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The Contribution of the Social and Solidarity Economy to Economic Growth

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ABSTRACT

This work extends the basic analytical framework of macroeconomic growth to encompass the notion of social inclusion and to reduce the inconsistencies between growth and development. Specifically, we introduce the social and solidarity economy (SSE) into the macroeconomic debate on economic growth to acknowledge and making visible its contribution to total output increase, while working towards greater inclusion. Our analytical strategy relies on the discussion of four theoretical models. First, we illustrate a modified version of the Solow model; second, we introduce social inclusion as a labour-augmenting factor, and we illustrate how it triggers endogenous growth. Third, we modify a simplified model of endogenous growth by introducing among the arguments of the production function social inclusion as a labour-augmenting factor and by replacing the R&D with the SSE production function. Fourth, we introduce an encompassing growth model to identify the optimal mix of social inclusion and technological progress that may support endogenous growth. The added value of our research is twofold: (1) we lay the foundations for an alternative pattern of development that may fit well the initial conditions of a low resource economy lacking endogenous technological progress, and (2) we propose a logical framework to identify a continuum of trajectories of development, that is coherent with the diversity of initial conditions observed at country level.

JEL Classification: O00, O35, Q01, L30

1 | Introduction: A Closer Look at the Macroeconomic Foundations of Growth

In the last years, the world has experienced multiple and ever-increasing crises, which, according to the United Nations (UN) recent resolution 'Promoting the social and solidarity economy for sustainable development', recall the need to develop solidarity networks and emphasize the role of cooperation for the promotion of democracy and social justice (United Nations (UN) 2023). Far from these goals, the persistence of oligopolistic industries, or concentrated control in transnational production organisation (Cowling and Sugden 1987; Wade 2009), exacerbated by the Covid-19 pandemic have accelerated the trend towards polarisation: while advanced economies take responsibility for implementing a Green New Deal, through digitalisation and ecological transition, so-called developing economies are struggling with basic welfare services, evidencing 'fault lines' (IMF 2021) that divide countries into different groups, making a single development narrative inapplicable. The trend towards a new geopolitical order and the war in Ukraine and in Palestine have further increased power concentration and uncertainties, contributed to the rise of inflation and loss of purchasing power, and provoked a general disruption in production and trade flows across the globe.

To cope with this scenario of economic turbulence and to plan effective economic policy for resilience and recovery, this paper reconsiders some basic growth models, representing the widely acknowledged theoretical support for long-run macroeconomic policies. Specifically, in growth theory the case of a production function with exogenous technological progress has often been used, throughout the 20th century, as a reference, sustained by the emergence of information and communication technologies (ICTs) in the 1990s and, parallel to this, the knowledge economy (Solow 1956; Mankiw et al. 1992). Essentially, this approach considers growth as the outcome of capital accumulation, which is however subject to diminishing returns and depreciation. Hence growth ('the residual') must be associated to some exogenous factor (alternatively called knowledge, or technological progress). Sustainability issues and failures to converge among countries indicate that such model, as well as its subsequent interpretations, is not well-equipped to addressing the diffused socioeconomic needs which have emerged within and across countries and does not sufficiently account for the difficulties of the public sector and the market economy to promote economic, social, and environmental justice, as entailed by the sustainability goals.

Having identified this research gap, our work extends the (neo)classical analytical framework to encompass the notion of social inclusion and to reduce the inconsistencies between growth and development. Specifically, the three interconnected dimensions of sustainable development (the economic, the social, and the environmental one) are at the core of the action of the social and solidarity economy (SSE) (Borzaga et al. 2017; Utting 2015). The latter identifies forms of economic organisation (including cooperatives and mutuals, non-profit associations, non-governmental organisations, social enterprises, foundations) that produce services, mostly in response to market and government failures, often innovatively and in many cases including community constituencies and users from whom the very same needs emerge. These activities contribute to the growth of production and employment, while reducing social marginalisation and inequalities. Hence, as we shall argue, they can be usefully merged with existing accounts.

A wide literature on social infrastructure and its interplay with economic performance had addressed similar concerns, highlighting for instance the need to include public investments in welfare services, culture, public infrastructures, R&D, thus enlarging the notion of capital (Barro 1990). Still, to date, macroeconomics has devoted no attention to the SSE and the investments that these organisations make in welfare and transformative services. Instead, the SSE has been recognised by the United Nations more than a decade ago, and the International Labour Organisation has stressed its potential to create decent work, support employment in emerging sectors and contribute to the inclusion of informal workers into the formal economy (Borzaga et al. 2017).

Hence, our research integrates instances belonging to different fields of economic analysis, encompassing growth literature and more recent contributions on the nature and aims of the SSE. The goal of our research is to position the SSE into the macroeconomic debate on economic growth by acknowledging and making visible its contribution to total output increase, while working towards greater inclusion. The attempt is to provide a macroeconomic justification of the role of the SSE, thus overcoming a theoretical polarisation, where mainstream macroeconomic theory and heterodox approaches to development coexist but, often, do not communicate, the first having been able to influence economic policy while leading to a marginalisation of the latter, and make a case for a broader understanding of development policies. To do this, we first introduce social inclusion among the arguments of the long-run aggregate production function, as a determinant of labour productivity, and explain how this turns a modified version of the Solow model into a model of endogenous growth. Then, we elaborate a revised version of a simplified model of endogenous growth to consider social inclusion as an endogenous driver of labour productivity and economic growth. Finally, we develop an encompassing model of endogenous growth by adding to the aggregate production both an R&D and an SSE production function, to argue that each country may identify its particular optimal mix of technological progress and social inclusion to enhance sustainable economic growth.

Specifically, the expected outcome of this research is to illustrate how, along with technological transfer, trade and capital accumulation (Solow 1956; Helpman 1988; P. M. Romer 1990; Grossman and Helpman 1991; Aghion and Howitt 1992; Barro and Sala-i-Martin 1995), social inclusion can have positive effects on productivity and generate new employment, thus representing a potential driver of economic growth. Furthermore, social inclusion can increase the total factor productivity, as in the case of neutral technological progress.

The paper is organised as follows: After this introduction, Section 2 presents the case for integrating macroeconomic growth and SSE literature. Section 3 illustrates the theoretical framework used to identify the contribution of the SSE to economic growth. Section 4 discusses the findings, offers some concluding remarks and proposes implications for policy makers and future research.

2 | Conceptual Approach: Bridging Two Seemingly Unrelated Fields

Economic growth has been at the core of the debate on development since the dawn of political economy. After Keynes (1936), the relation between savings, investments and capital accumulation (Harrod 1939; Domar 1947), the effects of technological advances (Solow 1956) and the transition from a traditional backward society to a modern and efficient one (Hettne 1995; Lewis 1955; Rosenstein-Rodan 1961; Hirschman 1958) have been a major concern of economic policy, even for the strands of literature focussing on underdevelopment, such as structuralism and dependency (Prebisch 1950; CEPAL 1952; Baran 1957; dos Santos 1970).

It was during the Seventies that the environmental question entered the policy debate (Boulding 1966; Meadows et al. 1972) with approaches that called for qualitative improvements in living conditions decoupled from a quantitative increase in consumption (Daly 1974), stressing the existence of individual, social and, foremost, environmental limits to growth (Easterlin 1974; Georgescu-Roegen 1971; Hirsch 1976; Lovelock 1979).

Recently, the growth model has once again been put at the core of the mainstream macroeconomic theory (Barry 2020). In all most popular growth models, capital accumulation and technological progress have persisted at the core of the analytical framework, even if efforts have been made to incorporate other dimensions, as human capital, natural resources, and learning-by-doing. Also, a stream of macroeconomic research focuses on the nexus between quality of institutions and growth (for instance, Bondy and Maggor 2023, include growth coalition and organised labour, while Acemoglu et al. 2005, investigate the role of institutions as drivers of long-run economic growth), although with substantial differences from our work, that posits the need to focus on the SSE as a specific kind of welfare institution.

