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Components of autonomous demand growth and financial feedbacks: Implications for growth drivers and growth regime analysis

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Components of autonomous demand growth and financial feedbacks: Implications for growth drivers and growth regime analysis

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Abstract
Since autonomous demand has to be financed independently of income from current production, this paper starts with the requirement that autonomous demand-led growth models have to include endogenous money and credit, and hence financial dynamics. It then seeks to make two contributions. First, we show that the inclusion of financial stock-flow interactions in a simple closed economy autonomous demand-led growth model provides an endogenous mechanism which, under certain conditions, aligns two autonomous growth rates, as a requirement for long-run equilibrium. Second, using that model, we prove that the relative size of autonomous growth contributions may be misleading as a guide to classify growth regimes if autonomous growth rates are interdependent, both for the steady state growth equilibrium as well as for the traverse towards this equilibrium. Furthermore, we show that the relative growth contributions are economic policy contingent. Therefore, in Sraffian supermultiplier demand-led growth decomposition exercises, interdependencies between autonomous growth components should not be ignored when growth drivers are supposed to be identified, both in medium- to long-run growth regime analysis, as well as in the analysis of autonomous drivers of short-run cycles.

Keywords: Sraffian supermultiplier and endogenous credit, two autonomous growth drivers, demand-led growth accounting, growth regimes

JEL code: E11, E12, E20, E62

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1. Introduction

Initial versions of Sraffian supermultiplier autonomous demand-led growth models (Serrano 1995, Freitas and Serrano 2015, 2017) have paid little attention to the monetary and financial requirements and implications of these models. However, as recently pointed out again by Cesaratto and Di Bucchianico (2020) and Cesaratto and Pariboni (2022), autonomous demand growth needs to be financed by other sources than income from current production. This necessarily implies the endogenous generation of means of finance, and hence endogenous money and credit, as it has been developed in post-Keynesian monetary theory (Lavoie 2022, ch. 4; Hein 2023a, ch.3). According to Cesaratto and Di Bucchianico (2020, p. 3-4), two implications arise from this:[1]

> 'From a theoretical point of view, it creates a natural field of convergence between the endogenous money literature and the Sraffian supermultiplier approach. From a substantial point of view, inclusion of the financial side leads us to regard autonomous demand-led as prone to financial crisis due to excess indebtedness, for instance, of households or of peripheral countries (…).'

Starting with Pariboni (2016), the debt dynamics associated with financing autonomous demand have been explored and the long-run stability conditions for autonomous demand-led growth have recently been examined in Freitas and Christianes (2020), Hein and Woodgate (2021), Morlin (2022), and Vieira Mandarino (2020), for example.

Morlin (2022) has explicitly focussed on the discussion of two autonomous growth drivers, government spending and exports. As is well known in the autonomous-demand led growth literature, two or more components of autonomous demand require that these components will have to grow at same rate in the long run, if each of them is meant to contribute to growth in this long run (Allain 2022). Otherwise, the share of the driver(s) with the lower growth rate(s) will converge towards zero. In Morlin (2022), the two autonomous growth drivers, exports and government expenditures, are considered to be independent of each other. The adjustment then takes place via a balance of payments constraint, towards which government policies respond, in order to prevent over-indebtedness, financial fragility and, finally, financial crises. Either governments reduce their expenditure growth or/and they apply industrial policies in order to increase the income elasticities of export (and reduce those of imports). In his general and abstract analysis of two (or more) autonomous growth rates, Allain (2022) discusses three options for their convergence: (1) one (seemingly) autonomous parts still contains an induced element which make it converge to the growth rate of the truly autonomous component, (2) discretionary decisions adjust one rate to the other, (3) changing

[1] See Cesaratto (2017), Cesaratto and Di Bucchianico (2020), and Cesaratto and Pariboni (2022) for detailed accounts of the close relationship between autonomous demand-led growth and post-Keynesian monetary circuit and endogenous money theory. In this context, Cesaratto and Pariboni (2022, p. 306) also point out the close relationship of Sraffian supermultiplier models with Kalecki's notion that external markets created by government deficits and export surpluses are drivers of growth: 'The autonomous components of aggregate demand, which in the supermultiplier model drive growth and coincide with Kalecki-Luxemburg's external markets, can be financed by purchasing power creation by banks, by accumulated wealth or foreign income. … By definition, external markets are fueled by debt creation, and the seed of financial instability and crisis can be traced here.'

financial conditions and financial constraints enforce an adjustment through policy change, similar to Morlin's (2022) arguments.[2]

We do not deny the actual and potential relevance of such mechanisms. However, in this paper, we will argue that the explicit inclusion of finance into autonomous demand-led growth models already generates a mechanism, which may align two (or more) autonomous growth rates to each other, under certain conditions. Endogenous credit and finance associated with autonomous demand growth, generate (changes of) financial assets and liabilities, as well as future income flows related to these financial assets and liabilities, which are independent of production, each potentially generating and funding autonomous demand (consumption, residential investment, exports)[3]. Although present in the closed economy autonomous demand-led growth model driven by government expenditures provided by Hein and Woodgate (2021), it has not been made explicit as a mechanism potentially aligning two (or more) autonomous growth rates.[4] To provide a simple model aligning two autonomous growth rates via the financial stock-flow interaction is hence the first contribution of this paper. For this purpose, we will make use of Allain's (2021) general and abstract distinction between an active and a passive autonomous growth driver, where the latter endogenously adjusts to the former.[5]

We will provide a simplified version of the model proposed by Hein and Woodgate (2021), in which government expenditures growth is the active autonomous growth rate while rentiers' consumption out interest income becomes the passive autonomous growth rate. The explicit consideration of financing autonomous government demand thus provides the grounds for considering two autonomous growth rates, with the dynamics of the stocks (of debt and thus assets) and income generated from these stocks providing the link through which the growth rate of the passive component endogenously adjusts towards the growth rate of the active component. Such an adjustment thus does not need any external constraint and policy interventions or rules to meet this constraint.

