Pensions as an engine of growth. An approach to the Spanish case in 2021, based on the multiplier-accelerator model (a Sraffian supermultiplier).

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Abstract
In this paper, following Cesaratto's lead (Cesaratto, 2005, especially chapters 6-8), we measure the impact of pensioners' spending on output and employment in the Spanish economy in 2021 by means of the Sraffian supermultiplier, taking pensioners' expenditure as a component of autonomous demand. To do so, we follow another lead, from Dejuán (2014, see also Dejuan et al., 2022), who suggests using the Leontief inverse of an extended SAM (social accounting matrix) that also includes both induced consumption and expansionary investment as a multisectoral supermultiplier, or multiplier-accelerator.
The weight of PAYG pensions to people aged 65 or older in 2021 is 8% of GDP and their expenditure "requires" 7% of total production and total employment (directly, indirectly and hyper-indirect or induced). The government recovers 47 cents in taxes for each euro spent on pensions.
In a pension-led economy, indebtedness converges to a finite value.

Keywords: Pensions, supermultiplier, subsystems, endogenous money.
JEL Classification: E11, E12, E20, C67, H55

1. Introduction.

Pay-As-You-Go (PAYG onwards) pension schemes have been subjected to strong criticism for a long period of time by authors sympathetic to the Neo-classical approach. Firstly, they claimed that they tend to slow down economic growth (e.g. Feldstein, 1974), because contributions to social security are a form of saving that cannot be used to fund investment (they fund aged people's consumption). Later, demographic shifts, it was argued, would amplify those negative consequences (World Bank, 1994), because falling birth rates and increasing life expectancy would require either increasing payroll taxes, shifting the labor supply to the left and downwards (e.g. Modigliani et al., 2000), or else the government budget deficit should rise, something detrimental to economic growth as well because of the increase of interest rates as public deficits rise. The usual recommendation to sort out this situation has been to shift towards a fully funded pension system, with the transition problem -i.e., a generation of workers has to pay contributions to PAYG and to a fully funded pension scheme- being acknowledged.

By contrast, the Classical-Keynesian theoretical standpoint[1] provides a sound basis for understanding PAYG pension systems as a source of demand that can be helpful for raising the rate of employment of an economic system (Cesaratto, 2005). In that view, the pensioners' demand for consumer goods puts in motion existing idle resources through the Keynesian principle of effective demand, and in that process, the resources required to finance the pension system are generated so that there is no sort of crowding-out effect.[2]

In the Classical-Keynesian view, demographic shocks are seen as problematic as well, though through other channels: they do not pose an unsurmountable supply-side limit for the production of goods and services demanded by pensioners in the long run, but they may reduce the reserve army leading to a fall of profits; the reaction to this is likely a decline of investment and a demand for Neo-Malthusian measures that preserve the reserve army (Cesaratto, op.cit., p. 277): raising the retirement age, reduction of benefits, tightening the eligibility of becoming a pensioner, et cetera.

In this paper, following Cesaratto's lead (Cesaratto, op.cit., especially chapters 6-8), we measure the impact of pensioners' spending on output and employment in the Spanish economy adopting the Sraffian supermultiplier theoretical standpoint, taking pensioners' expenditure as a component of autonomous demand. To do so, we follow another lead, from Dejuán (2014, see also Dejuan et al., 2022), who suggests using the Leontief inverse of an extended SAM (social accounting matrix) that also includes both induced consumption and expansionary investment as a multisectoral supermultiplier. This, combined with the vector of pensioners' spending on the consumer goods basket, gives us a disaggregated measure of the impact of the Spanish PAYG scheme in terms of output, labor and value added. This approach has some similarities with Pasinetti's notion of vertically hyper-integrated subsystems (Pasinetti, 1988).

A measure of the impact of pensions on activity and employment is obtained for the Spanish economy in 2021, which gives us a clue of how many resources pensions will mobilize in 2050, when the number of retired pensioners reaches its ceiling.

The structure of the paper is the following. Sections 2 and 3 deal with whether a PAYG pension scheme is a burden for an economic system or rather an opportunity to put in motion resources that otherwise would have remained idle. Section 4 offers the formal way to measure the impact of retirement pensions paid to people aged 65 or older in Spain in 2021, whilst section 5 contains our numerical results. In section 6 we study some conditions required for the stability of a pension-led economy. Conclusions are in section 7.

[1] See Eatwell and Milgate, 1983, chapter 1. See also Cesaratto, 2021, chapters 1 and 3.

[2] Garegnani summarizes the pension debate as "the absolute epitome of the dichotomy between what we may call the 'principle of scarcity', and what has been called the 'principle of the underutilization of productive resources in a market economy'" (quoted in Pivetti, 2006, p. 381).

2. PAYG pension schemes: a burden for the system?

Institutions concerned with the sustainability of public finances see ageing as a source of problems because of its expected consequences on rising PAYG pension costs. The European Commission's Ageing Reports illustrate this point. The way in which they obtain long-term macroeconomic projections reveals, in our view, that PAYG pension schemes are considered a burden for the system (for details on how it elaborates its projections, see European Commission, 2020, and for a critical revision of those procedures Carnazza et al., 2023). In essence, the key element of our argument is that the European Commission (EC onwards) produces supply-side projections of potential GDP, that ultimately depend on an estimation of the size of the population, which is elaborated without any reference to aggregate demand.[3] Then, a growing pension expenditure, because of demographic changes, will require a higher contribution to social security (or cuts in benefits) to keep public finances balanced, as far as output is at its potential level. This problem is aggravated if the estimated NAWRU (the non-accelerating wage rate of unemployment), is too high, because in that case contributions to social security will be underestimated.

The latter problem, as shown in Carnazza et al., op.cit., is that if the NAWRU depends *excessively* on observable rates of unemployment and the latter's definition is very restrictive (discouraged workers do not count as unemployed, or part-time workers willing to work full time are not counted as such). Hence, the estimation of potential GDP is related to a particular notion of macroeconomic equilibrium, ruled by an average of observable situations, and not so much to the maximum level of output that is attainable when all resources are fully used.

Table 1, quoted from the EC 2021 Ageing Report (EC, 2021), shows that public pensions in the four largest economies of the Euro zone account for between 10% and 17% of GDP over 2019-70, with the ratio of people aged 65 or more over those aged between 20 and 64 increasing between 50% and 100%; the social security system is expected to be nearly balanced between 2030 and 2050 (Germany) or in deficit (between 1% and 5% of GDP in Spain, France and Italy); full employment is assumed differently for each country: whilst for Germany it means a rate of employment (for people aged between 16 and 64) of almost 76%, for the rest of countries that rate lies between 65% and 71%.