Against this background, in our research we contribute to the literature on economic growth by providing an attempt to include the SSE in Solow's basic framework and other simplified models of endogenous growth. Specifically, by referring to the solidaristic and relational contribution of the organisations of the SSE we identify further elements that can contribute to economic growth while improving people's freedoms (*à la* Sen). We suggest that investments in the SSE provide the humus for an increase in productivity while fostering sustainability goals. Hence, macroeconomic models could benefit from integrating other socioeconomic institutions (i.e., non-profit besides for profit) and behaviours (i.e., pro-social besides self-centred) into the analysis, in the face of the ineffectiveness of capital accumulation, human capital, technology and growth rates to address major sustainability issues.

Our theoretical analysis draws on two complementary conceptual bodies. The first one is the triple bottom line of sustainable development, with its three intertwining dimensions: the environmental, the social, and the economic one (Elkington 1997; Hammer and Pivo 2017). These three dimensions must be considered together, finding combinations that are desirable and beneficial for society. In a technocentric approach, environmental challenges could be met by re-orienting technological progress towards efficient and socially responsible eco-innovation. Consequently, sustainable technological change can be represented by considering technological progress as restricted to socially responsible and environmentally sustainable innovations. This could be achieved, as an example, by establishing that funds financing technological innovations satisfy the environmental, social and governance standards (ESG) (Gallucci et al. 2022).

The second conceptual body identifies a role for the SSE in fostering sustainable development, as, by its own nature, it pursues achievements along the economic, social and environmental dimension, adapts to the specificities of local communities (TFSSE 2014; Lee 2020), places public value ahead of individual utility (Laville 2014, 2023), and has traditionally been oriented to the satisfaction of needs and collective interests in contexts where state or market-oriented forms of economic activity proved non-viable (Salustri and Viganò 2017; Santos 2012). At the macroeconomic level, the SSE can be framed within the debate on the nature and role of social infrastructure in endogenous growth processes (Hall and Jones 1999; Chin and Chou 2004; Fransen et al. 2018; North 1990). In response to the market failures generated by private for-profit firms and public failures (Sacchetti and Borzaga 2021), SSE organisations retain social responsibility elements towards both internal stakeholders and communities (Sacchetti and Tortia 2020), which are supported by institutional infrastructure, by their governance forms as well as by practices of networking and solidarity amongst SSE organisations themselves.

Although the organisational and legal forms to be included in SSE differ across countries, in general the SSE includes charities, foundations, social enterprises, cooperatives, and mutuals. When taking the form of cooperatives, SSE prioritise employment stability, often choosing to adjust wages in response to economic fluctuations rather than resort to layoffs. This practice contrasts with traditional firms, which may favour workforce reductions to keep wage levels unchanged during economic downturns (Zevi et al. 2011). In this way, they tend to contribute to a more stable work environment, albeit with greater wage variability. Moreover, when integrating explicit social and community interests in their activities and goals, they reduce the production of exclusion costs (e.g. social exclusion), that is those negative external effects associated with current dominant ways to organise production (Sacchetti and Borzaga 2021).

Also, the SSE improves resilience by providing stable work-integration opportunities for vulnerable workers or small businesses (Salustri 2023) and designing inclusive responses to failures in the labour market. Furthermore, in a context of persistent reduction of public investment, fiscal policies with scarce redistributive effects, and growing inequalities, the SSE contributes to reducing the underprovision of marketable and non-marketable goods and services in peripheral territories and for neglected social groups, offsetting the lower aggregate demand, social infrastructure gaps and higher production costs that often characterize the margins (Salustri 2023).

To explain, SSE organisations have evidently been internalising negative externalities by building reserves, reinvesting their surplus and protecting job stability also in times of crisis (Birchall 2013; Birchall and Ketilson 2009), promoting inclusion in decisions (Tortia et al. 2022), and have therefore been associated with poverty reduction in terms of work quality, income, capabilities, surplus distribution, private-public synergies (Birchall 2004), immaterial wellbeing with respect to self-actualisation (Sacchetti and Tortia 2013), and productivity (Fakhfakh et al. 2012). As a consequence, SSE organisations also imply high performance at both organisational level (Tortia et al. 2022), and in terms of community welfare (Pérotin 2013; Sabatini et al. 2014), improving the overall efficiency of an economy through positive external effects (Sacchetti and Borzaga 2021).

Against this backdrop, we initially present our baseline model, that is a modified version of the Solow model resembling a balanced growth path of the economy, then we introduce social inclusion as a labour-augmenting factor, and we illustrate how it triggers endogenous growth. As a second step of the analysis, we modify a simplified model of endogenous growth by introducing among the arguments of the production function social inclusion as a labour-augmenting factor and by replacing the R&D with the SSE aggregate production function. The resulting model illustrates how social inclusion may activate a path of locally and self-defined development in regions or countries characterized by low capital endowments and scarce endogenous innovation. We conclude our research with the analysis of an encompassing model, obtained by reducing the number of inputs to one and by adding both an R&D and an SSE production function. Based on the results achieved, we argue that each country may identify its optimal mix of technological progress and social inclusion to enhance sustainable economic growth, according to its endowment of resources, ethical values, and level of technological progress.

3 | The Contribution of the SSE to Economic Growth

In our research, following standard growth theory, we build on the aggregate production function. However, we immediately deviate from the standard framework by considering technological progress as capital-augmenting, and by introducing a modified Solow model (MSM) where the intensive form of the production function isolates the level of income per unit of effective capital. Furthermore, we assume that capital and technological progress grow at a constant rate, while changes in the labour force (i.e. fully employed) positively depend on the consumption rate. This model 'mirrors' the basic Solow model, consequently, and not surprisingly, decreasing returns to scale lead to a steady-state equilibrium, and an increase in the consumption rate has only a temporary effect (it modifies the steady-state equilibrium, but it does not trigger a permanent growth process). Then, we upgrade the MSM by adding to the production function the level of social inclusion as a labour-augmenting factor. We observe how in this case the Inada conditions are violated, and the modified Solow model with exogenous social inclusion (SMSM) leads to a sustained growth of output per unit of effective capital, building the ground for a more complex analysis of endogenous growth models.

Consequently, we elaborate a modified version of a simplified model of endogenous growth (SMGM) to illustrate how a higher level of social inclusion might contribute to increase labour productivity, triggering an inclusive growth process focussed on the creation of new employment. Finally, having unfolded a growth process antithetical to that one postulated by a simple growth model with endogenous technological progress, we conclude our theoretical analysis with the identification of an encompassing model of endogenous growth (EMEG), obtained by adding both an R&D and an SSE aggregate production function and, for sake of simplicity, by reducing the number of inputs to one (we assume that the economy is using labour and capital efficiently, i.e. along the technology expansion path, then the single input is an efficient combination of labour and capital). Specifically, we illustrate how each country may identify its optimal mix of technological progress and social inclusion to enhance sustainable economic growth, according to its endowment of resources, ethical values, and level of technological progress.

3.1 | The Modified Solow Model (MSM)

Consider the production function

$$Y(t) = F(L(t), A(t)K(t)), \tag{1}$$

where $Y(t)$ represents the level of production at time t, $L(t)$ the amount of labour employed at time t, $K(t)$ the quantity of capital employed at time t, and $A(t)$ represents technological progress at time t. In (1) all variables depend on time, that is treated as a continuous variable. As A and K enter the production function multiplicatively, we refer to the argument AK as 'effective capital', which is in line with standard terminology.

Assume that:

1. The production function has constant returns to scale in its two arguments (labour and effective capital) and it can be written in its intensive form, given by

$$y(l(t)) = f(l(t)), \tag{2}$$

where y denotes the ratio $Y(t)/A(t)K(t)$, that is, the ratio of the level of output per unit of effective capital, and $l(t)$ denotes the ratio $L(t)/A(t)K(t)$, that is, the ratio of labour per unit of effective capital.