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[2] For a stock-flow supermultiplier model with two debt-financed autonomous expenditures (autonomous government and household consumption), and interrelations between sectoral autonomous demand growth and sectoral indebtedness, with possible emergence of financial fragility processes, see Pedrosa et al. (2023).

[3] We do not mention government expenditure here, because we hold that in sovereign money economies, governments do not have to pre-fund their expenditures, although policy makers may have imposed some policy rules (government debt ceilings, debt brakes, balanced budgets etc.) which may impose a constraint on government expenditures, which may then interact with other autonomous expenditure components. In countries without sovereign money, government expenditures would have to be mentioned here, too.

[4] Freitas and Christianes (2020) have two autonomous growth rates (government expenditures and capitalist consumption), but just assume that the two will be equal in the long run, without discussing their interaction. Brochier and Macedo e Silva (2019) have presented and autonomous demand-led stock-flow consistent growth model driven by consumption out of wealth, with wealth being endogenous in the long run. They thus include financial issues, but only have one autonomous growth rate which is endogenous.

[5] In the journal version of his paper, Allain (2022) has abandoned the distinction between 'active' and 'passive' components of autonomous demand in favour of 'autonomous' and 'semi-autonomous' demand components. He thus follows Fiebiger (2018, 2020) and Lavoie and Fiebiger (2019), who have argued that 'semi-autonomous' may be a better terminology to indicate the independence of parts of demand from income generated in current production, which may be, nonetheless, through some other mechanism be related to the dynamics of production in the long run. They refer to Kalecki (1968, pp.265-269), who is using 'semi-autonomous' for the autonomous part of capitalists' consumption, and the effect of technical change and innovations on investment.

Furthermore, we will discuss the empirical implications of our model regarding the recent research on autonomous growth drivers and growth regimes (Campana et al. 2023, Freitas and Dweck 2013, Girardi and Pariboni 2016, Labat and Summa 2023, Morlin et al. 2022, Passos and Morlin 2022). This research has relied on the de-composition of autonomous and induced components of aggregate demand, the calculation of growth contributions of autonomous growth drivers (government expenditures, credit-financed private consumption, residential investment and exports), as well as on growth contributions of the changes in the components of the supermultiplier (the propensities to consume, to invest and to import) (Hein 2023b). However, it has not addressed the (potential) interrelationship between the different components of autonomous demand. We will show, theoretically, that our model with government expenditures as the active component of autonomous demand may, under certain conditions, including the economic policy regime, generate a regime in which autonomous private consumption expenditures as the passive component of autonomous demand may dominate in terms of the growth contributions. Classifying such an economy as autonomous consumption-led would thus be somewhat misleading. This indicates that the integration of financial flow and stock variables, and their interaction, may establish important links between the autonomous components of aggregate demand and their growth contributions, which should be considered in the growth regime analysis. To point this out clearly is the second contribution of our paper.

The paper is organised as follows. In Section 2 we will present the most basic closed economy model driven by autonomous government expenditures growth, as the active, and the growth of consumption out of interest income, as the passive component of autonomous demand that adjusts towards the growth of the active component in long-run equilibrium. Section 3 then turns to current research on demand-led growth accounting based on the Sraffian supermultiplier growth model. It argues that classifying countries according to the relative size of the growth contributions of autonomous demand components may be misleading. This is then demonstrated making use of the simple model, both for the long-run growth equilibrium and for the traverse towards this equilibrium. Section 4 summarises and concludes.

2. A simple closed economy autonomous demand-led growth model with an active and a passive component of autonomous demand

Here we develop a simple Sraffian supermultiplier model that is primarily driven by the growth rate of autonomous government spending. However, since government spending is financed through the issuance of government bonds, the resulting public interest payments induce rentier consumption, which serves as a “secondary” or “passive” component of autonomous expenditures. Thus, the growth of autonomous government expenditure enables rentiers’ autonomous consumption and, it will be shown, sets the pace for long-run output growth and capital accumulation. Yet, as we shall also show, this does *not* imply that the growth contribution of government spending is necessarily greater than that of autonomous consumption, such that this economy would always be classified as government demand-led. Indeed, despite the causal primacy of government spending in this simple model, we can show that the growth contribution of autonomous consumption may exceed that of government spending in the short run as well as the long run, giving rise to a seemingly autonomous-consumption-led economy.

