain, respectively) or as relatively more or less indebted countries (Greece, Italy, and Belgium, and Austria, Finland, France, Germany, Ireland, Netherlands, Portugal, and Spain, respectively). Table 2 reports the results based on the most relevant estimation method (FE in all cases, except for the cases of central and relatively less indebted countries, for which the POLS estimation method is found to be the relevant one) (see Sections S2–S4 of the Supplementary for a detailed report of the empirical results obtained for the central and peripheral countries, for the relatively old and relatively young counties, and for the more relatively indebted and less relatively indented counties, respectively).

Table 2. Robustness analysis by subgroups.

	Central EA Countries	Peripheral EA Countries	Relatively Old EA Countries	Relatively Young EA Countries	Relatively More Indebted EA Countries	Relatively Less Indebted EA Countries
$CAGPB_{it-1}$	0.4776 *** (0.0618)	0.6826 *** (0.0382)	0.5234 *** (0.0332)	0.5518 *** (0.0571)	0.1519 *** (0.0291)	0.5677 *** (0.0344)
$\Delta debt_{it}$	−0.0569 *** (0.0100)	−0.0399 *** (0.0093)	−0.0362 *** (0.0072)	−0.0672 *** (0.0216)	−0.0171 *** (0.0043)	−0.0824 *** (0.0088)
g_{it}	0.0056 ** (0.0024)	0.0260 *** (0.0034)	0.0068 *** (0.0011)	0.0299 *** (0.0053)	0.0108 *** (0.0014)	0.0084 *** (0.0014)
$\Delta findev_{it}$	−0.0117 * (0.0064)	−0.0096 (0.0058)	−0.0286 *** (0.0063)	0.0021 (0.0051)	0.0005 (0.0046)	−0.0020 (0.0051)
$outputgap_{it}$	0.2897 *** (0.0402)	0.1081 *** (0.0189)	0.2630 *** (0.0186)	0.1022 *** (0.0331)	0.4460 *** (0.0152)	0.1140 *** (0.0173)
inf_{it}	−0.0604 *** (0.0183)	−0.0169 (0.0109)	−0.0460 ** (0.0082)	−0.0237 (0.0158)	0.0150 ** (0.0062)	−0.0420 *** (0.0113)
Δold_{it}	−48.4968 *** (12.3465)	−8.0904 * (12.4508)	−54.5766 *** (11.9974)	14.4282 (18.9968)	−25.4034 ** (−12.1541)	−22.4860 * (12.6003)
Constant	0.3505 *** (0.0966)	−0.1149 (0.1359)	0.4704 *** (0.0763)	−0.2972 *** (0.1159)	−0.0220 (0.0734)	0.1640 ** (0.0771)
Estimation method	POLS	FE	FE	FE	FE	POLS
N	234	195	273	156	117	312
R ² overall		0.8812	0.8916		0.9869	0.7898
R ² within	0.8234	0.8884	0.9020	0.8278	0.9879	0.7920
R ² between		0.7944	0.9176		0.9595	0.8490
BIC	376.59	410.55	399.70	350.65	5.25	618.74
AIC	348.94	384.37	370.82	326.25	−16.85	588.80

Source: Authors' own elaboration. Notes: In the ordinary brackets below the parameter estimates are the corresponding z-statistics, computed using White (1980)'s heteroskedasticity-robust standard errors. In the square brackets below the specification tests are the associated p-values. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively. The most adequate estimation method for each group has been selected according to the Breusch and Pagan's Lagrange multiplier test, the F test for fixed effects, and the Hausman test statistic.

As can be seen in Table 2, the explanatory variables detected in the fiscal reaction functions for the different groups of countries are in general very similar. It is interesting to note that the discretionary fiscal policy is strongly persistent, as denoted by the positive and statistically highly significant coefficient on the lagged $CAGPB$ variable, being especially higher in the cases of peripheral, relatively younger, and relatively less indebted countries. We also find that the coefficient on $\Delta debt$ is negative and statistically significant, suggesting once again that the fiscal authority does not react to

an increase in the debt-to-potential GDP ratio by improving the cyclically adjusted primary balance to restrain the debt ratio from rising further and not being consistent with long-term fiscal solvency. This result is in line with Paniagua et al. [59] since, using fiscal reaction functions, they find that core and peripheral countries reacted only after a certain debt threshold was reached not before, such as after the European Monetary System or after the 2007 financial crisis.