2. The intensive form of the production function satisfies

$$f(0) = 0, \dot{f}(l(t)) > 0, \ddot{f}(l(t)) < 0; \ f(\infty) = \infty \tag{3}$$

and Inada conditions, that are given by

$$\lim_{l(t)\to 0} \dot{f}(l(t)) = \infty, \ \lim_{l(t)\to\infty} \dot{f}(l(t)) = 0. \tag{4}$$

3. Capital and technological progress grow at a constant rate given by:

$$\dot{K}(t) = g_K K(t), \dot{A}(t) = g_A A(t); \tag{5}$$

4. Output is allocated between consumption and investment in constant, exogenous proportions, where c is the consumption rate, or propensity to consume, and it holds that $0 < c < 1$. Specifically,

$$Y \equiv C(Y) + S(Y) = cY + (1 - c)Y = cY + sY. \tag{6}$$

5. Each unit of output allocated to consumption yields a unit of new labour and labour depreciates at a constant rate λ, then the law of motion of labour is given by

$$\dot{L}(t) = cY(t) - \lambda L(t). \tag{7}$$

6. The sum of g_K, g_A, and λ is positive.

Theorem 1. *Under assumptions 1–6, the economy converges, regardless of its initial conditions, to a balanced growth path (i.e., a steady-state equilibrium) in which each variable grows at a constant rate. Specifically, the steady-state equilibrium is found by equating to zero the growth rate of labour per unit of effective capital in*

$$\frac{\dot{l}(t)}{l(t)} + g_A + g_K = \frac{cf(l(t))}{l(t)} - \lambda. \tag{8}$$

Consequently, under assumptions 1–6, a steady-state equilibrium exists for l^* such that

$$\frac{f(l^*)}{l^*} = \frac{(\lambda + g_A + g_K)}{c}. \tag{9}$$

Proof. Given the assumption of constant returns to scale in the two arguments, the production function can be rewritten in its intensive form with respect to the 'effective capital'—that is, the product of capital per technological progress (AK)—as in (2). Assumption 2 implies that the path of the economy does not diverge, and that the intensive form of the production function is strictly increasing and strictly concave (see Equations 3 and 4). Due to Assumption 3 (see Equation 5), labour is the only factor that does not grow at a constant rate and its law of motion is given by (7). Furthermore, the unit of labour per unit of effective capital is defined as

$$l(t) = \frac{L(t)}{A(t)K(t)}. \tag{10}$$

By applying the chain rule, it can be noticed how

$$\begin{aligned}
\dot{l}(t) &= \frac{1}{(A(t)K(t))^2}(\dot{L}(t)A(t)K(t) - (\dot{A}(t)K(t) + A(t)\dot{K}(t))L(t)) \\
&= \frac{\dot{L}(t)}{A(t)K(t)} - \frac{\dot{A}(t)L(t)}{(A(t))^2K(t)} - \frac{\dot{K}(t)L(t)}{A(t)(K(t))^2} \\
&= \frac{\dot{L}(t)}{L(t)}\frac{L(t)}{A(t)K(t)} - \frac{\dot{A}(t)}{A(t)}\frac{L(t)}{A(t)K(t)} - \frac{\dot{K}(t)}{K(t)}\frac{L(t)}{A(t)K(t)} \\
&= \frac{\dot{L}(t)}{L(t)}l(t) - g_A l(t) - g_K l(t) = \frac{\dot{L}(t)}{L(t)}l(t) - (g_A + g_K)l(t).
\end{aligned} \tag{11}$$

It follows that

$$\frac{\dot{l}(t)}{l(t)} = \frac{\dot{L}(t)}{L(t)} - g_A - g_K, \tag{12}$$

and consequently, that

$$\frac{\dot{L}(t)}{L(t)} = \frac{\dot{l}(t)}{l(t)} + g_A + g_K.$$

Recalling (2) and (7), it must be, as illustrated in (8), that

$$\frac{\dot{l}(t)}{l(t)} + g_A + g_K = \frac{cf(l(t))}{l(t)} - \lambda. \tag{13}$$

In steady state, $\dot{l}(t) = 0$, and consequently, similarly to (9),

$$cf(l^*) = (\lambda + g_A + g_K)l^*. \tag{14}$$

Equation (14) means that the steady-state equilibrium is achieved when consumption per unit of effective capital $cf(l^*)$ equals the level of necessary consumption per unit of effective capital.

Corollary 1. *Consider the case of a Cobb-Douglas production function at constant returns to scale. It follows that.*

$$Y(t) = L(t)^{\alpha}(A(t)K(t))^{1-\alpha}, 0 < \alpha < 1. \tag{15}$$

If all the previous assumptions hold, a steady-state equilibrium is found for

$$l^* = \left(\frac{\lambda + g_A + g_K}{c}\right)^{\frac{1}{\alpha-1}}. \tag{16}$$

Proof. If Inada conditions are satisfied, the intensive form of (15) is

$$y(t) = \frac{Y(t)}{A(t)K(t)} = L(t)^{\alpha}(A(t)K(t))^{1-\alpha} = \left(\frac{L(t)}{A(t)K(t)}\right)^{\alpha} = l^{\alpha}. \tag{17}$$

By replacing the right-hand side of (17) in the steady-state condition (14), it follows that

$$l^{*\alpha-1} = \frac{(\lambda + g_A + g_K)}{c}$$

and consequently, as already illustrated in (16), a steady-state equilibrium is found for

$$l^* = \left(\frac{\lambda + g_A + g_K}{c}\right)^{\frac{1}{\alpha - 1}}.$$

Figure 1 illustrates the equilibrium of the modified Solow model. The horizontal axis represents the level of labour per unit of effective capital, while the vertical axis represents the level of output per unit of effective capital. The intensive form of the production function $f(l)$ starts from the origin of axes and grows at a decreasing rate as far as l increases. The level of consumption per unit of effective capital $cf(l)$ lies below $f(l)$ and has the same properties. Similarly, the dashed line specifies the level of necessary consumption per unit of effective capital that keeps the level of labour per unit of effective capital stationary. As illustrated in Equations (8) and (9) and proved in Equations (10–14), the steady-state equilibrium is achieved when consumption per unit of effective capital $cf(l)$ equals the level of necessary consumption per unit of effective capital. Mirroring the basic version of the Solow model, the optimal level of saving per unit of effective capital is found when the derivative of the

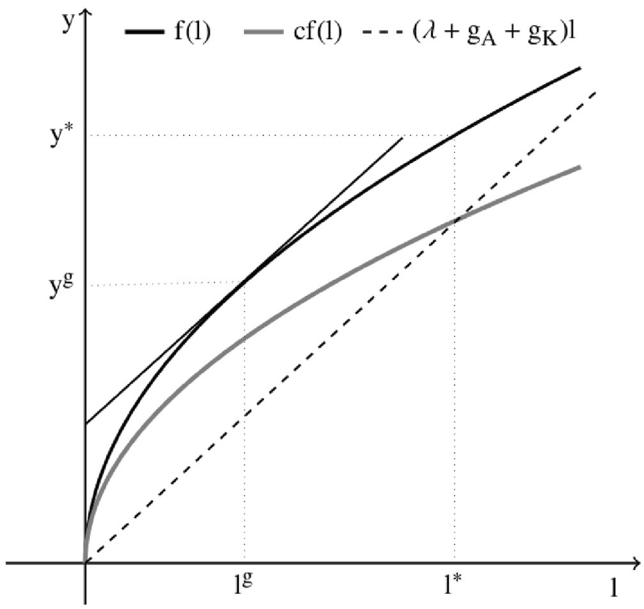

FIGURE 1 | Steady state equilibrium in the modified Solow model.

production function equals the level of necessary consumption per unit of effective capital. Consequently, Figure 1 represents a case of overconsumption, as the equilibrium that maximizes saving per unit of effective capital is found for a lower level of c.

3.2 | A Modified Solow Model With Exogenous Social Inclusion (RMSM)

In the revised version of the modified Solow model (RMSM), we add among the factors of production social inclusion applied to labour (it could be defined as labour augmenting). In this case, also S and L enter multiplicatively in the aggregate production function, consequently we refer to the argument SL as ‘effective labour’.

Consider the production function

$$Y(t) = F(S(t)\,L(t), A(t)\,K(t)), \tag{18}$$

where $Y(t)$ represents the level of production at time t, $L(t)$ the amount of labour employed at time t, $K(t)$ the quantity of capital employed at time t, $S(t)$ the level of social inclusion carried out by the SSE at time t, and $A(t)$ the technical progress at time t.