We develop the model as follows, assuming constant prices and a price level equal to unity such that nominal and real values are the same. Suppose consumption (*C*) is given by the product of the marginal propensity to consume (*c*) and the sum of income arising from production (*Y*) and interest paid on government debt (*iL*):

$$C = c(Y + iL), \quad 0 < c < 1. \tag{1}$$

where L is the stock of government debt and i is the interest rate on government debt. Investment (*I*) is fully induced by the level of output (Y), where the responsiveness of investment to changes in output is governed by the marginal propensity to invest (h), which is fixed in the short run and variable in the long run in a way that shall be described later:

$$I = hY, \quad 0 < h < 1. \tag{2}$$

Supposing that government expenditures (G) are fully autonomous and grow at a constant rate of γ:

$$\hat{G} = \gamma, \quad 0 \leq \gamma, \tag{3}$$

we can solve for the short-run equilibrium (denoted by an asterisk) level of output through equating output with the sum of planned consumption, investment, and government expenditures, which are taken as given in the short run, such that:

$$Y^* = \frac{ciL + G}{1 - c - h} = m\,(C^A + G) = mZ. \tag{4}$$

Equation 4 shows that the short-run equilibrium level of output depends on the supermultiplier, $m = \frac{1}{1-c-h}$, and on autonomous demand (*Z*), which in our simple model is made up of two components, autonomous government spending (*G*) and autonomous consumption out of interest income arising from public debt ($ciL = C^A$). However, these two components are related. Since we ignore taxes, we suppose that new government debt is issued to cover government spending and interest payments on outstanding government debt in any period, as in Hein and Woodgate (2021). Government deficit-financed expenditure thus adds to the stock of government debt held as interest yielding assets by the private households, which then affects autonomous consumption out of interest income.

Based on our assumptions, the time rate of change (denoted by a dot) of public debt is given by:

$$\dot{L} = G + iL. \tag{5}$$

Dividing by the stock of government debt, it follows that the growth rate (denoted by a hat) of government debt is determined by the ratio of government spending to government debt ($\rho \equiv G/L$) and the interest rate:

$$\hat{L} = \rho + i. \tag{6}$$

Making use of the public spending-to-debt ratio ρ, we can express the short-run equilibrium output from Equation 4 as a function of the level of government debt, assuming a given public spending-to-debt ratio in the short run:

$$Y^* = \mu L, \tag{7}$$

with $\mu = \frac{ci+\rho}{1-c-h}$. It follows, then, that the growth rate of output (g) is given by the sum of the growth rate of μ and the growth rate of public debt:

$$g = \hat{Y} = \hat{\mu} + \hat{L}, \tag{8}$$

where the growth rate of μ is given by:

$$\hat{\mu} = \frac{(\dot{c}i+\dot{i}c+\dot{\rho})(1-c-h)+(\dot{c}+\dot{h})(ci+\rho)}{(1-c-h)(ci+\rho)}. \tag{9}$$

For the purposes of the analysis that follows, however, we will assume the overall marginal propensity to consume and interest rate are time invariant, such that $\dot{c} = \dot{i} = 0$. The time rate of change of the public spending-to-debt ratio, on the other hand, is given by:

$$\dot{\rho} = \rho(\gamma - i - \rho). \tag{10}$$

The dynamic equations for the marginal propensity to invest and for the rate of capacity utilisation, as the ratio of output over the capital stock ($u = Y/K$), specified in Equations 11 and 12, follow the usual form seen in the Sraffian supermultiplier literature. The former is dependent upon deviations of the utilisation rate from the firms' target rate, the long-run normal rate (u_n), and the responsiveness (η) of the marginal propensity to invest to deviations of capacity utilisation from the normal rate:

$$\dot{h} = h\eta(u - u_n). \tag{11}$$

The latter is determined by the difference between the growth rate of output and the accumulation rate of capital (g_k):

$$\dot{u} = u(g - g_k). \tag{12}$$

Dividing Equation 2 by the capital stock, the accumulation rate is given by the marginal propensity to invest and the rate of capacity utilisation as defined above:

$$g_k = hu. \tag{13}$$

The long-run steady state of our system, where $\dot{\rho} = \dot{h} = \dot{u} = 0$, is captured in Equations 14-17, where double asterisks denote long-run equilibrium values.[6]

$$g^{**} = \hat{L}^{**} = g_k^{**} = \gamma \tag{14}$$
$$u^{**} = u_n \tag{15}$$
$$h^{**} = \gamma / u_n \tag{16}$$
$$\rho^{**} = \gamma - i \tag{17}$$

In the steady state, the growth rates of output, government debt and the capital stock are all equal to the growth rate of government spending, as the active component of autonomous demand (Equation 14). Since in the long-run equilibrium, the growth rate of government debt is equal to the autonomous growth rate of government spending, for a given interest rate and a given propensity to consume out of any income, also the growth rate of consumption out of interest income, the passive component of autonomous demand, converges to the growth rate of government spending. The model is thus ultimately driven by government expenditures, the active component of autonomous demand, and autonomous consumption, the passive component, adjusts towards that growth rate through the adjustment of the growth rate of government debt, and thus interest income, to the growth rate of the active component of autonomous demand.

In long-run equilibrium, capacity utilisation is at its target or normal rate (Equation 15). The marginal propensity to invest also converges to its long-run value, which is determined by γ and u_n (Equation 16). This means that, given some exogenous normal utilisation, there is a positive relation between the propensity to invest (or the business investment share) and the growth rate of government spending (and consequently, the growth rate of autonomous demand and output in steady-state), which is a common property of supermultiplier models.[7]

[6] We ignore the trivial solutions where the long-run equilibrium values are zero.
[7] This has consequences for the level of output in the steady state (Equation 4), as a higher propensity to invest increases the level of output.

Equation 17 says the long-run public spending-to-debt ratio is given by the difference between the growth rate of government spending and the interest rate on government debt. Hence, for economically meaningful long-run values, it must be the case that:

$$i < \gamma. \tag{18}$$

This represents a basic stability condition, which can be found elsewhere (e.g. Freitas and Christianes 2020, Hein and Woodgate 2021). It is analogous to the 'Domar condition' (Domar 1944), remembering that in our case there are no taxes and the public sector is permanently in deficit, so the growth rate of output (government spending) must be higher than the interest rate to avoid an explosive trend of the debt-to GDP ratio.