[3] In the elaboration of GDP projections, total employment is obtained by multiplying the population aged 16 and over (which is taken as a given), times the rate of participation, times the unit minus the NAWRU (the non-accelerating wage rate of unemployment). Next, GDP is expected to grow according to the evolution of employment and labor productivity, the latter depending on the expected growth of total factor productivity and capital deepening (a Cobb-Douglas production function is assumed). See for details EC, 2020, chapter 3. The problem, in our view, is that the population is taken without any reference to aggregate demand. This is especially serious when it comes to projections 30 years (or more) ahead, because immigration or changes in labor participation rates can cause substantial deviations.

Table 1: Pensions and labor force. Some European countries. 2019-2070.

		2019	2030	2050	2070
Spain	Public pensions expenditure (%GDP)	12,3	12,3	13,0	10,3
	(of which, old-age and early pensions)	9,0	9,4	10,6	8,1
	Contributions	11,8	11,8	11,8	11,8
	Old age dependency ratio (20-64)	32,1	40,9	64,7	62,5
	Employment rate (15-64)	63,4	65,3	71,2	70,9
	Unemployment rate (15-64)	14,2	14,2	7,2	7,0
	Labor productivity growth	0,6	1,1	1,7	1,5
France	Public pensions expenditure (%GDP)	14,8	15,6	14,3	12,6
	(of which, old-age and early pensions)	12,1	13,1	12,1	10,7
	Contributions	11,8	11,5	11,5	11,6
	Old age dependency ratio (20-64)	36,5	44,9	54,8	56,9
	Employment rate (15-64)	65,5	66,2	68,4	68,6
	Unemployment rate (15-64)	8,6	8,4	7,0	7,0
	Labor productivity growth	0,7	0,8	1,5	1,5
Italy	Public pensions expenditure (%GDP)	15,4	17,3	16,2	13,6
	(of which, old-age and early pensions)	12,6	14,5	13,6	11,7
	Contributions	10,7	11	11,1	11
	Old age dependency ratio (20-64)	38,9	48,0	66,5	65,6
	Employment rate (15-64)	59,1	61,7	64,6	64,9
	Unemployment rate (15-64)	10,2	9,2	7,1	7,0
	Labor productivity growth	0,0	0,7	1,7	1,6
Germany	Public pensions expenditure (%GDP)	10,3	11,5	12,2	12,4
	(of which, old-age and early pensions)	8,1	9,4	10,3	10,7
	Contributions	10,1	11,1	11,8	12,2
	Old age dependency ratio (20-64)	36,1	46,4	52,8	54,6
	Employment rate (15-64)	76,7	75,7	75,9	75,9
	Unemployment rate (15-64)	3,2	4,2	4,2	4,2
	Labor productivity growth	0,8	1,4	1,5	1,5

Source: European Commission (2021).

Although these estimations usually come hand-in-hand with caution warnings because of the uncertainty associated with making predictions for such a long period, there is some consensus that they are useful for ascertaining the long-run trend of some variables. However, what is the justification for expecting a rate of unemployment in France, Italy and Spain around 7% in 2050, whilst in Germany it will be expected around 4%? Or why will Spain have the same rate of part-time workers in 2070 as in 2020, whose rate of full-time equivalents and occupied persons is around 5 percentage points lower than in France or Italy? Further, is it correct to assume that demographic variables are independent of long-term economic forecasts?

3. Or are PAYG pensions an opportunity for employment and economic growth?

From a Classical-Keynesian viewpoint, demand rules output in the short run, within the limit posed by the maximum utilization of a given endowment of productive capacity and employment; and this statement is also valid in the long run, because investment in productive capacity is governed by the rate of growth of demand (i.e. is an induced component of

aggregate demand), that in turn is a multiple of autonomous demand, making productive capacity, and employment, an endogenous variable; the theory of investment, based on a flexible accelerator,[4] ensures that the stock of capital and output keep a certain stable relation along the time, driven by autonomous demand: a higher (lower) rate of growth of autonomous demand will lead to a larger (smaller) stock of capital and a larger (shorter) amount of employment. In this view, the procedure used by the European Commission is not legitimate because employment is not an exogenous datum.

In this context, a PAYG pension scheme can be viewed as a source of economic growth, as it is an autonomous element of the aggregate demand (Cesaratto, 2005, chapter 6). Then, the Sraffian supermultiplier (Serrano, 1995a, Bortis, 1997, Cesaratto et al., 2003, Dejuán, 2005, amongst many others) appears as an adequate approach to study the impact of pension expenditures on an economic system.

As it is well known, under full adjustment of output to its normal level, it is ruled by autonomous demand according to the following expression: [5]

$$(3.1) \qquad Y(t) = \frac{1}{s - v(g_z + d) + m} Z(0)(1 + g_Z)^t = \frac{K(t)}{v} = \frac{L(t)}{l}$$

Where Y(t) is GDP, s is the aggregate marginal propensity to save, g_Z is the rate of growth of autonomous demand, d is the rate of depreciation of fixed capital, m is the propensity to import, z_0 is autonomous demand in the base year, v is the capital-to-output ratio, K(t) is the stock of productive capital in period t, L(t) is the volume of employment and l is the productivity of labour. It is assumed that autonomous demand generally includes public spending, residential investment and exports.

According to the logic of the supermultiplier, output, productive capacity and employment are dependent variables whose trend is governed by non-capacity-creating autonomous components of aggregate demand, where the engines of growth are located. The model is stable if the sum of the marginal propensities to spend is less than one (Freitas and Serrano, 2015, p. 271, expression (19); Serrano and Freitas, 2017, p. 79, expression (12)). This does not mean that output and employment can reach whatever value following the rule of autonomous demand in the short-run: outstanding productive capacity poses a ceiling to output, large changes in the labor supply cannot be made in the short run and natural resources can lead to bottlenecks. However, provided the rate of growth of autonomous demand is not beyond a certain limit and it grows following a relatively stable path,[6] in the long-run, the stock of capital and employment shall follow the path ruled by autonomous demand: that is why the Keynesian principle of effective demand is valid in the short and in the long run.

In this account, the consumption of pensioners, which is funded with public transfers from a PAYG pension scheme, is an additional ingredient of autonomous demand. Hence, pensioners' consumption could be viewed as an engine of growth, *responsible* for a certain amount of production, produced fixed capital, and employment; and if pensioners' consumption rises permanently due to an increase in the number of pensioners and/or the amount of pension benefits, making the rate of growth of autonomous demand g_Z rise, output will increase due to an increase of autonomous demand and an increase of the supermultiplier. Formally, from expression (3.1):

[4] As it is well known, the flexible accelerator aims to capture the effect of changing utilization of capacity on the decisions to invest. On this, see for instance, Dejuán, 2005, p. 236.