Assume that:

1a. The production function has constant returns to scale in its two arguments (effective labour and effective capital) and it can be written in its intensive form, given by

$$y(l(t)) = f(l(t)), \tag{19}$$

where y denotes the ratio $Y(t)/A(t)K(t)$, that is, the ratio of the level of output per unit of effective capital, and $l(t)$ denotes the ratio $S(t)L(t)/A(t)K(t)$, that is, the ratio of effective labour per unit of effective capital.

2a. Capital, technological progress and social inclusion grow at a constant rate given by:

$$\dot{K}(t) = g_K K(t), \dot{A}(t) = g_A A(t), \dot{S}(t) = g_S S(t). \tag{20}$$

3a. Given 2a, the intensive form of the production function satisfies

$$\begin{aligned} &f(0) = 0, \lim_{l(t)\to 0+} \dot{f}(l(t)) = \infty, \dot{f}\,(l(t)) > 0, \\ &\lim_{l(t)\to\infty} \dot{f}(l(t)) = k > 0, f(\infty) = \infty. \end{aligned} \tag{21}$$

The fourth condition in (21) means that the second Inada condition is violated, and it can be proved that the first derivative of the production function has a positive, but not monotonically decreasing, slope.

4a. Output is allocated between consumption and investment in constant, exogenous proportions, as illustrated in (6).

5a. The law of motion of labour is given by (7).

6a. The sum of g_K, g_A, g_S, and λ is positive.

Theorem 2. *Under assumptions 1a–6a, the term $S(t)$ triggers a continuous growth of the level of effective output per unit of effective capital $S(t)y(t)$. Specifically, it must be that.*

$$\dot{l}(t) = cS(t)f(l(t)) - (\lambda + g_A + g_K - g_S)l(t) > 0, \forall t > 0. \tag{22}$$

Proof. The production function illustrated in (18) can be rewritten in its intensive form with respect to the ‘effective capital’—that is, the product of capital per technological progress (AK)—as in (19). Labour is the only factor that does not grow at a constant rate (see Equation 20) and its law of motion is given by (7). By dividing both terms of (7) by $A(t)K(t)/S(t)$, and by applying the chain rule, it can be noticed how

$$\begin{aligned} \dot{l}(t) &= \frac{1}{(A(t)K(t))^2}\big((\dot{S}(t)L(t) + S(t)\dot{L}(t))A(t)K(t) \\ &\quad -(\dot{A}(t)K(t) + A(t)\dot{K}(t))S(t)L(t)\big) \\ &= \frac{\dot{S}(t)L(t)}{A(t)K(t)} + \frac{S(t)\dot{L}(t)}{A(t)K(t)} - \frac{\dot{A}(t)S(t)L(t)}{(A(t))^2K(t)} - \frac{\dot{K}(t)S(t)L(t)}{A(t)(K(t))^2} \\ &= \frac{\dot{S}(t)}{S(t)}\frac{S(t)L(t)}{A(t)K(t)} + \frac{\dot{L}(t)}{L(t)}\frac{S(t)L(t)}{A(t)K(t)} \\ &\quad - \frac{\dot{A}(t)}{A(t)}\frac{S(t)L(t)}{A(t)K(t)} - \frac{\dot{K}(t)}{K(t)}\frac{S(t)L(t)}{A(t)K(t)} \\ &= g_S l(t) + \frac{\dot{L}(t)}{L(t)}l(t) - g_A l(t) - g_K l(t) \\ &= \frac{\dot{L}(t)}{L(t)}l(t) + (g_S - g_A - g_K)l(t). \end{aligned} \tag{23}$$

From (23) it follows that

$$\frac{\dot{l}(t)}{l(t)} = \frac{\dot{L}(t)}{L(t)} + g_S - g_A - g_K$$

and consequently, that

$$\frac{\dot{L}(t)}{L(t)} = \frac{\dot{l}(t)}{l(t)} - g_S + g_A + g_K. \tag{24}$$

Recalling (19) and (7), from (24) it follows, as in (22), that

$$\dot{l}(t) = cS(t)f(l(t)) - (\lambda + g_A + g_K - g_S)l(t) > 0, \forall t > 0.$$

Corollary 2. *Consider the case of a Cobb-Douglas production function that satisfies assumption 1a–6a. It follows that*

$$\frac{\dot{l}(t)}{l(t)} = cS(t)l^{\alpha - 1} - (\lambda + g_A + g_K - g_S) > 0, \forall t > 0. \tag{25}$$

Proof. The constant returns to scale Cobb-Douglas production function can be modelled as

$$Y(t) = (S(t)L(t))^{\alpha}(A(t)K(t))^{1-\alpha}, 0 < \alpha < 1.$$

Under the assumption of Constant returns to scale in the two inputs, the intensive form is

$$y(t) = \frac{Y(t)}{A(t)K(t)} = (S(t)L(t))^{\alpha}(A(t)K(t))^{-\alpha} = \left(\frac{S(t)L(t)}{A(t)K(t)}\right)^{\alpha} = l^{\alpha}.$$

Replacing the left-hand side of the intensive form in the equation of motion of labour, it follows that:

$$\frac{\dot{l}(t)}{l(t)} - g_S + g_A + g_K = cS(t)l^{\alpha-1} - \lambda,$$

and (25) is straightforward.

Figure 2 illustrates the main features of the revised modified Solow model. When social inclusion is added to the production function as a labour-augmenting factor, the curve describing the level of effective consumption per unit of effective capital (the dashed line) never crosses the line of the necessary effective consumption per unit of effective capital. Specifically, as long as

$$cS(t)l^{\alpha-1} > (\lambda + g_A + g_K - g_S),$$

the level of effective output per unit of effective capital will continue to grow. To put it differently, in the revised modified Solow model there is no convergence of effective income per unit of effective capital, even among similar economies. Specifically, two economies having the same social inclusion and consumption rates will enjoy the same growth rate of income per unit of effective capital, regardless of their starting position. In that case, the respective effective incomes per unit of effective capital will evolve augmenting the distance from each other. This contrasts to the Solow model, where countries with similar parameters should approach the same per capita income level in the steady state. This model can be considered as a starting point for a more complex model of endogenous growth.

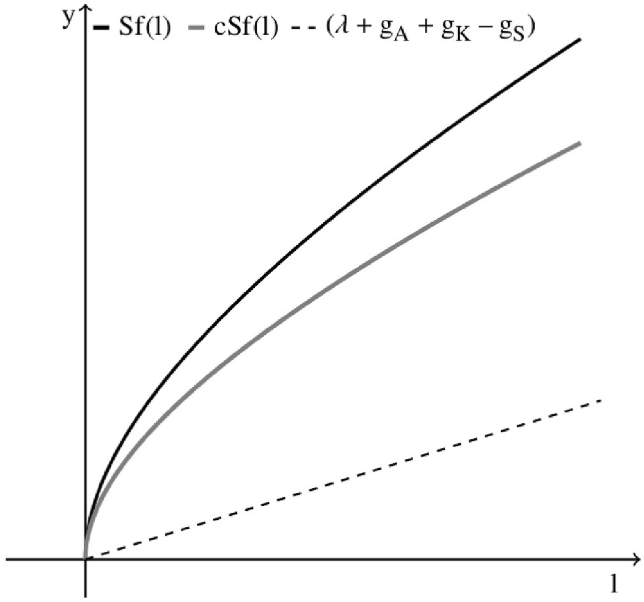

FIGURE 2 | The revised modified Solow model.

3.3 | A Modified Growth Model With Endogenous Social Inclusion (SMGM)

In this subsection we illustrate how a higher level of social inclusion might contribute to increase labour productivity, triggering an inclusive growth process based on the creation of new employment. Specifically, consider an aggregate production function as (18), with labour augmenting social inclusion and capital augmenting technological progress. We represent the SSE as an alternative production sector that, by means of labour, capital, technological progress and social inclusion, extends the level of social inclusion of the overall economy. To simplify the analysis, we assume that both the aggregate production function and the SSE function are of Cobb-Douglas type, and we restrict the parameters values to exclude the case of increasing returns to scale. Second, we consider the fraction of output consumed and the fraction of labour and capital employed in the SSE sector as exogenous and constant.