A further stability condition is revealed through analysis of the system's Jacobian evaluated at the long-run equilibrium using the Routh-Hurwitz conditions. This second stability condition is essentially the same as that found in similar Sraffian supermultiplier models.[8] It can be expressed in terms of a limit on the growth rate of government expenditures:

$$\gamma < (1 - c - \eta)u_n. \tag{19}$$

Since many similar derivations can be found in the literature and since stability analysis is not the focus of this paper, we relegate our derivation to the appendix and assume stability conditions (18) and (19) are fulfilled throughout the analysis that follows.[9]

3. Contributions of components of autonomous demand to growth

3.1 Insights from the supermultiplier demand-led growth accounting

The simple model with two autonomous growth drivers presented in the previous section provides some interesting insights into the dynamics of the relative importance of the components of autonomous demand growth. Therefore, it can provide some analytical basis to discuss the results of the recent empirical literature on supermultiplier demand-led growth accounting. This literature uses the supermultiplier theory (Serrano 1995, Serrano et. al. 2023) to organize the data and to measure the contribution to growth of several autonomous and induced components of demand (Campana et al. 2023, Freitas and Dweck 2013, Girardi and Pariboni 2016, Labat and Summa 2023, Morlin et al. 2022, Passos and Morlin 2022).

The methodology of the supermultiplier demand-led growth accounting consists of developing a 'theoretically informed decomposition' (Morlin et al. 2022, p. 32) of economic growth building upon a distinction of demand between autonomous and induced components. This decomposition gives us the contribution of each of the autonomous and induced components of demand to the growth rate of output. The supermultiplier demand-

[8] See Freitas and Serrano (2015, p.14), who also elaborate on the interpretation of this stability condition. A similar stability condition is found in, for example, Hein and Woodgate (2021) and Morlin (2022).

[9] For an assessment of the empirical plausibility of the stability conditions (18) and (19) for the case of the United States, see respectively, Blanchard (2019) and Haluska et al (2021).

led growth accounting is thus an alternative to the supply-side growth accounting (Hulten 2010), as the former assumes that growth is driven by aggregate demand, while the latter assumes that growth is supply-led. It is also an alternative to other demand-led growth accounting, such as the national income and financial accounting decomposition approach (Hein 2011a, 2011b, 2012), as it imposes the supermultiplier theory to organize the data into induced and autonomous components of demand (for a comparison, see Campana et al. 2023, Hein 2023b, Morlin et al. 2022).

More specifically, the output growth is decomposed into changes in the parameters of the supermultiplier and changes in the components of autonomous demand, like in Equation 4 of our theoretical model above. The contribution to growth of each of these demand components will depend on their respective growth rates and their relative share in aggregate demand. Thus, a component that has a larger share of aggregate demand and is growing slowly can make a larger contribution to growth than a component that has a smaller share but a higher growth rate.

It should be noticed that the empirical exercises based on supermultiplier demand-led growth accounting have some differences with the simple theoretical supermultiplier models, such as the one presented in Section 2. First, the supermultiplier growth accounting uses actual data (in general, annual data), which imply disequilibrium processes according to the theoretical model, as the parameters of the supermultiplier may always be changing and the components of autonomous demand may grow at different rates. However, the results of the theoretical model are in general discussed in terms of steady-state solutions, with autonomous demand components growing at the same rate and an unchanging steady-state supermultiplier, which is compatible with that growth rate.

Second, there is a divergence concerning the level of detail between the theoretical model and the empirical methodology. As the demand-led decomposition should reflect the actual data, it must include all the components of demand present in the data. On the contrary, our theoretical model imposes some simplifying assumption, such as a closed economy with no taxes and public transfers, and only two autonomous demand components. In the literature of the supermultiplier demand-led accounting, it is included into the supermultiplier parameters, besides the propensities to invest and to consume, both the tax burden and the import coefficient. Moreover, the autonomous demand includes other components, such as residential investment, private consumption out of credit, and exports (Campana et al. 2023, Girardi and Pariboni 2016, Morlin et al. 2022, Passos and Morlin 2022).[10]

We can use some stylized results from these empirical exercises to think about our discussion of active and passive components of autonomous demand and its relative contribution to growth. The Spanish economy experienced a higher average growth rate of output and a real estate boom in the period of 1998-2007. We can consider residential

[10] The level of disaggregation of autonomous components can be even more detailed, e.g., with the distinction between government consumption and investment, investment by state-owned enterprises, business investment in R&D, and consumption out of public transfers and public wages (Labat and Summa, 2023). However, in none of the papers of the supermultiplier demand-led growth accounting literature the consumption out of interest on public debt is included.

investment as the active autonomous component of demand, and government spending as passive (because Spain has had a target primary government budget surplus).[11] However, the contribution of autonomous demand by the public sector was higher than the contribution by residential investment (Labat and Summa 2023). This result arises from two facts: first, because the housing boom and bubble generated windfall tax revenues and allowed fiscal expansion, given the fiscal rule. Second, because the share of autonomous demand financed by the government in aggregate demand is higher than the share of residential investment. So, despite the higher growth rates of residential investment than government spending, the latter made a bigger contribution to growth than the former.

A similar story can be told for the Brazilian economy in the 2000's. Here we will consider exports as the active autonomous demand driver and government spending as the passive, also because of a primary surplus target.[12] Again, the contribution of autonomous demand financed by the public sector to growth was higher than that of exports (Campana et al. 2023). This result also is the consequence of two facts: first, because the commodity boom and the strengthening of south-south trade increased tax revenues and allowed a public expansion, again given a primary surplus target in the government budget; second, because again the share of autonomous demand financed by the government in aggregate demand is higher than the share of exports.