[5] This expression is similar to equation (8) in Serrano (1995b, p. 80), equation (7) in Bortis (1997, p. 146) or expression (5) in (Dejuán, 2005, p. 237).

[6] Among Sraffians, the maximum rate of growth is inversely related to the maximum eigenvalue of the matrix of intermediate consumptions. See for instance Pasinetti (1977, chapter VII, p. 203 and ff.).

(3.2) $$Y_p(t) = \frac{1}{s - v(g_z + d) + m} C_p(0)(1 + g_{Cp})^t$$

Where Y_p is the amount of output that depends on the expenditure of pensioners on consumer goods C_p through the relation encapsulated in the supermultiplier, and g_{Cp} is the rate of growth of pensioners' consumption.[7]
Expression (3.2) begs three questions that we deal with in separate sub-sections. Firstly, are we dealing with an intergenerational zero-game income redistribution? Secondly, is there any financial limit to the growth of pensioners' consumption? And thirdly, is there any limit for output so it cannot follow the pace ruled by pensioners' spending?

Are we dealing with an intergenerational zero-game income redistribution?
If pensions rise and payroll contributions to social security rise as well, to keep its budget balanced, the effect on output is ambiguous according to the supermultiplier: on the one hand, autonomous demand rises with pensions, but the supermultiplier declines because of the fall of the workers' propensity to consume.
However, keeping pensions relatively high has three positive effects on output: (*i*) a more generous pension does not induce workers to increase their savings when they are near their retirement age if they fear that their pensions will be too low; (*ii*) PAYG pensions are a stable component of autonomous demand, that behaves anti cyclically in an economic crisis, as it happened in Spain between 2009 and 2013; and (*iii*) if social security revenues are raised from taxes on income with a low spending propensity (or even on wealth) rather than on wages, aggregate demand would be less affected.[8]

Do existing resources pose a limit to the growth of PAYG pension payments?
The Classical-Keynesian view is in full agreement with money endogeneity. In this view, pensions can be funded ex nihilo (i.e. no previous savings are required). The monetary efflux, in Circuitiste parlance (e.g. Graziani, 2003), will put the wheels of production in motion to obtain the goods and services demanded by pensioners. In Euro Zone countries like Spain, where the central bank is the banker of the treasury, the funding of public spending occurs as described with the help of the following figure (see also Lavoie 2022, and Ehnts, 2020; see also Cesaratto and Di Bucchianico, 2020):

Figure 1: Example of how public debt is sold in primary markets to a bank.

Central Bank			Private bank	
+100 RO	Dep. Gov +100		+100 Bonds	RO +100
	Dep. Gov -100 Reserves +100		+100 Reserves	Dep. Gov +100
-100 RO	Reserves -100		-100 Reserves	RO -100

[7] Under the assumption that induced consumption out of profits is nil, the marginal propensity to save, s, in expression (3.2) can be defined as $(1 - c_w)\ (W/Y)\ (1 - t^d)\ (1 - t^{SS})$, where c_w is the marginal propensity to consume out of wages, W is the mass of gross wages, t^d is the direct tax rate, and t^{ss} is the social security contribution rate. W includes the contributions paid by the employers on behalf of her workers, and therefore t^{ss} includes the rate paid by the employer.
[8] The social security budget is part of the general government budget and, as such, the gap between outlays (pensions benefits) and proceeds (workers' social security contributions) can be covered with general taxes: there is no justification to keep social security outlays balanced with revenues. In the Spanish case, the Government made a "loan" out of general taxes to the Social Security in 2021 amounting to 8% of its total budget.

When the government plans to make a payment (e.g., to pay pensions amounting to 100 monetary units, mu onwards), it offers bonds in primary markets. A bank willing to buy those bonds (for itself or for a third agent, thus acting as a broker), can fund its purchase with reserves borrowed from the central bank (RO stands for 'refinancing operation', a loan of central bank reserves to banks).[9] Then, the government has a deposit at the central bank and the private bank holds government bonds.[10] In general, once the sale of bonds in primary markets takes place, the government deposit is next transferred to the private bank, and with that operation, the volume of reserves held by the bank at the central bank increases *pari pasu*. Then, these reserves are used by the private bank to cancel the initial loan of reserves. The transfer of the government deposit to banks and the subsequent cancellation of the refinancing loan are justified because if the government made payments outright from its account at the central bank this would shock the supply of reserves in the interbank money market thus altering the overnight interest rate.[11]

When pensions are paid, the government deposit is transferred to pensioners. At this moment, the circulation phase begins, and it continues with the spending of pensions, and with the spending of those proceeds by producers of consumer goods and services and so on.

The reflux phase consists of the payment of contributions to the social security and the settlement of its debt to banks. Nevertheless, it should be noted that the social security system could be financed with taxes other than payroll taxes.[12] And if taxes are not enough to cancel the government's debt to the bank (i.e. for the repurchase of bonds issued at the beginning of the circuit), bonds should be refinanced.

If banks holding bonds wish to get rid of them, and this causes an increase in the bond yield because of an excess supply in the bond market, the central bank can always purchase all bonds in excess at a price of its choice. This view draws on Lerner's notion of functional finance (Lerner, 1943, and contributions in Nell and Forstater, 2004).

In principle, there is no limit to the monetization of public spending, or if there is any, it is in the willingness of banks to purchase public debt, and that of central banks to provide banks with the required reserves. This applies particularly to the Euro Zone, whose institutional setup self-imposes a limit to governments' public deficits.

By contrast, it is not clear whether there is any limit to public debt: those sympathetic to the so-called Modern Monetary Theory – for instance, Wray, 2022, Kelton, 2020 – would reject any limit (provided an economic system is below full-employment), whilst some post-Keynesian authors -e.g. Sawyer, 2021, Woodgate et al., 2023- would agree with the notion of sustainable public debt, given by the condition g > i (that is, the rate of growth of nominal GDP higher than the nominal interest rate on public debt), suggesting that g is also affected by public spending.

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[9] Those bonds can be used as eligible collateral. Alternatively, if the bank holds sufficient reserves, as may be the case after implementing Quantitative Easing, it can avoid borrowing reserves from the central bank.

[10] It should be noted that, ultimately, this operation is similar to granting a loan, with the difference being here that the bank creates a deposit when it purchases a bond (it is as if the loan adopts the form of buying a security).

[11] We agree with Lavoie (2022) that, contrary to supporters of MMT, this does not prove that the central bank monetizes public spending (as, for instance, Ehnts (2020) does): if banks do not wish to buy government bonds, and the central bank cannot purchase them in primary markets, governments cannot spend.