In sum, we consider the following growth model

$$\begin{cases} Y(t) = (S(t)(1-b_L)L(t))^{\alpha}(A(t)(1-b_K)K(t))^{1-\alpha} \\ \dot{S}(t) = C\ (A(t)b_K K(t))^{\delta}(b_L L(t))^{\tau}S(t)^{\omega} \end{cases}, \tag{26}$$

with $C > 0$, $0 < b_L < 1$, $0 < b_K < 1$, $0 < \alpha < 1$, $\delta \geq 0$, $\tau \geq 0$, $\omega \geq 0$, $\delta + \tau + \omega \leq 1$.

The modified growth model with endogenous social inclusion illustrated in (26) is set in continuous time. Fraction b_L of labour and b_K of capital are used in the SSE, while the remaining fractions of labour and capital are used in the production sector. The level of social inclusion is common to the whole economy, consequently it positively and equally affects the performances of both sectors.

It is worth noting how, while the aggregate production function has constant returns to scale, the SSE function does not necessarily have constant returns to scale in L and K. We limit our analysis to the case of decreasing returns to scale, as, in case of increasing returns to scale, the model would predict ever-increasing growth, while we are interested in identifying a constant growth rate for labour and social inclusion. Finally, we assume that

$$\dot{K}(t) = g_K K(t), \dot{A}(t) = g_A A(t), \dot{L}(t) = cY(t), \tag{27}$$

where c denotes the propensity to consume, that is exogenous (for the sake of simplicity, $\lambda = 0$, i.e., a zero-labour factor depreciation rate is assumed), and $g_K, g_A \geq 0$. Also, illustrated in (27) the initial levels of K, A, L and S are given and strictly positive.

Theorem 3. *By substituting the production function into the law of motion of labour, after some computation it can be obtained that*

$$\frac{\dot{g}_L(t)}{g_L(t)} = (1-\alpha)\big(g_A + g_K - g_L(t)\big) + \alpha g_S(t). \tag{28}$$

Also, from the SSE function in (26) it can be found that

$$\frac{\dot{g}_S(t)}{g_S(t)} = \delta\big(g_A + g_K\big) + \tau g_L(t) + (\omega - 1) g_S(t). \tag{29}$$

By setting $\dot{g}_L(t) = \dot{g}_S(t) = 0$, from (28) and (29) a system of two equations for g_L^* and g_S^* is obtained. The system is given by

$$\begin{cases} g_L^* = \big(g_A + g_K\big) + \dfrac{\alpha}{1-\alpha} g_S^* \\ g_L^* = -\dfrac{\delta}{\tau}\big(g_A + g_K\big) + \dfrac{(1-\omega)}{\tau} g_S^* \end{cases}. \tag{30}$$

When $\frac{(1-\omega)}{\tau} > \frac{\alpha}{1-\alpha}$, regardless of the initial values of g_L and g_S—that are determined by the parameters of the model and by the initial values of A, S, L, and K—the system (30) has a stable equilibrium identified by the solutions

$$\begin{cases} g_S^* = \dfrac{(1-\alpha)(\tau + \delta)}{(1-\alpha)(1-\omega) - \tau\alpha}\big(g_A + g_K\big) \\ g_L^* = \dfrac{(1-\alpha)(1-\omega) + \alpha\delta}{(1-\alpha)(1-\omega) - \tau\alpha}\big(g_A + g_K\big) \end{cases}. \tag{31}$$

Instead, when $\frac{(1-\omega)}{\tau} < \frac{\alpha}{1-\alpha}$, regardless of the initial values of g_L and g_S, the latter grow indefinitely, and the economy embarks on a path of ever-increasing growth. Also, when $\frac{(1-\omega)}{\tau} = \frac{\alpha}{1-\alpha}$, the two *loci* are parallel, and g_L and g_S grow indefinitely without achieving a stable value. Finally, when $\frac{(1-\omega)}{\tau} = \frac{\alpha}{1-\alpha}$ and $\big(g_A + g_K\big) = 0$ the two *loci* are coincident and g_L^* and g_S^* converge to zero (the stable equilibrium overlaps with the origin of the axes). However, this is a rather infrequent case, as it requires a very stringent relationship between the parameters.

Proof. By substituting the production function of goods and services into the law of motion of labour, it follows that

$$\dot{L}(t) = cY(t) = c(S(t)(1-b_L)L(t))^{\alpha}(A(t)(1-b_K)K(t))^{1-\alpha}. \tag{32}$$

By dividing by $L(t)$ Equation (32), defining the factor

$$d_L = c(1-b_L)^{\alpha}(1-b_K)^{1-\alpha} \tag{33}$$

and using (33) to rewrite (32) in a more compact form, it is obtained

$$g_L(t) \Leftrightarrow \frac{\dot{L}(t)}{L(t)} = d_L\left(\frac{S(t)L(t)}{L(t)}\right)^{\alpha}\left(\frac{A(t)K(t)}{L(t)}\right)^{1-\alpha} = d_L S(t)^{\alpha}\left(\frac{A(t)K(t)}{L(t)}\right)^{1-\alpha}. \tag{34}$$

Taking logs and differentiating with respect to time, from (34) it follows that:

$$\frac{\dot{g}_L(t)}{g_L(t)} = \alpha g_S(t) + (1-\alpha)\big(g_A + g_K - g_L(t)\big). \tag{35}$$

Similarly, dividing the SSE function by $S(t)$, defining

$$f_S = C{b_K}^{\delta}{b_L}^{\tau} \tag{36}$$

and using (36) to rewrite it in a more compact from, it follows that:

$$g_S(t) \Leftrightarrow \frac{\dot{S}(t)}{S(t)} = f_S(A(t)K(t))^{\delta} L(t)^{\tau} S^{(t)\omega-1}. \tag{37}$$

Taking logs and differentiating (37) with respect to time we find that:

$$\frac{\dot{g}_S(t)}{g_S(t)} = \delta\big(g_A + g_K\big) + \tau g_L(t) + (\omega - 1) g_S(t). \tag{38}$$

Setting $\dot{g}_L(t) = \dot{g}_S(t) = 0$, from (35) and (38) it can be obtained that

$$g_L^* = g_A + g_K + \frac{\alpha}{1-\alpha} g_S^*. \tag{39}$$

$$g_L^* = -\frac{\delta\big(g_A + g_K\big)}{\tau} + \frac{(1-\omega)g_S^*}{\tau}. \tag{40}$$

The analysis of the system given by (39) and (40) leads to the conclusions stated in the Theorem.

Figure 3 illustrates (39) and (40), that are two of the four nullclines of the system of non-linear differential equations given by (35) and (38). For given values of parameters, the critical point (g_S^*, g_L^*) identified by (31) is a stable equilibrium. A more formal analysis encompassing all critical points and nullclines is developed in Appendix.

3.4 | An Encompassing Model of Endogenous Growth (EMEG)

Having unfolded a growth process antithetical to that one postulated by the Solow model with endogenous technological progress, we conclude our theoretical analysis with the

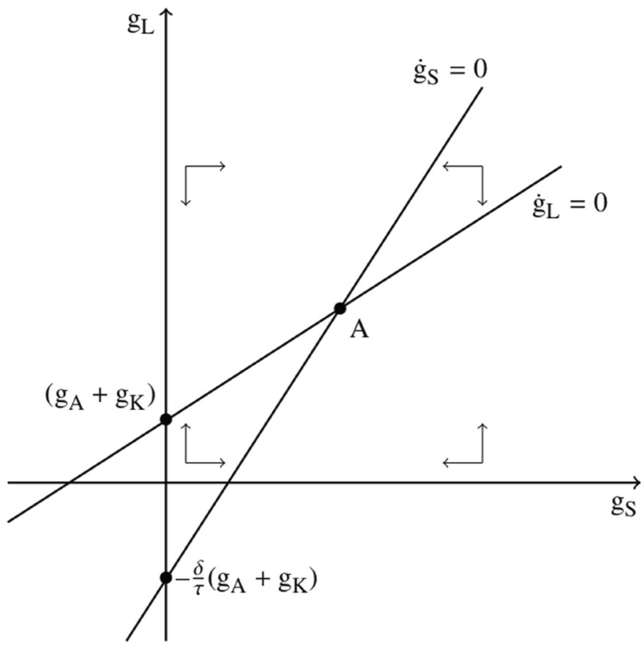

FIGURE 3 | Phase portrait of the system given by (39) and (40).

identification of an encompassing model, obtained, for sake of simplicity, by reducing the number of inputs to one and by adding both an R&D and an SSE aggregate production function. We are interested in modelling how each country may identify its particular optimal mix of technological progress and social inclusion to enhance sustainable economic growth, according to its endowment of resources, ethical values, and level of technological progress.