Similar to the theoretical model by Morlin (2022), in both examples it is a policy rule, which links the two autonomous growth drivers and makes government expenditure growth the passive autonomous growth rate in both cases, while residential investment has been the main active component in the Spanish case and exports in the Brazilian case. This then also affects the relative importance of the two autonomous growth drivers in the disequilibrium process, as underlying the empirical data for growth accounting exercises. We do not question the relevance of such a policy rule aligning autonomous growth rates and affecting their relative importance. However, we hold that even without any policy rule related to government expenditures and government debt (or to exports and foreign indebtedness as additionally included in Morlin's 2022 model), active and passive autonomous growth drivers can be distinguished because of the 'automatic' stock-flow interactions in a monetary production economy. These are, in a sense, prior to the imposition of policy rules on the economic actors and parts of the autonomous growth components, and thus deserve a more careful treatment, before policy rules etc. are introduced and their effects are considered.

3.2 The active and the passive components of autonomous demand growth and the relative contribution to growth: the long-run steady-state

As already pointed out, active and passive components in our model are clearly linked through the stock-flow effects of deficit financed consumption, taking the interest rate and the propensity to consume out of income as given. This can be shown, first, for the steady state

[11] We are simplifying the story, because exports can also be included as a second active autonomous driver for the Spanish economy.

[12] This is, of course, just a simplified stylized story, as autonomous consumption out of credit and residential investment can be included as important sources of active autonomous driver in the Brazilian case, too.

properties. In this steady state, (1) the supermultiplier is not changing, as the propensity to invest has already been adjusted and the propensity to consume is fixed by assumption and (2) government spending and autonomous consumption out of interest income arising from public debt grow at the same rate. Consequently, the relative contribution to growth of these two autonomous components depends only on their relative share in aggregate demand.

We can express the relationship between these two components in the steady-state, making use of the solution for the long-run government spending-debt ratio (Equation 17):

$$\frac{C^{A**}}{G^{**}} = \frac{ciL^{**}}{G^{**}} = \frac{ci}{\rho^{**}} = \frac{ci}{\gamma - i} \tag{20}$$

The relative share between autonomous consumption out of interest income and government spending, in the long run, will thus depend on three variables: the propensity to consume, the interest rate and the growth rate of government spending. With the long-run stability condition given, the first two factors increase the autonomous consumption-to-government spending ratio, while the last reduces it.

Since in long-run equilibrium the growth contributions of autonomous consumption and of autonomous government expenditures are given, respectively, by $C_{GC}^{A} = \gamma \frac{C^A}{Y}$ and $G_{GC} = \gamma \frac{G}{Y}$, Equation 20 also represents the relative growth contributions. We thus get:

$$C_{GC}^{A} > G_{GC}, \qquad \text{if} \;\; \gamma < i(1 + c). \tag{21}$$

In the long-run growth equilibrium, the growth contribution of the passive component of autonomous demand, C_{GC}^{A}, is hence greater than the active component, G_{GC}, if the autonomous growth rate of government spending is sufficiently small. A higher rate of interest and a higher propensity to consume make such a case more likely. However, it should be recalled from conditions (18) and (19) that stability requires that $i < \gamma < (1 - c - \eta)u_n$. Hence, while increases in the interest rate and the propensity to consume make the growth contribution of autonomous consumption greater relative to that of government spending, it should be noted that such increases also pose a threat to systemic stability should these parameters become too large.

The explicit consideration of financing autonomous demand thus, first, provides the grounds for two autonomous growth rates, with the dynamics of the stocks of debt and thus assets and income generated from these stocks providing the link through which the growth rate of the passive component, autonomous consumption, endogenously adjusts towards the growth rate of the active component, government expenditures. Second, the growth contributions of passive and active components are determined by those model parameters, which are related to the conditions of finance, the rate of interest, the propensity to spend out of financial income (equal to the average propensity to consume in our simple model), and by the growth rate of the active component of autonomous demand. The relative growth contributions may hence be affected by economic policies, i.e. monetary policies affecting the long-term rate of interest on government debt, distributional policies related to wealth and income inequality affecting the average propensity to consume, and, finally, the growth rate of government expenditures, of course.

3.3 The active and the passive components of autonomous demand growth and the relative contribution to growth: the traverse

It is not just in the hypothetical long-run equilibrium of our model that the passive autonomous growth contribution, may be greater than the active autonomous growth contribution. Also in the short-run disequilibrium traverse, we may have such a result. We can define the dynamic disequilibrium condition for the growth contribution of our active component of autonomous demand, government spending, to be smaller than that of the passive component, autonomous consumption:

$$C_{GC}^{A} > G_{GC}, \qquad \text{if} \qquad \hat{L}\frac{ciL}{Y} > \gamma\frac{G}{Y}, \tag{22}$$

which, by inserting Equation 6 for $\hat{L}$ and rearranging, is the same as:

$$\rho < \frac{ci^2}{\gamma - ci}. \tag{23}$$

Note that, since long-run stability requires $\gamma > i$, it follows that the right-hand side of Condition 23 is positive by assumption. This inequality implies that, despite the model being ultimately driven by government spending, C_{GC}^{A} is greater than G_{GC} when ρ is sufficiently small.