[12] According to Wray (2005, p. 2): 'framers of the Social Security Act anticipated [critiques on the basis that it was socialistic] and consequently formulated the program as if it were an insurance plan, with payroll taxes that could be counted as "contributions" and "benefit payments" that bore some relation to the contributions. Americans came to believe that they earned benefits because they "paid into" the program. […] Hence, rather than socialistic welfare, the program has been viewed as little different from a pension plan".

Do existing resources pose any limit to the response of output to pensioners' expenditure on goods and services?

Demographic shocks (low birth rates and large life expectancies) may pose a supply-side limit to the amount of output an economy can produce once an economic system reaches a full-employment position.[13] However, as Cesaratto (2005, chapter 8) has put it, demographic variables, particularly those related to the labor market, can be seen as endogenous, mostly because of the relatively low participation of women and mature workers in the labor market, immigration and labor saving technical change,[14] with some limitations: a generous pension system can encourage mature workers to retire before the official age; and immigration can be problematic if low earning workers see foreign workers as competitors for welfare benefits. The true problem, according to the Italian author, is with the Political Economy consequences of a falling reserve army: the scarcity of labor, combined with a strong aggregate demand, may cause a rise in wages and, therefore, a decline in profits; this could lead capitalists to demand a set of *Neo-Malthusian* measures with the aim increasing that reserve army (Cesaratto, op.cit., p. 277), in order to recover the control over the economic process: tightening the requirements to reach pension benefits through parametric reforms of the PAYG system (delaying the retirement age, requiring more years contributing to the system in order to attain higher pensions, even introducing notional defined-contribution accounts), asking for a shift towards a fully funded system, slowing down the pace of accumulation, or simply weakening the institutions that support the bargaining labor power.[15]

4. Pensions, the supermultiplier and Pasinetti's growing subsystems

In this paper, we deal with a multisectoral supermultiplier that links pensioners' expenditure to a certain volume of output. The structure is similar to the conventional supermultiplier, which is highly aggregated (expression (3.1) in the previous section). Our proposal is rooted in the Sraffian notion of subsystems.

Sraffa (1960, Appendix A) defines a subsystem as the fraction of a whole economic system, which produces several commodities and is in a self-replacement state, that ensures its self-replacement when the net output consists of just one commodity.

Pasinetti (1988) extends the notion of Sraffian subsystems to dynamic analysis, assuming that the original economic system expands at different sectoral growth rates. For our purposes, we shall define the subsystem of the basket of consumer goods and services that retired pensioners buy with their pensions; such composite commodity grows at the rate at which the number of pensioners increases.

Besides defining the subsystem of a composite, instead of a single commodity, another difference with Pasinetti is in the treatment of fixed capital. For empirical reasons, we shall assume that, at the end of a production process, a one-year older commodity used as fixed capital is not a different commodity but a percentage of the same commodity. Further, we shall assume that the depreciation of each commodity used as fixed capital is linear, given by the inverse of its lifetime. And an additional difference is that part of the consumption vector is treated as induced consumption.

In formal terms, the whole system is described as follows:

$$\mathbf{K_t X}(\boldsymbol{t}) + \mathbf{A X}(\boldsymbol{t}) + (\mathbf{K_t} + \mathbf{A})\mathbf{X}(\boldsymbol{t})g + \mathbf{b a_n X}(\boldsymbol{t}) + \mathbf{Z}(\boldsymbol{t}) = \mathbf{X}(\boldsymbol{t}) + \mathbf{K_{t+1}X}(\boldsymbol{t}) \tag{4.1}$$

[13] It should be noted that if this constraint is binding, a fully funded pension system would not be a solution to this problem.

[14] For instance, immigrant population in Spain was 2,56% of total population in 1995 (a little more than one million people), reaching 13,46% in 2010 (more than 6 million people). Besides immigration, it is possible to increase the labor supply through rising the participation rate of women and mature workers. Technical change may help though this is less certain that it can contribute to achieving these objectives.

[15] This view can be traced back to Kalecki, 1943. See particularly his Part II, section 4.

Where $\mathbf{K_t}$ is a square matrix of fixed capital per unit of output and $\mathbf{K_{t+1}}$ is a square matrix of one-year older fixed capital per unit of output, which is obtained as a by-product at the end of the production process. The term $(\mathbf{K_t} + \mathbf{A})\mathbf{X}(\boldsymbol{t})g$ stands for induced investment, **b** is a (column) vector of consumer goods purchased by a worker, $\mathbf{a_n}$ is a (row) vector of direct labor, and $\mathbf{Z}(\boldsymbol{t})$ accounts for a vector of autonomous demand. The term $\mathbf{ba_n X}(\boldsymbol{t})$ is induced consumption. The sum of induced investment, induced consumption and autonomous demand gives the vector of final deliveries.
If we define the matrix of depreciation as:

(4.2) $\mathbf{D} = \mathbf{K_t} - \mathbf{K_{t+1}}$

We can rearrange (4.1), obtaining:
(4.3) $\mathbf{X}(\boldsymbol{t}) = [\mathbf{I} - \mathbf{A}(1+g) - (\mathbf{D} + g\mathbf{K}) - \mathbf{ba_n}]^{-1}\mathbf{Z}(\boldsymbol{t})$

Next, we define the vector of pensioners' consumer goods $\mathbf{C}_{\boldsymbol{p}}(\boldsymbol{t})$ which is part of vector $\mathbf{Z}(\boldsymbol{t})$. Then the pensioners' quantities subsystem becomes:

(4.4) $\mathbf{X}_{\boldsymbol{p}}(\boldsymbol{t}) = [\mathbf{I} - \mathbf{A}(1+g) - (\mathbf{D} + g\mathbf{K}) - \mathbf{ba_n}]^{-1}\mathbf{C}_{\boldsymbol{p}}(\boldsymbol{t})$