Consider an aggregate production function as (18), with labour augmenting social inclusion and capital augmenting technological progress. To reduce the complexity of the analysis, we assume that the production process evolves along the technology expansion path, consequently X is a composite input that represents the efficient combination of L and K that is used to produce each level of Y. We represent the R&D and the SSE as alternative economic sectors that, by means of labour, capital, technological progress, and social inclusion, extend, respectively, the level of knowledge and social inclusion of the overall economy. To simplify the analysis, we assume that the aggregate production function and the R&D and SSE functions are of Cobb-Douglas type, and we restrict the parameters values to exclude the case of increasing returns to scale in the R&D and SSE sector. Second, we consider the fraction of the composite input employed in the R&D and in the SSE sector, as well as its growth rate, as exogenous and constant. It is worth noting how, if the aggregate production function exhibits constant returns to scale in L and K, and the equation of the technology expansion path is linear (as in the case of Cobb-Douglas technology), the simplified aggregate production function must be linear in X. Based on these premises, we are interested in identifying under what conditions the linear ASX production process grows at a positive but constant rate, instead of embarking in an ever-increasing growth path.

Theorem 4. *Given the following growth model*

$$\begin{cases} Y(t) = A(t)S(t)(1 - a_X - b_X)X(t) \\ \dot{A}(t) = B(a_X X(t))^{\gamma} S(t)^{\omega} A(t)^{\theta} \\ \dot{S}(t) = C(b_X X(t))^{\tau} S(t)^{\rho} A(t)^{\sigma} \\ \dot{X}(t) = mX(t) \end{cases}, \tag{41}$$

with $B > 0, \theta, \gamma, \omega \geq 0, 0 \leq (\theta + \gamma + \omega) < 1, C > 0, \rho, \tau, \sigma \geq 0, 0 \leq (\rho + \tau + \sigma) < 1, m \geq 0$. The growth rate of technological progress is given by

$$g_A(t) \Leftrightarrow \frac{\dot{A}(t)}{A(t)} = B(a_X X(t))^{\gamma} S(t)^{\omega} A(t)^{\theta - 1}, \tag{42}$$

while the growth rate of social inclusion is given by

$$g_S(t) \Leftrightarrow \frac{\dot{S}(t)}{S(t)} = C(b_X X(t))^{\tau} S(t)^{\rho - 1} A(t)^{\sigma}. \tag{43}$$

If $\frac{(1-\theta)}{\sigma} > \frac{\omega}{1-\rho}$ and $m > 0$, g_A and g_S achieve a stable equilibrium that is given by

$$\begin{cases} g_A^* = \dfrac{\gamma(1-\rho) + \omega\tau}{(1-\theta)(1-\rho) - \omega\sigma} m \\ g_S^* = \dfrac{\tau(1-\theta) + \gamma\sigma}{(1-\theta)(1-\rho) - \omega\sigma} m \end{cases}. \tag{44}$$

Proof. By taking the logarithmic derivative of (42), it is obtained that the growth rate of $g_A(t)$ is equal to:

$$\dot{g}_A(t) = \left(\gamma m + \omega g_S(t) + (\theta - 1) g_A(t)\right) g_A(t). \tag{45}$$

Likewise, by taking the logarithmic derivative of (43), it is obtained that the growth rate of $g_S(t)$ is equal to:

$$\dot{g}_S(t) = \left(\tau m + (\rho - 1) g_S(t) + \sigma g_A(t)\right) g_S(t). \tag{46}$$

The SSE function in (41) implies that $g_S(t)$ is always positive, while the R&D function in (41) implies that $g_A(t)$ is always positive. Furthermore, putting $\dot{g}_A(t) = \dot{g}_S(t) = 0$, it holds that

$$(1-\theta) g_A^* - \omega g_S^* = \gamma m. \tag{47}$$

$$\sigma g_A^* + (\rho - 1) g_S^* = -\tau m. \tag{48}$$

When $\frac{(1-\theta)}{\sigma} > \frac{\omega}{1-\rho}$, the system formed by (47) and (48), regardless of the initial values of g_A and g_S, converge to a stable equilibrium identified by the solutions illustrated in (44).

When $\frac{(1-\theta)}{\sigma} < \frac{\omega}{1-\rho}$, regardless of the initial values of g_A and g_S, the latter grow indefinitely, and the economy embarks on a path of ever-increasing growth (however, we prove in Appendix that for the EMEG it is impossible to identify a case in which the nullclines diverge in the first quadrant). Finally, it is worth noting how both growth rates depend on the (exogenous) growth rate of input X. So, when $m = 0$ they take a null value.

Figure 4 illustrates (47) and (48) that are two of the four nullclines of the system of non-linear differential equations given by

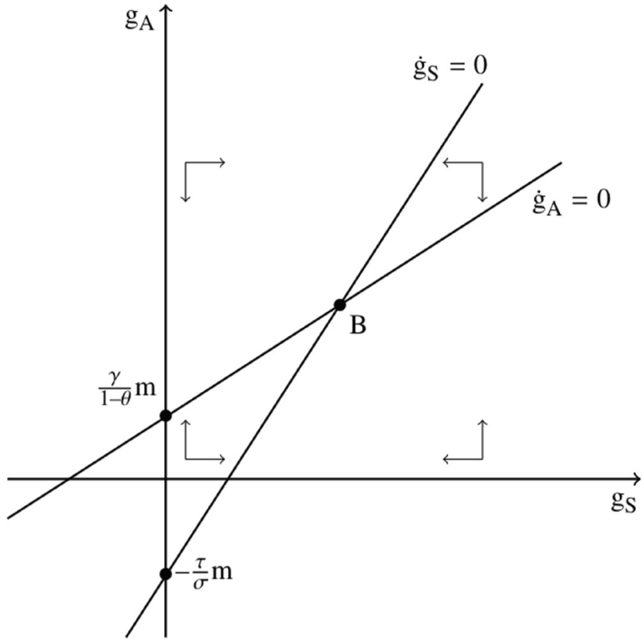

FIGURE 4 | Phase portrait of the system given by (47) and (48).

(45) and (46). For given values of parameters, the critical point (g_S^*, g_A^*) identified by (44) is a stable equilibrium. A more formal analysis encompassing the analysis of all critical points and nullclines is developed in Appendix.

4 | Discussion and Conclusions

This paper illustrates the interplay between economic growth and social inclusion, where the latter is increased by the organisations of the SSE, highlighting their synergies with the pursuit of sustainable development. The added value of our approach, is that, after having identified a possible source of heterogeneity among the equilibrium level of output of a sample of countries—that is, heterogenous levels and changes of social inclusion—it identifies an alternative pattern of development, according to a scheme that seems to fit well into the initial conditions of a low resource economy lacking endogenous technological progress. Then, building on this intermediate result, we have suggested a logical framework to identify a continuum of trajectories of development, coherent with the diversity of initial conditions observed at country level (IMF 2021). This has been obtained using a combination of standard (technological progress and capital accumulation) and heterodox approaches (solidarity and social inclusion).

The underlying assumption is that economic growth and social inclusion are not antinomic concepts—a happy degrowth is not the obvious counterpart of social inclusion. In the same vein, ethical individualism is not the clear-cut match for economic growth. Rather, under relatively general assumptions, they become the two sides of the same coin. This means that, by restricting technological progress to the subset of the eco-efficient innovations and adding social inclusion among the arguments of the aggregate production function, a macroeconomic model encompassing the three dimensions of sustainable development is obtained, and the latter identifies a process of multidimensional growth (not only economic, but also social and environmental).