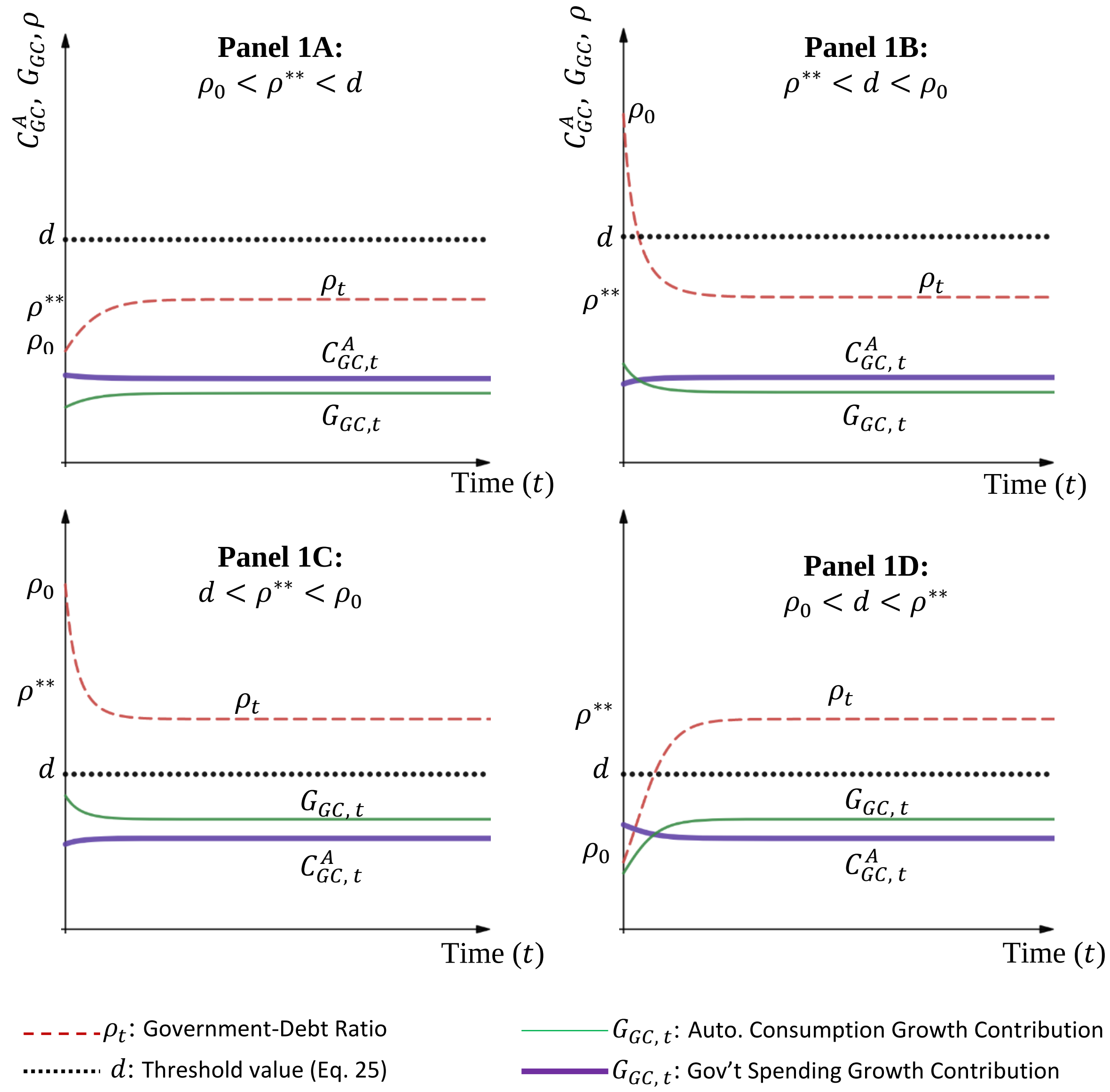
To analyse different cases, we start by inserting the steady state value of ρ into its equation of motion in Equation 10, which yields:

$$\dot{\rho} = \rho(\rho^{**} - \rho). \tag{24}$$

We see that ρ steadily falls (rises) to its steady state value if the initial value (ρ_0) exceeds (falls below) its long-run equilibrium value. Next, we denote the threshold value on the right-hand side of inequality (23), which determines which of the two growth contributions is larger, by:

$$d = \frac{ci^2}{\gamma - ci}. \tag{25}$$

Figure 1. *The growth contributions of autonomous consumption (C^A_{GC}) and government spending (G_{GC}) depend on the evolution of the government spending-to-debt ratio (ρ)*



By inequality (23), the value of ρ_t in any period t relative to this constant determinant, d, tells us which growth contribution is greater. Since we know the evolution of ρ is determined by its initial value (ρ_0) and its steady state value (ρ^{**}), then if, for example, $\rho_0 < \rho^{**} < d$ it must be the case that the growth contribution of autonomous consumption will be greater than that of government spending not just in the long run, *but in every period* in the traverse towards this long-run equilibrium. This situation is shown in Panel 1A of Figure 1. Panel 1B shows the case where $\rho^{**} < d < \rho_0$. Now the growth contribution of autonomous consumption exceeds that of government spending in all periods bar the initial ones. Lastly, Panels 1C and 1D show the cases where the growth contribution of government spending surpasses that of autonomous consumption in all periods in the former and in all periods bar the initial ones in the latter.

Hence, our simple model shows that the analysis of autonomous growth contributions alone is not sufficient to determine the ultimate driver of growth in any given economy, in line with the stylized empirical cases pointed out in Section 3.1. In our example, it is perfectly possible that autonomous consumption contributes more to output growth than autonomous government spending in the long run and the short run, despite government spending being the underlying engine of growth. This result requires an interest rate on government debt that is positive and smaller than but close to the growth rate of government spending, together with a high propensity to consume out of interest income (which is equal to the average propensity to consume in our simple model).