Scalar *g* is the rate of growth of the number of pensioners, and $\mathbf{C}_{\boldsymbol{p}}(\boldsymbol{t})$ is the vector of consumer goods purchased by pensioners. Coefficients of vector $\mathbf{X}_{\boldsymbol{p}}(\boldsymbol{t})$ account for the sectoral total output that is put in motion with the expenditure of pensions $\mathbf{C}_{\boldsymbol{p}}(\boldsymbol{t})$: that is, direct and indirect production required to obtain a vector of final deliveries (as within the traditional Leontief's inverse), plus the total output needed for the expansion of capacity, not only fixed but also circulating capital, plus the total output which is required to produce the consumer goods bought by workers hired during the process. All commodities are produced but the system: imports are thus excluded.
Our supermultiplier is the inverse matrix in expression (4.4), where all elements in the matrices that make it are domestically produced. This supermultiplier is quite similar to the one in expression (6) in Dejuán et al., 2020, p. 7 with two differences: (1) we include only domestically produced inputs, and (2) induced investment includes circulating capital as well and the rate of growth *g* is that of the growth of pensioners.
From expression (4.4) we can obtain the vectors of total labor, value added and imports associated with consumer demand from pensioners:
(4.5) $\mathbf{L}_p(\boldsymbol{t}) = \mathbf{a_n} \cdot \widehat{\boldsymbol{X}}_{\boldsymbol{p}}(\boldsymbol{t})$
(4.6) $\mathbf{VA}_p(\boldsymbol{t}) = \mathbf{va} \cdot \widehat{\boldsymbol{X}}_{\boldsymbol{p}}(\boldsymbol{t})$
(4.7) $\mathbf{M}_p(\boldsymbol{t}) = \mathbf{m} \cdot \widehat{\boldsymbol{X}}_{\boldsymbol{p}}(\boldsymbol{t})$

Where **va** and **m** are (row) vectors of value added and imports per unit of output, and symbol ^ denotes a diagonal matrix.
Our supermultiplier has one advantage and one limitation. The advantage is that it provides disaggregated information at the sectoral level, so we can have more information about the sectoral impact of pensioners' expenditures than using the aggregate supermultiplier. The disadvantage is that our supermultiplier is linear. This means that it cannot measure the impact of shocks in the autonomous demand because the accelerator (which measures the reaction of investment to changes in the degree of utilization of productive capacity) is not flexible.

5. Some numerical results from the Spanish economy.
How many workers are required to produce the goods and services demanded by pensioners in a PAYG pension scheme? What is the portion of output that *depends* on pension expenditure?

How much money returns to the government as taxes after paying pensions? We face these questions regarding the Spanish economy in 2021.

This table gives us some general information for 2021, which shall be useful to put our results in context:

Table 2: Spanish economy, 2021. Some general data.

PIB	1.206.842 € million
Total (contributive) pension payments	139.969,6 € million
Pension payments: retirement, aged 65 or more	97.334,7 € million
Number of retired pensioners aged 65 or more	5.930.983 people.
Contributions to Social Security	125.144,2 € million
Employment (persons)	19.773,6 thousand people
Employment (full-time equivalent units)	18.362,3 thousand people
Total labor supply	23.203,2 thousand people
Total outstanding public debt (EDP)	1.427.238 € million

Source: INE (Spanish Statistics Agency) Social Security and Banco de España.

Contributive pensions amount to 11,6% of GDP (non-contributive pensions, corresponding to people who have not contributed to the system and obtained a minimum benefit, are not included in this item). Retirement pensions of those aged 65 or older are 8,1% of GDP. Total contributions to the social security system are 10,4% of GDP, covering 89,4% of contributive pension payments. The rate of unemployment at the end of 2021 was 13,3%. The ratio of public-debt-to-GDP is 118,3%.

Now, we focus on the statistical information that is required in expression (4.6). Firstly, we offer below information about the pensioners' consumer basket at a disaggregation of 15 industries (although our calculations have been for a disaggregation at 64 industries). The second column in Table 3 (Pensioners' expenditure) stands for row vector $\mathbf{C}_{\boldsymbol{p}}(\boldsymbol{t})$.

Table 3. Distribution of Social Security spending on retirement pensions (2021)

A-15		Consumption profile of Pensioner Households	Pensioners' Expenditure
S01	Agriculture, forestry and fishing	1.72%	1,201.4
S02	Energy supply, water supply and waste management activities	1.96%	1,364.1
S03	Food, beverages, tobacco and textiles	6.82%	4,750.2
S04	Manufacture	3.41%	2,376.1
S05	Construction	1.33%	923.9
S06	Wholesale and retail trade	20.87%	14,538.7
S07	Transport	2.19%	1,528.6
S08	Accommodation and food service activities	9.66%	6,727.0
S09	Information and communication	3.68%	2,566.2
S10	Financial and insurance activities	5.79%	4,033.9
S11	Real estate activities	27.09%	18,874.6
S12	Professional, scientific and technical activities; administrative and support service activities	1.38%	961.2
S13	Public administration, defense and education	0.61%	422.1
S14	Health services and social work activities	5.93%	4,129.2
S15	Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organizations and bodies	7.57%	5,274.1
	Total domestic consumption by pensioners (producer prices)		**69,671.2**
	Total imported consumption by pensioners (producer prices)		9,485.3
	Total pensioners' consumption (producer prices)		**79,156.5**
	Tax on products		9,953.4
	Total pensioners' consumption (purchasing prices)		**89,109.9**
	Direct taxes		8,224.8
	Social Security spending on retirement pensions		**97,334.7**
	Number of retirement pensions (thousands)		**5,931**

Note: Monetary values in million euros.
Source: Own elaboration based on 2021 HBS (INE, 2021).

The composition of the pensioners' consumer basket has been obtained from the Household Budget Survey. For our calculations, we had to subtract direct taxes (8,224.8 € million) from paid pensions, and then subtract indirect taxes (9,953.4 € million), in order to measure pensioners' consumption spending into producer prices (these are the prices in which Input-Ouput figures are computed). Next, we set aside goods and services purchased by pensioners that are not produced in Spain (9,485.3 € million). Hence, when Social Security paid 97,334.7 € million in retirement pensions for those aged 65 or older, the latter spent 69,671.2 € million in consumer goods produced in Spain, valued in producer prices. The largest items in the consumer basket are real estate activities and wholesale and retail trade. Followed by accommodation and food service activities.

Next, we premultiply vector $\mathbf{C}_{\boldsymbol{p}}(\boldsymbol{t})$ in Table 3 by matrix $[\mathbf{I} - \mathbf{A}(1+g) - (\mathbf{D} + g\mathbf{K}) - \mathbf{b}\mathbf{a}_{\mathbf{n}}]^{-1}$, as described in expression (4.4) in the previous section. Matrix **A** is a square (64 x 64) symmetric input-output matrix of domestic intermediate inputs; the last input-output matrix published by Spanish Statistics Agency is for 2015, so we have updated it following the Euro method described in Eurostat (Eurostat, 2014).
Matrices **D** and **K**, for depreciation of the stock of fixed capital and fixed capital matrices respectively, have been obtained from information about the net stock of fixed capital provided by the Fundación BBVA and IVIE (2023) for 2020 (we have assumed that capital coefficients do not change from 2020 to 2021). Matrix **K** has 8 types of fixed capital goods; matrix **D** is calculated by dividing each fixed capital good in matrix **K** by its useful lifetime (this information has been taken from the Spanish Tax Agency). Row vector **b** has been estimated using

information from the Household Budget Survey. It accounts for the consumer basket that a representative worker buys during a year with her wage. It includes only domestic goods and services. All consumption funded with wages and mixed-income has been assumed endogenous. Finally, we have assumed *g* = 2.5%.