Based on these premises, our research supports the hypothesis that social inclusion is an important driver of economic growth and can substitute—or complement—technological progress and capital accumulation and, more in general, input accumulation. By introducing social inclusion in a modified Solow model, it has been illustrated how the former can have positive effects on the growth rate of employment, thus contributing to a broader understanding of socioeconomic policies. Specifically, given highly differentiated and to some extent dual initial conditions (consider, as an example, a group of rich countries characterized by high endogenous technological progress and a group of poor countries characterized by scarce endogenous technological progress), a homogeneous receipt for development would prevent action in all those contexts where the initial conditions are incompatible with the basic assumptions.

Our results have deep implications for development policy. They suggest that a one-fits-all formula for development is not recommended for the multiple and diverse challenges facing developed and emerging countries. We suggest that policy may be usefully tailored on the specific resources that can be mobilised in each specific context, be it national or local, and take into consideration the peculiar socio-economic needs expressed by society.

There are, however, limitations to our analysis that might provide the basis for further research. First, the SMGM model and the EMEG are simplified models of endogenous growth, consequently additional research might contribute to developing more sophisticated and complex revised frameworks of analysis, as an example by introducing our basic assumptions on the aggregate production function in models that account for the decisions taken at the microeconomic level (as the Ramsey-Cass-Koopmans model and the Diamond model), that consider a more complex framework of endogenous growth (as the Romer's model of endogenous technological change), and that introduce additional variables as learning-by-doing and human capital.

Second, it is worth noting how the revised models illustrated in this research (the RMSM, the SMGM, and the EMEG) account for a specific kind of social infrastructure, that is the SSE, but empirical research is needed to provide evidence of how the heterogenous size of the SSE and different trends in social inclusion might impact on cross-country income differences. Specifically, our research did not lead to the identification of robust data to test the extended model. The evidence may not be easy to assemble since definitions of what should fall under the SSE umbrella differ across regions and nations, while data are absent in many countries or, when available, statistics are relatively recent and not granular enough to monitor their evolution. Perhaps the feasibility of a cross-national effort to collect systematic information on the contribution to growth of the SSE could resemble the approach that has been used by the Italian National Institute of Statistics (ISTAT) to build the permanent census of no profit entities, which has produced systematic mustering of data at national level, and has then been used to compile the second report on the size of the SSE (in 2015 there were 379,176 organisations equal to 8% of total organisations, 49 billion Euros equal to 6.7% of national GDP; 1,5 million workers equal to 9.1% of employment; and 5.5 million volunteers).

Third, our approach is limited to an analysis of long-run trends, and consequently it overlooks short run and mid-term dynamics. More research might contribute to identify the implications of our analysis for monetary and fiscal policy. Also, our SSE-centred perspective on growth might contribute to provide more robust evidence of the effects of cross-country differences on other outcomes, including democracy and environmental quality. The multiplicity of human needs stands in contrast to the simple concern with technology and capital, which are two characteristics assumed in theoretical and empirical work, and the substantive neglect in that literature of the role of the SSE. Arguably, having focussed on two growth drivers mainly has also driven the research questions over the past years and hence the neglect of the role of other resources and support structures. The failure to include the SSE may thus limit understanding of many key issues, including the persistence of poverty, social exclusion and environmental degradation even in rich and technologically advanced societies. It follows that, perhaps, one important lesson to take away from our contribution is that using one or two variables to capture the essence of the 'wealth of nations' is not conducive to a proper understanding and needs to be supported and complemented by more comprehensive empirical approaches. These can also account for variations in the institutional system that supports growth, hence changing its qualitative composition.

Still, more research is needed, for example to understand whether the SSE can grow and contribute even in the absence of an established conventional growth path. Consequently, researchers may be interested in exploring the relationship between social inclusion and economic growth in more detail (i.e., what happens when the growth rate of social inclusion and the growth rate of labour in the SMGM—or, alternatively, the growth rate of social inclusion and the growth rate of technological progress in the EMEG—do not converge to a stable equilibrium, or the initial conditions identify a point outside the basin of attraction of the stable equilibrium) and providing robust empirical evidence that may suggest what scenario is most suitable to represent the trajectory of macroeconomic development of a country.

More theoretical challenges are also lurking. For example, from an evolutionary perspective, one important theme in the theoretical literature on the SSE is that of 'isomorphism', that is how organisations keep their identity in the face of external pressures (DiMaggio and Powell 1983). Analysis encompassing 'isomorphism' will be interesting to those wondering whether the SSE will be subsumed by competitiveness and conventional profit-oriented (rather than pro-social) structures; this is even more so as SSE organisations are under constant strain for legitimacy (Mason 2012), which comes from maintaining both social efficacy and economic efficiency.

Finally, it is worth noting how the SSE, here intended as the main actor involved in the achievement of social inclusion, faces several challenges that limit its potential impact (i.e., undercapitalisation and lack of access to finance, which makes it difficult for social enterprises and cooperatives to scale up and to achieve their full potential; lack of awareness, recognition and legitimisation of the SSE by policymakers and the general public). To overcome these challenges, policymakers may want to develop legal frameworks for implementing policies and programs in support of SSE's action. This could include designing forms of public-private partnership that include the SSE for the production of services, providing access to finance that is not tied to investor's profit maximising objectives; incentivising social enterprises and cooperatives through appropriate tax regimes, investing in education and awareness-raising campaigns. By doing so, policymakers can create an enabling environment for social transformation and for the creation of more inclusive and sustainable economies.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

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Appendix

Consider the following system of two non-linear differential equations

$$\begin{cases} \dot{X} = F_1(X,Y) = X(r_1 - a_1 X - b_1 Y) \\ \dot{Y} = F_2(X,Y) = Y(r_2 - a_2 Y - b_2 X) \end{cases} \tag{A1}$$

where a_1, a_2, b_1, b_2, r_1, r_2 are real parameters such that $a_1, a_2, r_1, r_2 > 0$ and $b_1, b_2 < 0$. By setting

$$X = g_S, Y = g_L,$$

$$r_1 = \delta(g_A + g_K),\ r_2 = (1-\alpha)(g_A + g_K),$$

$$a_1 = (1-\omega), a_2 = (1-\alpha),$$

$$b_1 = -\tau,\ b_2 = -\alpha,$$

(35) and (38) are obtained (i.e., the SMGM), while, by setting

$$X = g_S, Y = g_{A,}$$

$$r_1 = \tau m, r_2 = \gamma m,$$

$$a_1 = (1-\rho), a_2 = (1-\theta),$$

$$b_1 = -\sigma, b_2 = -\omega,$$

(45) and (46) are obtained (i.e., the EMEG).

Having identified a correspondence among (A1) and, alternatively, (35) and (38), or (45) and (46), our goal is to describe the planar dynamics generated from (A1).