In our sample of EA countries, after controlling for other relevant factors, the fiscal policy reaction to an increase of one percentage point in the variation of the debt-to-potential GDP ratio ranges from 0.04 percentage point for the relatively old countries to 0.08 percentage points for the relatively less indebted countries. Concerning the control variables, we find a positive and statistically significant coefficient on real growth, being particularly high in the cases of the relatively young countries and the peripheral countries. As for financial development, our results suggest significant negative effects on discretionary fiscal policy, being especially large in the relatively old and central countries. With regard to the output gap, the positive and highly significant estimated coefficient can be interpreted as an indication that the government can act as automatic stabilizers trying to mitigate the effects of market fluctuations in the economy. In other words, the fiscal policy focuses on fostering government spending during downturns and increasing taxes and reducing public expenditure during inflationary periods. Interestingly, our results suggest a stronger negative effect of consumer price inflation in the central and relatively old countries. Finally, concerning the potential impact of aging, we find a negative and statistically significant effect in all cases except for the relatively young countries (although it is not statistically significant at conventional levels). Our results suggest that an increment of one percentage point of the old-dependency ratio implies a reduction in the *CAGPB* ranging from 8.09 percentage points in the peripheral countries to 54.58 percentage points in the relatively old countries (note that the result for the EA peripheral countries is only statistically significant at the 10% level).

Finally, to further assess how each explanatory variable contributes to the explanation of the dependent variable, we perform stochastic dynamic simulations. Table 3 summarizes the results, examining the predictive power of the estimated model and assessing the relative contributions of the optimal explanatory variables per category is reported using a simple definition of standardized coefficients (Bring, [121]) (see Section S5 of the Supplementary Materials, for further details on the standardization of regression coefficients and the calculation of the relative contributions of the explanatory variables). As can be seen, our results suggest that while $\Delta debt$, $\Delta findev$, *outputgap*, and *inf* exercise a relative greater role in EA peripheral countries (note that four countries of the EA peripheral grouping were involved in the EA bailouts (Greece, Ireland, Portugal, and Spain), *g* and Δold play a greater role in explaining the evolution of *CAGPB* in EA core countries. Regarding the aging grouping, *g*, $\Delta findev$, *outputgap*, and Δold have a higher impact in the behavior of the *CAGPB* in the relatively old countries, while *g*, *inf*, and Δold exert a greater effect in the determination of the *CAGPB* in the relatively indebted countries. As expected, the estimated contribution of aging is higher in relatively old countries (26.96 percent).

Table 3. The long-run relative contribution of the explanatory variables (%).

Variables	All EA Countries	Central EA Countries	Peripheral EA Countries	Relatively Old EA Countries	Relatively Young EA Countries	Relatively More Indebted EA Countries	Relatively Less Indebted EA Countries
$\Delta debt$	16.57	15.18	17.80	10.91	19.18	12.03	20.07
<i>g</i>	13.21	13.15	13.53	17.25	12.49	17.11	13.53
$\Delta findev$	8.34	7.55	8.57	8.55	5.45	9.02	9.54
<i>outputgap</i>	10.66	13.91	12.42	27.06	9.17	10.21	11.73
<i>inf</i>	33.24	31.31	34.03	33.90	35.03	34.19	31.43
Δold	17.99	18.91	13.66	26.96	18.66	17.45	13.61

Source: Authors' own elaboration.

7. Concluding Remarks

In this paper, we try to contribute to the previous literature analyzing the fiscal sustainability hypothesis on the 11 EA countries over the period 1980–2019. To achieve this purpose, we apply panel data techniques controlling for several macroeconomic variables (real economic growth, financial development, output gap, inflation rate, trade balance, and real effective exchange rate) as well as population aging. Moreover, we try also to disentangle which are the main explanatory variables for different subsamples of countries to assess if there exist differences among them.