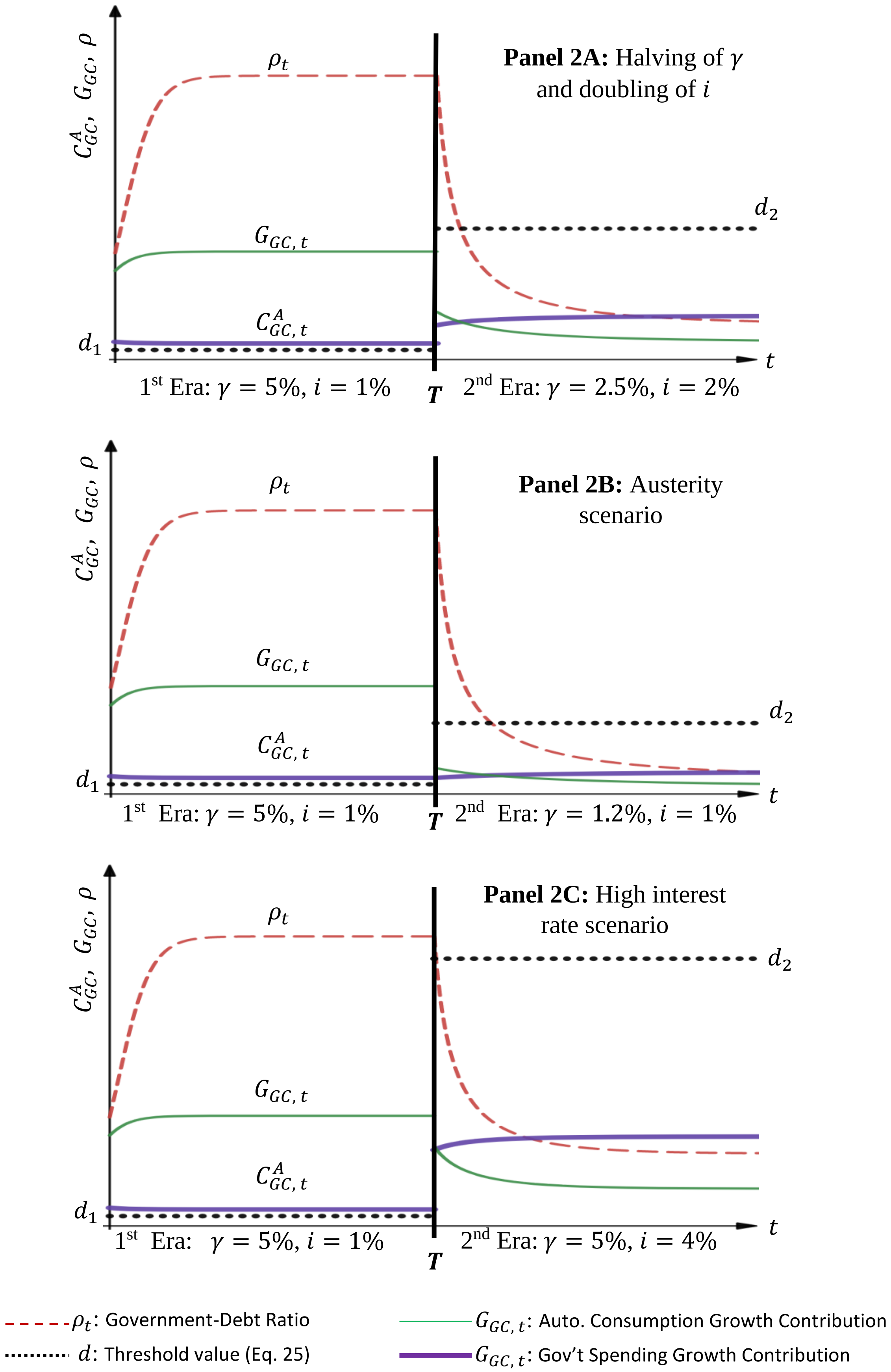
In addition to the endogenous changes in the dominant growth contribution seen above, we can also employ our simple model to analyse the effects of exogenous changes in the policy variables in the disequilibrium traverse. In particular, we can observe what happens to the relative growth contributions at any period in time given a change in the growth rate of government expenditures and a change in the interest rate on government debt.

Figure 2 depicts the evolution of the same key macroeconomic variables over time as Figure 1, but now the economy experiences a policy shock in period *T*. This gives rise to two periods of analysis: A pre-shock, first policy era where γ is far greater than i and a post-shock, second policy era where γ falls, i rises, or both occur simultaneously. In the first scenario in Panel 2A, γ halves from 5% to 2.5% and i doubles from 1% to 2%. In Panel 2B, we have a severe austerity scenario in which i remains constant at 1% but γ falls considerably, from 5% to 1.2%. Lastly, in Panel 2C, γ remains constant at 5% but i quadruples from 1% to 4%.