Vector $\mathbf{X}_p(t)$ of total output, as in expression (4) is:

Table 4. Total Output generated by Social Security spending on retirement pensions (2021)

A-15		Total effect on Output		%Output over Total Output in 2021
S01	Agriculture, forestry and fishing	4,913.5	2.90%	7.71%
S02	Energy supply, water supply and waste management activities	7,648.0	4.51%	6.41%
S03	Food, beverages, tobacco and textiles	13,984.5	8.24%	8.84%
S04	Manufacture	17,264.7	10.17%	3.41%
S05	Construction	8,002.0	4.72%	4.68%
S06	Wholesale and retail trade	26,187.3	15.43%	9.22%
S07	Transport	7,621.8	4.49%	6.05%
S08	Accommodation and food service activities	11,640.6	6.86%	12.64%
S09	Information and communication	5,993.8	3.53%	6.04%
S10	Financial and insurance activities	11,046.8	6.51%	12.96%
S11	Real estate activities	27,332.1	16.11%	18.07%
S12	Professional, scientific and technical activities; administrative and support service activities	10,593.4	6.24%	5.66%
S13	Public administration, defense and education	2,136.8	1.26%	1.27%
S14	Health services and social work activities	6,848.6	4.04%	5.35%
S15	Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organizations and bodies	8,488.9	5.00%	11.84%
	Total Output generated by spending on retirement pensions	**169,702.9**	**100.00%**	**7.04%**

Note: Monetary values in million euros.
Source: Own elaboration.

Table 4 gives us $\mathbf{X}_p(t)$ in expression (4.4). We see that pensioners' expenditure is *responsible* for a little more than 7% of total output: at the sectoral level, 18% of total real estate activities, and roughly 12% of arts, entertainment and recreation, of financial and insurance activities, and accommodation and food services, and almost 10% of trade (wholesale and retail). This information is in producer prices (prices do not include indirect taxes).

Regarding total employment, as measured in expression (4.5), results are provided in Table 5. Total employment, that is direct, indirect and induced employment in the production of the final deliveries demanded by 5,931 thousand pensioners is 1.295,5 thousand full-time equivalent units, a little more than 7% of total employment (in full-time equivalent units). This is especially relevant in sectors like arts, entertainment and recreation (almost 15% of total employment), financial and insurance, real estate activities, and accommodation and food services (around 12%). According to our calculations one full-time equivalent unit of work produces the consumer basket of roughly 4.6 retired pensioners, or alternatively, one retired pensioner puts in motion 0.2 full time working units.
Using this proportion, when in 2050 there will be 11,147 thousand retired pensioners, the amount of employment required to produce their consumer basket will amount to 2,434.8 thousand full-equivalent working units, roughly 10,75% of total employment (assuming a rate of participation of 78,7% and a rate of unemployment of 4%). We believe that this figure indicates that a PAYG pension system is bearable.

And with respect to the impact of pensioners' spending on value added (expression 4.6), this can be seen in Table 6. Total pensioners' expenditure (total pensions after direct taxes) at producer prices, which amounts to 79,156.5 € million, leads to the generation of an amount of value added (at producer prices) of 87,017.2 € million (it should be noted that only 69,671.2 € million are spent on final domestic goods and services). Hence, we have a multiplier effect of pensions on value added of 1.1.

Finally, an interesting result is that when the government pays 97,334.7 € million in pensions, it ends up recovering 45,612.6 € million in taxes, which means a rate of return of 46.9%. Figure 1 illustrates this. The first channel would be the direct taxes on income that both households of pensioners (8,224.8 million euros) and households of employees involved in production to meet pensioners' consumption (8,777.4 million euros) pay to the Government. The second channel involves the net taxes on production from the increase in the level of industrial output sustained by pensioner consumption (2,244.9 million euros). This increase in production includes all the direct, indirect, and induced impacts previously defined. The third channel comprises the payroll taxes transferred from households to the Government derived from the total wages sustained by pensioners' consumption (8,255.5 million euros). Lastly, the fourth channel accounts for the indirect tax on goods and services initially purchased by pensioner households (9,953.4 million euros) plus indirect tax on goods and services derived from the indirect and induced effects on production to meet pensioners' consumption (8,156.6 million euros).

Table 5. Employment sustained by Social Security spending on retirement pensions (2021)

A-15		Direct Effect	Indirect effect	Induced effect	Total Effect		%Total effect over Total Lequiv in 2021
S01	Agriculture, forestry and fishing	13,630.5	24,792.8	16,500.3	54,923.6	4.24%	7.77%
S02	Energy supply, water supply and waste management activities	7,225.8	5,604.7	5,239.3	18,069.8	1.39%	7.69%
S03	Food, beverages, tobacco and textiles	14,819.2	16,150.8	12,733.4	43,703.4	3.37%	8.67%
S04	Manufacture	5,115.6	17,412.5	24,321.7	46,849.8	3.62%	3.48%
S05	Construction	7,099.6	14,432.6	39,958.9	61,491.2	4.75%	4.68%
S06	Wholesale and retail trade	172,058.6	39,890.6	85,151.4	297,100.6	22.93%	9.97%
S07	Transport	11,415.8	22,430.1	18,443.7	52,289.6	4.04%	6.47%
S08	Accommodation and food service activities	89,650.0	7,511.8	57,970.7	155,132.6	11.97%	12.64%
S09	Information and communication	5,415.0	5,949.6	5,293.6	16,658.2	1.29%	3.03%
S10	Financial and insurance activities	16,326.2	19,071.5	12,667.6	48,065.2	3.71%	12.67%
S11	Real estate activities	11,272.5	8,899.3	7,144.8	27,316.6	2.11%	12.53%
S12	Professional, scientific and technical activities; administrative and support service activities	6,811.2	85,074.3	50,560.1	142,445.6	11.00%	5.87%
S13	Public administration, defense and education	6,729.1	7,130.2	20,002.3	33,861.6	2.61%	1.25%
S14	Health services and social work activities	55,079.2	10,361.9	21,359.9	86,800.9	6.70%	5.68%
S15	Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organizations and bodies	146,190.4	15,764.4	48,861.4	210,816.2	16.27%	14.81%
	Total number of jobs	**568,838.6**	**300,477.2**	**426,209**	**1,295,524.8**	**100.00%**	**7.06%**

