INTRODUCTION TO THE *MACROECONOMIC DYNAMICS* SPECIAL ISSUE ON: GROWTH IN THE AFTERMATH OF THE FINANCIAL CRISIS: THEORIES, POLICIES AND SOURCES OF SUSTAINABLE DEVELOPMENT

(Guest Editors: Alberto BUCCI and Guido COZZI)

1. INTRODUCTION

The extent to which economists have emphasized the role of finance (*e.g.*, banks and other financial institutions) within their theoretical models, empirical applications, and policy-oriented research has been fluctuating over the last few decades. The interest in the topic was very high in the 1980s, then it sharply declined until the onset of the Great Financial Crisis of 2007-2009 when the attention towards the possible macroeconomic effects of finance has started increasing again. Indeed, the 2007's financial downturn led to enormous losses for several markets, to the bankruptcy of different banks, financial institutions and investors, and to a related general economic recession. Consequently, governments, central banks, and policy-makers were induced to implement a wide range of actions aimed to reduce the impact of the crisis and overhaul the financial system. These different actions ultimately affected not only financial markets but also the real economy, and changed the general perception of people towards *'finance'* (Zingales, 2015). Thus, understanding the impact and the main economic implications that the financial sector may have on economic activity and welfare is still crucial.

The post-crisis recovery was unusually long. In the US the trend GDP restarted on a parallel trajectory below the pre-crisis trend line. Hence the negative level shock of 2009 was never corrected. In the Eurozone recovery was even weaker, as the recession hit twice, and neither level

nor growth managed to get close to the pre-crisis trend line. The growth shock associated with the crisis triggered a new literature integrating growth and business cycle, and focusing on medium terms (Cozzi *et al.*, 2017, Benigno and Fornaro, 2018, Anzoategui *et al.*, 2019, etc.).

Although the debate on the link between finance and economic growth/development has newly revamped, there is still much disagreement about its overall conclusions. While some have argued that an advanced financial system is a key condition for development and industrialization (Gerschenkron, 1962), others have recently maintained that, without proper rules, finance can become a powerful force for planting the seeds of future financial crises (Schularick and Taylor, 2012; Mian and Sufi, 2014) with adverse implications for economic growth, income distribution, and social welfare.

The seminal empirical study on the finance-growth nexus is the paper by King and Levine (1993). They study a large cross-section of 77 countries over a long period of time (1960-1989), by controlling for a large set of country-specific indicators that in principle can affect economic growth and development (such as initial wealth, school enrollment, and population growth). Moreover, they use various proxies for financial development, *i.e.* liquid liabilities of the financial system normalized by GDP; bank credit divided by bank credit plus central bank domestic assets; and credit to the private sector normalized by GDP. Neglecting causality, the authors find in the data a strong and significantly positive association between contemporaneous measures of financial development and economic growth. Then, they offer the first attempt to establish causality within the finance-growth relation. In particular, they study how much of the cross-country variation in average subsequent economic growth may be explained by the value of financial development in 1960. Their regressions indicate that the beginning-of-period financial depth is a good predictor of succeeding rates of economic growth over the next 30 years, after controlling for beginning-of-period income, education, and proxies for monetary, trade, and fiscal policies. Finally, the authors look at the possible channels that can explain the association between financial development and

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economic growth and discover that the beginning-of-period financial development is linked to the rate of physical capital formation and to the efficiency of resource allocation during the sample period.