The qualitative effect of each of these three policy changes is the same in each scenario. The government spending-debt ratio falls in the second policy era while the threshold value rises from d_1 to d_2. As a result, the growth contribution of government spending far surpasses that of autonomous consumption in the pre-shock policy era while autonomous consumption contributes more to demand and output growth in the post-shock era (if not always immediately following any given shock in period *T*). Hence, we see the various ways by which the dominant growth contribution in our model economy may be determined by policy changes.[13]

[13] Though it is, of course, possible that decreases in γ and/or increases in i may not be sufficient in size to change the dominant growth contribution. Though not illustrated here, one could equally examine the opposite cases wherein the policy shock is a rise in γ and/or fall in i. Unsurprisingly, the result in the post-shock period is, in qualitative terms, the mirror image of what is depicted in Figure 2, i.e. a rising government spending-debt ratio ρ, lower threshold value d, higher (and rising) growth contributions of government spending, as well as lower (and falling) growth contribution of autonomous expenditure.

Figure 2 *Effect of various policy changes in period T on the growth contributions of government spending and autonomous consumption*



4. Conclusions

Starting from the requirement that autonomous demand-led growth models have to include endogenous money and credit, and hence financial dynamics, because autonomous demand has to be financed independently of income from current production, we have tried to make two contributions in this paper.

First, we have addressed the current debate on the implications of two (or more) autonomous growth rates and the need of adjustment of these two growth rates in long-run equilibrium, if each of the components is meant to contribute to aggregate demand growth. We have shown even for the most basic closed economy autonomous demand-led growth model that the inclusion of some financial stock-flow interaction provides an endogenous mechanism by means of which the passive component of autonomous growth, consumption out of interest income in our model, adjusts towards the active component, government expenditure growth in our model, provided that the general conditions for stability are met. In our view, the inclusion of such an endogenous mechanism, which has been ignored in much of the previous literature, is prior to the implementation of exogenous or policy constraints in order to align two or more autonomous growth rates, although we do not deny the relevance of the latter on empirical grounds.

Second, our paper has addressed the recent research on demand-led growth accounting based on the Sraffian supermultiplier growth model. We have started from the consideration that the relative sizes of autonomous growth contributions may be misleading as a guide to classify growth regimes if autonomous growth rates are interdependent. Based on our simple model we have shown that this may indeed be the case, both for the steady state growth equilibrium as well as for the traverse towards this equilibrium. Furthermore, we have shown for our model, that the relative growth contributions are economic policy contingent. This implies that, although the Sraffian supermuliplier demand-led growth decomposition exercise is an important step, interdependencies between autonomous growth components should not be ignored when growth drivers are supposed to be identified. This seems to be true both for medium- to long-run growth regime analysis, but also for the analysis of the autonomous drivers of short-run cycles.

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Appendix: Proof of Stability Conditions

A system is considered locally stable around its steady state if its Jacobian evaluated at the long-run equilibrium values (J^{**}), which for our model is given by:

$$J^{**} = \begin{pmatrix} \frac{\partial \dot{u}}{\partial u}\Big|_{u^{**},h^{**},\rho^{**}} & \frac{\partial \dot{u}}{\partial h}\Big|_{u^{**},h^{**},\rho^{**}} & \frac{\partial \dot{u}}{\partial \rho}\Big|_{u^{**},h^{**},\rho^{**}} \\ \frac{\partial \dot{h}}{\partial u}\Big|_{u^{**},h^{**},\rho^{**}} & \frac{\partial \dot{h}}{\partial h}\Big|_{u^{**},h^{**},\rho^{**}} & \frac{\partial \dot{h}}{\partial \rho}\Big|_{u^{**},h^{**},\rho^{**}} \\ \frac{\partial \dot{\rho}}{\partial u}\Big|_{u^{**},h^{**},\rho^{**}} & \frac{\partial \dot{\rho}}{\partial h}\Big|_{u^{**},h^{**},\rho^{**}} & \frac{\partial \dot{\rho}}{\partial \rho}\Big|_{u^{**},h^{**},\rho^{**}} \end{pmatrix} = \tag{A1}$$

$$\begin{pmatrix} \gamma[\frac{\eta}{1-c-\frac{\gamma}{u_n}}-1] & -{u_n}^2 & \frac{u_n ci}{ci+\gamma-i} \\ \gamma\eta/u_n & 0 & 0 \\ 0 & 0 & -(\gamma-i) \end{pmatrix},$$

fulfils the following three Routh-Hurwitz (RH) conditions:

1. $Det(J^{**}) < 0$,
2. $Tr(J^{**}) < 0$, and
3. $-Tr(J^{**})[Det(J_1^{**}) + Det(J_2^{**}) + Det(J_3^{**})] + Det(J^{**}) > 0$.

While some authors in the related literature mention a fourth RH condition, it is easy to show this extra condition is in fact redundant, as pointed out by Hein and Woodgate (2021).

It can be shown that:

$$Det(J^{**}) = -u_n\gamma\eta(\gamma-i) \tag{A2}$$

$$Tr(J^{**}) = \gamma[\frac{\eta}{1-c-\gamma/u_n}-1] - (\gamma-i) \tag{A3}$$

$$\begin{aligned} -Tr(J^{**})[Det(J_1^{**}) + Det(J_2^{**}) + Det(J_3^{**})] + Det(J^{**}) \\ = v[\frac{\eta}{1-c-\gamma/u_n}-1]\{(\gamma-i)Tr(J^{**}) - \eta u_n\gamma\} \end{aligned} \tag{A4}$$

The first RH condition is fulfilled when:

$$\gamma > i, \tag{A5}$$

which is the aforementioned basic requirement for an economically meaningful long-run value of the government spending-to-debt ratio ($\rho^{**} = \gamma - i$). RH conditions 2 and 3 are fulfilled if and only if the term in square brackets in Equations A3 and A4 are negative, i.e. when:

$$\eta + c + \gamma/u_n < 1. \tag{A6}$$

Rearranging this yields inequality (20) in the main text.