Source: Own elaboration

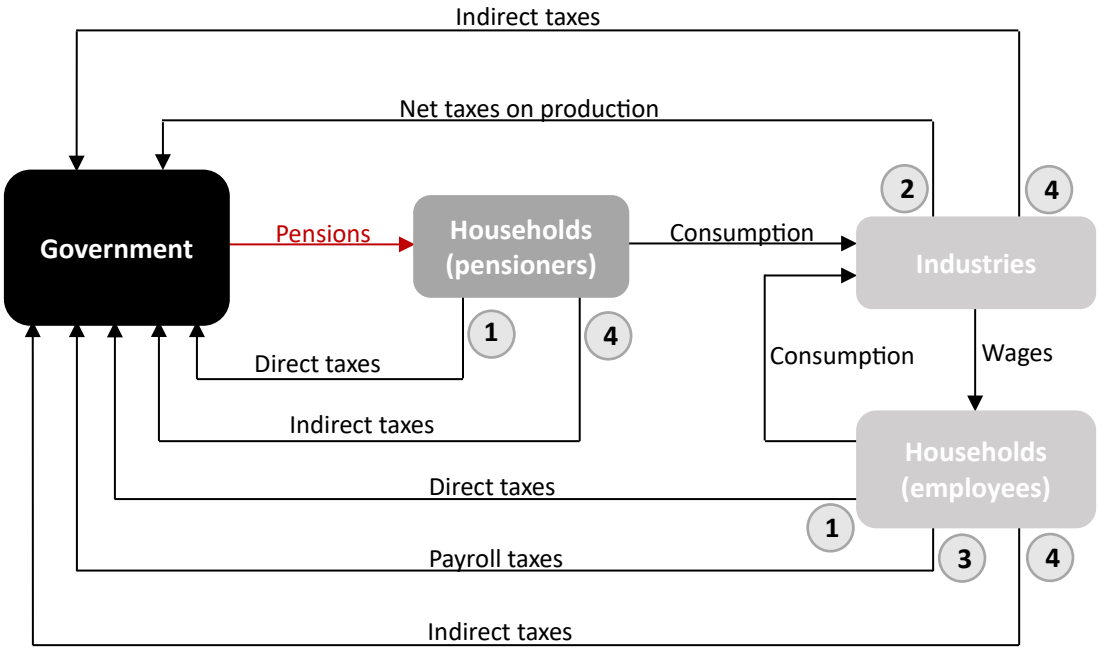
Note: Employment measured in number of equivalent jobs.

Table 6. Distribution of Income generated by Social Security spending on retirement pensions (2021)

A-15		Total effect on Value Added		%Value Added over Total Value Added in 2021
S01	Agriculture, forestry and fishing	2,428	2.79%	7.70%
S02	Energy supply, water supply and waste management activities	2,928.7	3.37%	6.42%
S03	Food, beverages, tobacco and textiles	2,994.8	3.44%	8.64%
S04	Manufacture	3,511	4.03%	3.36%
S05	Construction	2,845.5	3.27%	4.68%
S06	Wholesale and retail trade	14,033.7	16.13%	9.42%
S07	Transport	2,654.8	3.05%	6.15%
S08	Accommodation and food service activities	6,073.6	6.98%	12.64%
S09	Information and communication	2,561.2	2.94%	5.93%
S10	Financial and insurance activities	5,728.8	6.58%	12.35%
S11	Real estate activities	23,694.6	27.23%	18.25%
S12	Professional, scientific and technical activities; administrative and support service activities	5,567.7	6.40%	5.62%
S13	Public administration, defense and education	1,780.8	2.05%	1.36%
S14	Health services and social work activities	4,230.6	4.86%	5.38%
S15	Arts, entertainment and recreation; other service activities; activities of household and extra-territorial organizations and bodies	5,984	6.88%	13.24%
	Total Value Added generated by spending on retirement pensions	**87,017.8**	**100.00%**	**7.98%**
	Wages	27,202.3	31.26%	
	Payroll taxes	8,255.5	9.49%	
	GOS + mixed income	49,315	56.67%	
	Net taxes on production	2,244.9	2.58%	
	Intermediate consumption	40,467.3		
	Tax on products	8,156.6		
	Imports	34,061.2		
	Total Output generated by spending on retirement pensions	**169,702.9**		

Note: Monetary values in million euros.
Source: Own elaboration. N.B. Total Value Added plus intermediate consumption, tax on products and imports yields total output generated by pensions.

Figure 1: Fiscal return derived from Social Security spending on retirement pensions



Source: Own elaboration.

6. On the stability of a pension-led growth model.

In the previous sections, we had focused on the impact of pensioners' expenditures on output, employment and accumulation of fixed capital. In our approach, we considered pensions' expenditures as the only component of autonomous demand, grounding on the notion of Sraffa-Pasinetti subsystems. In this section we investigate whether a pension-led economy is stable in financial terms. This will be so if the rate of public debt, as a consequence of the deficits generated by a PAYG pension scheme, to GDP converge to a finite value.

On this issue, we follow Woodgate et al., (2023). In a PAYG pension-led economy, the determination of output in the long run would be given by the following expression:

$$(6.1) \qquad Y = \frac{c\prime \cdot i \cdot D + P}{1 - c\prime - h + m}$$

Where *D* stands for public debt, *P* is pensioners' expenditure and *i* is the nominal interest rate. Parameter *c'* stands for marginal consumption net of taxes (i.e., $c' = c \cdot (1 - t)$, where t is the tax rate on income). This expression is similar to expression (4) in Woodgate et al. (2023, p. 4).[16] In the expression above, output is a multiple of autonomous demand, but the autonomous demand includes consumption out of interest on public debt, besides pensioners' expenditure on consumer goods. In our model, public debt is the consequence of the public deficit caused by the payment of pensions.

Defining ρ = P / D, (with D being public debt) and assuming that pensions grow at an exogenous rate $\hat{p} = \gamma$, we rearrange expression (6.1) as:

$$(6.2) \qquad Y = \frac{c\prime \cdot i + \rho}{1 - c\prime - h + m} \cdot D = \mu \cdot D$$

[16] There is a minor difference: our expression includes the propensity to import, *m*. Here, for simplicity's sake we have assumed that all pensions are funded with public debt so there are no taxes in this approach, as Woodgate et al. do.