Other contributions, however, reveal that in recent times the positive relationship between finance and growth has not been as strong as it was in the data for the period from 1960 to 1989 (Rousseau and Wachtel, 2011), and that financial depth is no longer a significant determinant of long-run growth (Demetriades and Rousseau, 2016). Moreover, a non-negligible body of empirical research has also cast many doubts on the claim that the effect of finance on economic growth is monotonic. In this field of research, Shen and Lee (2006), studying the relationship between financial development and real GDP per capita growth in 48 countries, were among the first to find that the association between growth and bank development is best described as a weak inverse U-shape which becomes stronger when additional stock market variables are squared. A number of other studies using various datasets, empirical methodologies, and time periods, have now revealed robust non-linearities in the finance-growth nexus (see also Bucci *et al.*, 2018). Arcand *et al.* (2015) seek to quantify the threshold beyond which financial depth no longer has a positive effect on economic growth. To do this, they use data on 67 countries between 1970 and 2000 and employ a host of empirical approaches showing that financial depth starts having a negative impact on output growth when credit to the private sector reaches 100 percent of GDP. Beck, *et al.* (2014) find a similar threshold (around 109% of GDP, when not controlling for banking crises) after estimating dynamic panel regressions on a sample of 132 countries between 1980 and 2005.

At the moment there are three broad theory-based explanations for the non-linearities in the finance-growth nexus. The first one (Rioja and Valev, 2012) suggests that at high levels of financial development, the further deepening of financial markets can be associated with a type of financial services (such as mortgage/household credit) that have a lower growth potential than other types of finance (such as enterprise/business credit). The second (Rancière *et al.*, 2008) has to do with the

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hypothesis that there can be a trade-off between economic growth and fragility that is exacerbated by financial development. The third (Philippon and Reshef, 2012), instead, reveals that financial development yields a sort of brain-drain away from the real into the financial sector, so depleting the stock of human capital available for pro-growth activities such as innovation.

Related to this, another topic that the finance-growth literature has in recent times started exploring in great detail concerns the (indirect) effects that finance and financial development may have on economic growth and development through a bunch of related, but still different, channels. Two of these are certainly income inequality/distribution and human capital investment. In this regard, starting from the seminal papers by Galor and Zeira (1993) and Banerjee and Newman (1993), it is now clear that the presence of possible borrowing constraints may contribute, among others, to slow down the accumulation of human capital, which, in turn, has an impact on the distribution of income and the rate of long-term economic growth. It is therefore plausible (Jerzmanowski, 2017; Bucci and Marsiglio, 2019) that financial development may indirectly affect economic growth and income inequality via the human capital-channel.[1] Recent evidence, indeed, already points to the fact that the demand for higher education increased in financially deregulated states as private student loans from banks became cheaper and more readily available (Sun and Yannelis, 2016).

Finally, Chu *et al.* (2019) find that financial development can invert the nexus between IPRs and growth. In fact, in the presence of R&D credit constraints, stronger patents, by its negative level effects on GDP, can end up reducing innovation.

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[1] Bucci and Marsiglio (2019), in particular, find conditions under which human capital-based economic growth and financial development turn out to be non-monotonically related. Specifically, since in their framework financial development affects simultaneously the productivity of skill acquisition and the obsolescence rate of human capital, their analysis suggests that the human-capital-channel may represent an important starting point to shed some light on why in some countries there may be too much finance while in others too little.

In order to gain a better understanding on these (and other related) issues, and on the new role played by finance and financial institutions in the real economy and in economic growth following the Great Financial Crisis of 2007-2009, the Department of Economics, Management and Quantitative Methods at the University of Milan (Italy) decided to host in 2017 a three-day academic conference on *"Finance and Economic Growth in the Aftermath of the Crisis"*. The conference gathered a huge number of economists and policy-makers from all over the world who presented papers having as the main objective to re-examine the effects of finance on the real side of the economy and to discuss how finance (defined in a very broad sense) could have shaped the (old and new) sources of sustainable economic development in the near future. Another theme of the conference was the analysis of which policies (fiscal, monetary, trade, R&D/innovation policies) could have actually been adopted by governments and policy-makers in order to achieve, along with a higher rate of per-capita output growth, also such goals as a more stable financial system and a more equitable income distribution. The conference took place on September 11-12-13, was open to different methodologies and approaches (theoretical/empirical; mainstream/non-mainstream; aggregative/agent-based), and saw the two of us serving as members of a scientific committee including also Costas Azariadis (Washington University, St. Louis, USA), Herbert Dawid (University of Bielefeld, Germany), Domenico Delli Gatti (University of the Sacred Heart, Milan, Italy), Mauro Gallegati (Polytechnic University of Ancona, Italy), Stefano Neri (Bank of Italy, Rome), and Alberto Russo (Polytechnic University of Ancona, Italy). This *Journal* had, in the meantime, agreed to publish those papers that survived its usual, rigorous editorial review process as part of this special issue. The contributions included here are, therefore, among the latest efforts that try to evaluate the overall bearing of the recent theoretical and empirical debate on the long-run relation between finance and economic growth, and on the changing weight that, due to the recent Great Financial Crisis, old and new sources of economic development may have on future growth prospects worldwide. It is clear that many more years of work will be required to address in a more definitive way all of the