The system possesses four nullclines, precisely the straight lines

$$X = 0, \tag{A2}$$

$$Y = 0, \tag{A3}$$

$$Y = \frac{1}{b_1}(r_1 - a_1 X), \tag{A4}$$

$$Y = \frac{1}{a_2}(r_2 - b_2 X). \tag{A5}$$

The critical points are the following:

$$O = (0,0), A_0 = \left(\frac{r_1}{a_1}, 0\right), B_0 = \left(0, \frac{r_2}{a_2}\right),$$

$$E = (E_1, E_2) = \left(\frac{r_1 a_2 - b_1 r_2}{a_1 a_2 - b_1 b_2}, \frac{r_2 a_1 - b_2 r_1}{a_1 a_2 - b_1 b_2}\right).$$

Notice that A_0, B_0 belong always to the region $\{X, Y \geq 0\}$. The equilibrium point E exists if and only if $a_1 a_2 \neq b_1 b_2$ and it holds

$$E \in \{X, Y > 0\} \quad iff \quad a_1 a_2 > b_1 b_2,$$

$$E \in \{X, Y < 0\} \quad iff \quad a_1 a_2 < b_1 b_2.$$

Evaluating the Jacobian matrix of the 2-dimensional vector field $F(X, Y) = (F_1(X, Y), F_2(X, Y))$ at the critical points O, A_0, B_0, and E, one obtains

$$JF(O) = \begin{pmatrix} r_1 & 0 \\ 0 & r_2 \end{pmatrix},$$

$$JF(A_0) = \begin{pmatrix} -r_1 & -\frac{r_1 b_1}{a_1} \\ 0 & \frac{a_1 r_2 - r_1 b_2}{a_1} \end{pmatrix},$$

$$JF(B_0) = \begin{pmatrix} \frac{a_2 r_1 - r_2 b_1}{a_2} & 0 \\ -\frac{r_2 b_2}{a_2} & -r_2 \end{pmatrix},$$

$$JF(E) = \begin{pmatrix} -a_1 E_1 & -b_1 E_1 \\ -b_2 E_2 & -a_2 E_2 \end{pmatrix}.$$

From the matrices above we can state that O is a repelling equilibrium point, since both the eigenvalues of $JF(O)$ are positive. A_0 and B_0 are always saddle points, indeed $JF(A_0)$ and $JF(B_0)$ are triangular matrices, the elements on the principal diagonal are the eigenvalues, and it holds

$$(-r_1, -r_2) < 0 < \left(\frac{a_1 r_2 - r_1 b_2}{a_1}, \frac{a_2 r_1 - r_2 b_1}{a_2}\right).$$

The study of E is a little more challenging. It is worth noting how

$$tr(JF(E)) = -(a_1 E_1 + a_2 E_2) < 0,$$

$$det(JF(E)) = a_1 a_2 E_1 E_2 - b_1 b_2 E_1 E_2$$

$$= (a_1 a_2 - b_1 b_2)\frac{(a_2 r_1 - b_1 r_2)(a_1 r_2 - b_2 r_1)}{(a_1 a_2 - b_1 b_2)^2} = \frac{(a_2 r_1 - b_1 r_2)(a_1 r_2 - b_2 r_1)}{(a_1 a_2 - b_1 b_2)},$$

Then the trace of the matrix is always negative, while the determinant has the same sign of the real number $(a_1 a_2 - b_1 b_2)$. Since the numerator of the ratio is positive, we get

$$E \in \{X, Y > 0\} \textit{ and is a stable equilibrium} \quad iff \quad a_1 a_2 > b_1 b_2,$$
$$E \in \{X, Y < 0\} \textit{ and is an unstable equilibrium} \quad iff \quad a_1 a_2 < b_1 b_2.$$

To conclude, we illustrate some simulations. By setting

$$\alpha = 0.5, \ \omega = 0.4, (gA + gK) = 0.01, \tau = 0.4, \delta = 0.2$$

in the SMGM, or

$$\rho = \theta = \omega = \gamma = 0.2, \sigma = 0.4, \tau = 0.16 \text{ and } m = 0.01$$

in the EMEG, we obtain the phase portrait depicted in Figure A1, that illustrates a case of convergence of the two nullclines (A4) and (A5) in the first quadrant (the two nullclines (A2) and (A3) delimit the basin of attraction of the stable equilibrium E). As shown by the trajectories drawn in Figure A1, starting from each point in the first quadrant, the system (A1) tends towards the equilibrium E, in which a constant growth rate of social inclusion and employment for the SMGM (social inclusion and technological innovation for the EMEG), coexist.

Consequently, in the SMGM, social inclusion and employment are mutually reinforcing, and both contribute to economic growth. Put it differently, countries endowed with low capital and technological progress might develop an alternative strategy of economic growth focussed on increasing employment and social inclusion. Similarly, in the EMEG social inclusion and technological progress are mutually reinforcing, and both contribute to the endogenous growth of the aggregate product. It means that every country can find the optimal mix of social inclusion and technological progress to trigger endogenous growth, overcoming a dichotomic picture where Northern countries focus on capital accumulation and technological progress, while Southern countries promote social inclusion and employment (demographic) growth.

Finally, Figure A2 is obtained by setting

$$\alpha = 0.8, \ \omega = 0.4, \tau = 0.4, (gA + gK) = 0.01, \delta = 0.2$$

in the SMGM.

Instead, considering the EMEG, it is worth noting how

$$\omega \le \omega + \gamma \le 1 - \theta \text{ and } \sigma \le \sigma + \tau \le 1 - \rho,$$

consequently, it must be that

$$b_1 b_2 = \omega\sigma \le (1 - \theta)(1 - \rho) = a_1 a_2.$$

It implies that E belongs always to the open set $\{X, Y > 0\}$, and for the EMEG it is impossible to identify a case in which the nullclines diverge in the first quadrant. Then, Figure A2 illustrates a feasible phase portrait only for the SMGM. In this case, the nullclines (A2) and (A3) overlap with the horizontal and vertical axes, while the nullclines (A4) and (A5) converge in the third quadrant, but the equilibrium found at their intersection is unstable.

As shown by the trajectories drawn in Figure A2, each point in the first quadrant does not allow (A1) to converge towards equilibrium, as the growth rate of social inclusion and employment for the SMGM (social inclusion and technological innovation for the EMEG) are mutually self-reinforcing, supporting an ever-increasing process of economic growth.

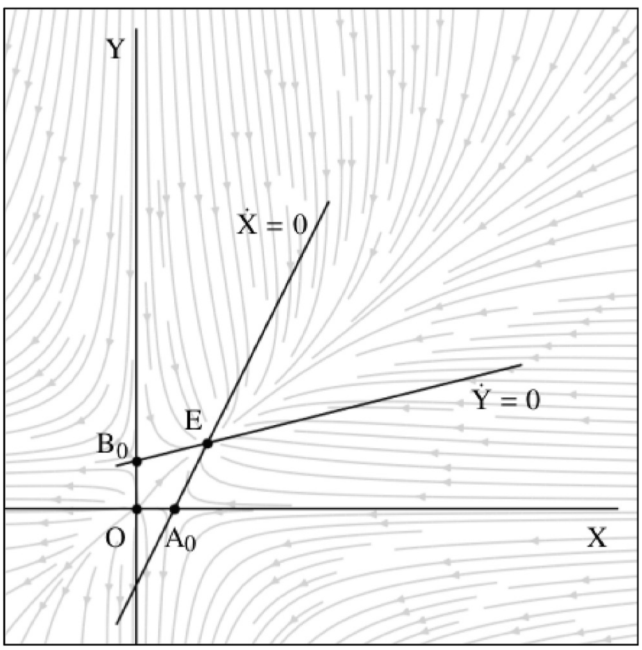

FIGURE A1 | Phase portrait of (A1) when a locally stable equilibrium in the first quadrant exists.

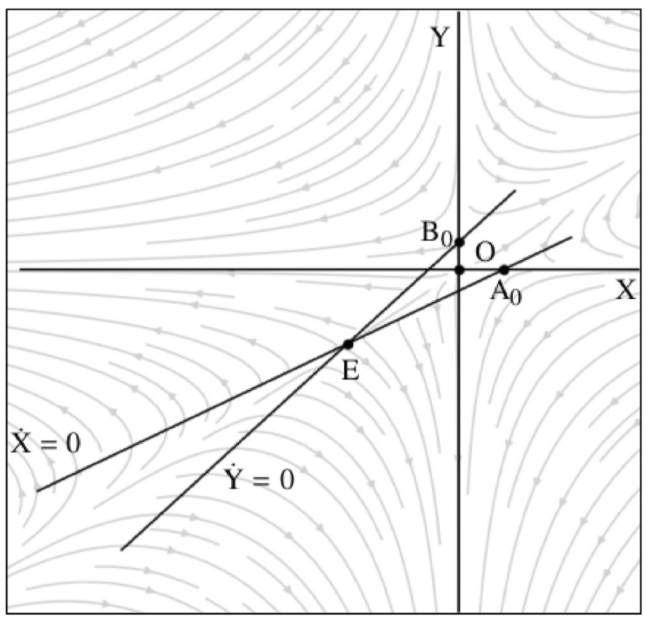

FIGURE A2 | Phase portrait of (A1) when the (unstable) equilibrium is in the third quadrant.