And then, the rate of growth of output can be written as:[17]

(6.3) $g_Y = \hat{\mu} + \widehat{D}$

The time rate of change of public debt, *dD*, (expression 5 in Woodgate et al, ibid), is:

(6.4) $dD = D \cdot i + G - t\mu D$

The last term on the right-hand side of (6.4) accounts for tax revenues. And, consequently, the rate of growth of debt (expression 6 in Woodgate) becomes:

(6.5) $\widehat{D} = i + \rho - t\mu$

On the other hand, we have that the pension-to-debt ratio changes according to the following expression:

(6.6) $d\rho = \rho(\gamma - i - \rho + t\mu)$

Additionally, we define ε = M / E, (with M being imports and E being external debt).
Given that in the steady state the propensity to invest, h (which is a function of the difference between the observed and the *normal* degree of utilization of productive capacity), the degree of utilization of productive capacity (which is a function of the difference between the rate of growth of output and capacity), the pension-to-public debt ratio, ρ, and the imports-to-external debt do not change, we can have the following long-run equilibrium solutions:

(6.7) $g_Y = g_K = \widehat{D} = \widehat{E} = \gamma$
(6.8) $u = u_n$
(6.9) $h = \left(\frac{v \cdot (\gamma + d)}{u_n}\right)$
(6.10) $\rho = \varepsilon = \gamma - (i - t\mu)$

In short, the rate of growth of output, capacity and public debt still are ruled by the rate of growth of pensions (expression 6.7) despite the existence of taxes, and the pension-to-public debt and imports-to-external debt ratios are given by the difference between the rate of growth of pensions and the interest rate minus the tax rate times parameter μ (the last term in expression 6.10 is not present in expression 17 Woodgate et al., ibid.). This can be read as that debt is sustainable provided the rate of growth of output is higher than the interest rate, from which we have to discount the tax rate times μ. As far as μ includes ρ, expression (6.10) should be rewritten as:

(6.10.*bis*) $\rho = \frac{\gamma - i(1 - t \cdot \sigma \cdot c\prime)}{1 - t \cdot \sigma}$

Where σ is the supermultiplier. Parameter ρ is positive provided that γ > I and t·σ·c' is less than one.
It is immediate to see that in the long-run equilibrium the public debt-to-GDP and the external debt-to-GDP ratios converge to a finite value. Defining b = D / Y and e = E / Y, we have that the rate of growth of b and e are $\hat{b} = \widehat{D} - g_Y$; $\hat{e} = \widehat{E} - g_Y$. From (6.7), we have that $\hat{b} = \hat{e} = 0$.

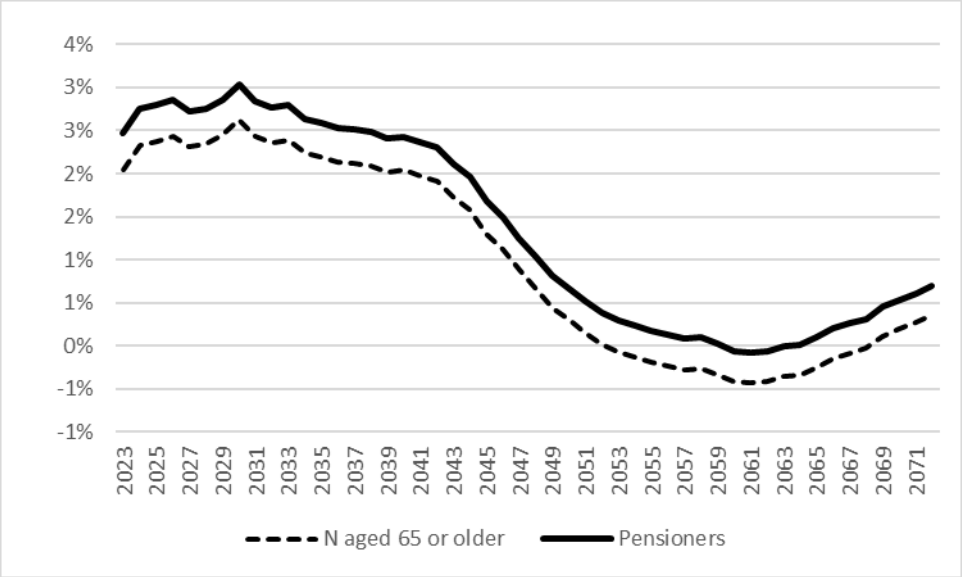
[17] The term $\hat{\mu}$ is zero in the long-run, because all parameters making μ are constant, including ρ.

Regarding the rate of public debt-to-GDP, from (6.2) and (6.10) we can have:[18]

(9) $$b = \frac{1-t\sigma}{\sigma(\gamma - i(1-t\sigma)(1-c'))}$$

The rate of public debt-to-GDP is inversely related to the rate of growth of pensions, and positively related to the rate of interest on public debt. This is a sort of variant of the well-known "Domar condition" of sustainability of public debt, where the output is required to grow faster than the interest rate.
The demographic projection of people aged 65 or older, and the number of retired pensioners in Spain over 2023-2072 is shown in the following figure:

Figure 2: People aged 65 or older and retired pensioners. Spain. Rate of growth.



Source: INE (Spanish Statistics Agency) and authors' elaboration.

The rate of growth of the number of retired pensioners is above 2% until 2045 (retired pensioners are 62% of total population aged 65 or more in 2022, and that percentage rises until 75% in 2072). If productivity increases by 1,5% per annum making wages rise at the same pace, which in turn is shifted to pensions, then pension spending would increase at a rate above 3% until 2045. Hence the condition $\gamma > i$ seems to be realistic.

7. Conclusion.

PAYG pensions are a component of autonomous demand in the Sraffian supermultiplier, and as such they can be seen as an engine of growth. In Spain, in 2021, pensions paid to people aged 65 or more amounted to a little more than 8% of GDP, and they demanded goods and services for around 7% of total production. 5,9 million pensioners put in motion almost 1,3 million full-time equivalent workers (7% of the labor supply). These figures make us believe that a PAYG pension scheme will be viable in the future: if in 2050, retired pension beneficiaries increase from 5,9 to 11,1 million people, they will demand more than 2,4 million full-time equivalent workers, 10,75% of expected employment in that time. It is quite likely that a large percentage of this labor force will have a non-resident origin and that this will come with a decline in the

[18] For "reasonable" values: t = 0,4, σ = 1,8, γ = 3%, i = 0,5%, c' = 0.57, then b ≈ 530%, which indeed is rather high. It should be noted, nevertheless, that no other sources of autonomous demand are considered in this analysis.

outstanding reserve army, so that profits might decline. These two factors will make it more difficult for pensions to act as a locomotive for the economy.
In 2021, for each euro spent in pensions, the government recovered 47 cents in taxes. In a model where pensions, plus the interest on public debt as a consequence of the public deficit generated by their payment, are the only ingredients of autonomous demand, the ratio of public debt-to-GDP converges to a finite value.

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