Our results suggest that aging has generated deep pressures on fiscal sustainability for both core and peripheral economies. Furthermore, another important finding is that the fiscal policy has not been consistent with long-term fiscal solvency regardless of the economies under study. The output gap has found also to be crucial in the behavior of cyclically-adjusted government primary balance; in particular, our results indicate a countercyclical fiscal policy during the analyzed period for all countries, suggesting the need for a thorough review of the design, supervision, and coordination of fiscal policy in the EA. Financial development has been negative and statistically significant for central but not for peripheral countries, meaning that has been easier to finance fiscal deficit with greater financial capacity. Finally, the inflation rate is found to deteriorate fiscal sustainability as we have detected a negative role of this variable in the fiscal reaction functions for both the whole sample of countries and the EA core countries, not being significant for the peripheral EA countries.

In order to assess the robustness of our results, we evaluate the fiscal sustainability hypothesis not only for central and peripheral countries but also for relatively old and young economies and for relatively more and less indebted nations. In all cases, we find empirical evidence to reject the hypothesis of long-term fiscal solvency, given our results suggest that cyclically adjusted government primary balance does not adjust to restore the government's IBC when it is facing an important increment of public debt. Regarding aging, we detect that higher old-dependency ratio deteriorates the cyclically adjusted government primary balance of a country, especially for relatively old countries and relatively more indebted economies. A negative and statistically significant impact of aging is identified in all cases, except for relatively young countries. In particular, a rise of one percentage point of the old-dependency ratio can generate a reduction of cyclically adjusted government primary balance ranging from 8.09 percentage points in the peripheral countries and 54.58 percentage points in the relatively old countries.

Moreover, trying to determine which are the most relevant factors that can help to understand the behavior of fiscal sustainability, we have detected that public debt, financial development, output gap, and inflation rate are the most important contributing factors for the EA peripheral countries, while real economic growth and old-dependency ratio are crucial explanatory variables for the EA core economies. In addition to the previous factors, financial development and output gap have a higher impact on the behavior of the cyclically adjusted government primary balance for the relatively old countries. Finally, the estimated contribution of aging is found to be higher in relatively old EA countries.

Our findings are in line with those presented by Tosun [122] or Elmeskov [123] since these authors highlight the need of additional measures such as public pension reserve funds as a way to control the increasing deficit in the PAYG system. More policies should be implemented to promote labor force participation, increasing fertility rates, providing more long-term provisions, increasing immigration, considering deeply reforms in the pension system (Harper, [124]). Furthermore, our results support the urgent need for change in the current EA policies to face long-term fiscal sustainability challenges as in Arévalo et al. [26]. As Yoshino et al. [19] contend, it is crucial to invest more in human capital and education to improve the productivity in the long run for the aging population can adopt new technologies. Furthermore, the tax framework should be restructured focusing on luxury tax, excise tax, or even with progressive rates to increase the tax base for high-income groups. Among recommendations proposed by these authors stand out the increasing contribution rates and the abolition of unjustified benefits.

Regarding policy implications, our results indicate that the nexus between changes in the public debt-to-potential GDP ratio and cyclically adjusted government primary balance differs according to country grouping and therefore could be crucially related to diversity in institutions and public policies that make up the socio-economic environment. Therefore, we consider that our results may have some practical meaning for national policymakers and international organizations responsible for regional and global fiscal surveillance and might shed some light on the possible effects that population aging could have on the effort of EA countries to restore public finances on a sustainable basis.

Given that both the global economy and the EA countries will be characterized in the long term by significantly lower potential growth than before (due to weak productivity gains and population aging), by very high global debt ratios (especially after the COVID crisis), and the return of inflation (due to aging, more favorable income distribution for wage earners, the cost of the energy transition, and the return to regional value chains), the issue of fiscal sustainability will be one of the most important challenges to be faced in the future (see, e.g., Oksanen, [125]).

Population aging will put increased financial pressure on old-age support systems. In countries where public transfers are high, including many in Europe, population aging will increase the fiscal pressure on public transfer systems, especially if patterns of taxation and benefits remain unchanged. Additionally, to maximize the benefits and manage the risks associated with population aging, governments should support continuing and lifelong education and health care for all; encourage savings behavior and healthy lifestyles throughout the life course; promote employment among women, older persons, and others traditionally excluded from the labor force, including through a gradual increase in the official retirement age; and support family-friendly policies to facilitate work–life balance and increased gender equality in both public and private life.

The objective should be for all EA countries to restore budgetary room for maneuver, rein in aging-related spending and strengthen potential output growth, thereby safeguarding the long-term sustainability of public finances. In our view, adjustment programs should be accompanied by structural reforms able to increase the adjustment capacity or the potential GDP in EA countries. Otherwise, the current policy dilemmas might only be solved (see Mody [126]) in a framework that allows orderly debt restructuring. In this respect, Alesina et al. [127] assure that cutting spending is the most effective way to achieve fiscal adjustments rather than raising taxes and, as in the European countries aging is one of the most important healthcare spendings, this issue should be paid special attention. Whether these spending cuts are implemented with other structural reforms such as market liberalization in the labor market and pension reforms, the economic cost of these budget cuts would be minimized because higher economic growth would be reached. Moreover, analyzing the impact of demographic changes in some European countries, Börsch-Supan et al. [128] also conclude that structural reforms in the labor market and pension system are needed.

Although as a response to the global crisis several new institutional measures have been introduced in the fiscal framework, both on the EU and on the member states' level, further reforms are needed to provide better fiscal sustainability outcomes (see, e.g., Reuter et al. [129]). This necessity has been recently reinforced by unprecedented fiscal actions implemented during and after the pandemic to save lives and livelihoods and to revive growth and job creation. A comprehensive approach is needed, tailored to each country's institutional and policy settings and social preferences, and may span many areas of public policy: improving the design of public pensions, incentivizing private savings, enhancing the efficiency of health care provision, expanding the coverage of social security systems, promoting employability and skills of older workers, and striving for a better labor market inclusion of women, youth, and migrants. Indeed, the European Commission [130] have recently announced social initiatives ensure a financially sustainable and socially fair and just response to the demographic change.

There are a number of directions that extensions from the analysis presented in this article. Three avenues that seem worthy of further research are: (i) the use of the alternative approach of debt affordability instead of debt sustainability (Moody's Investors Service [16]), (ii) the use of an alternative

demographic variable that takes into account different aspects of pension reform like the increase of the retirement age, and (iii) to consider nonlinear specifications in the econometric analysis. Given the mildly encouraging results of the present study, some optimism about the benefits of implementing these extensions seems justified.

Supplementary Materials: The following are available online at <http://www.mdpi.com/2071-1050/12/24/10276/s1>.

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Appendix A. Definition of the Variables and Data Sources

Variable	Description	Source
Cyclically adjusted general government primary balance (<i>CAGPB</i>)	The ratio of government primary balance to potential GDP (as proposed by Girouard and André [131]).	World Development Indicators (World Bank)
Public debt-to- potential GDP ratio (<i>debt</i>)	The ratio of public debt to potential GDP.	World Development Indicators (World Bank)
Real GDP (<i>gdp</i>)	The real economic growth rate.	AMECO database
Financial development (<i>findev</i>)	Financial development measured as the total credit to the private non-financial sector (as proposed by Cevik and Nanda [132]).	Bank for International Settlements
Output gap (<i>outputgap</i>)	Actual GDP less potential GDP as a per cent of potential GDP.	International Monetary Fund (World Economic Outlook Database)
Inflation rate (<i>inf</i>)	The inflation rate as measured by the consumer price index (annual %).	World Development Indicators (World Bank)
Old-dependency ratio (<i>old</i>)	The ratio between the number of persons aged 65 and over (age when they are generally economically inactive) and the number of persons aged between 15 and 64.	OECD Statistics

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