issues raised by the articles gathered in this special issue. However, all the contributors to the special issue have definitely taken an important step towards this key goal.

The following papers can ideally be divided into two distinct groups. The first group deals with issues more closely linked to (some specific) real aspects of economic growth and development (and contains contributions by Bucci, Carbonari, and Trovato; Bondarev; Gori, Manfredi, and Sodini), while the second group of papers deals with issues more closely related to finance and financial intermediation, monetary policy, innovation, and inflation (and contains papers by Byrska, Krawiec, and Szydlowski; Annicchiarico and Pelloni; Cova, Notarpietro, Pagano, and Pisani; Zheng, Huang, and Yang; Catullo, Giri, and Gallegati).

The next section presents a broad overview of the different contributions that are included in this special issue.

2. PRESENTATION OF THE SPECIAL ISSUE'S CONTRIBUTIONS

In the first paper, Bucci, Carbonari and Trovato re-examine, both theoretically and empirically, the long-run relationship between product market competition and economic growth, and between population growth and economic growth. Building on Romer (1990), they develop a theoretical model in which the trade-off between productivity gains (due to more specialization) and productivity losses (due to more complexity) is explicitly taken into account. The main innovation of their model is that it is able to account simultaneously for a non-monotonous, non-uniform relationship not only between population growth and economic growth, but also between the degree of the monopolistic markup and economic growth. In the empirical section of their article, the authors confront their theoretical predictions with the data. To deal with unobserved heterogeneity,

they employ a semi-parametric technique, which also allows to perform a cluster analysis. Using a sample of 23 OECD countries, with a time span ranging from 1970 to 2007, it is found that the population growth rate produces a (slightly) positive influence on real per capita GDP growth. Moreover, when statistically significant, the impact of the monopolistic markup on economic growth is found to be barely negative or positive. This implies that the sample used by the authors behaves consistently with the theoretical case where the specialization effect prevails over the complexity effect of innovation. Finally, the authors classify the countries and estimate for each cluster the impact that the population growth rate and the intermediate sector's markup exert on the 5-year average real GDP growth rate.

In most of growth literature, the intensity of spillovers is assumed to be uniform across technologies (even if dependent on the existing number of technologies, as in Peretto and Connolly, 2007, and Acemoglu *et al.*, 2012, among others). Recent exceptions are represented by Acemoglu and Cao (2015) and Chu *et al*. (2017) where firms' heterogeneity is allowed for, but this is not attributed to the structure of R&D spillovers as a whole. At the same time there is increasing evidence that growth rates of modern economies may be non-monotonic, or even declining (see, *e.g.*, Storper, 2011; Fernald and Jones, 2014; Gordon, 2016). Conventional growth theories are not capable of explaining these phenomena. The paper by Anton Bondarev proposes one potential source of such non-monotonic growth: heterogeneous and varying in time cross-technologies spillovers. A model of cross-technology interactions (that is more general than existing models regarding possible interdependencies of technological developments) is therefore developed. In particular, Bondarev's model combines dynamic structural change (as in Bondarev and Greiner, 2019) with fairly general R&D spillovers represented as infinite-dimensional linear operator. The properties for this operator to yield balanced growth are established and turn out to be very restrictive. Next, the notion of sustained growth is introduced which relaxes this concept by

allowing for time-limited non-monotonicities. Spectral properties of the spillovers operator play a key role in determining the size, scope and duration of technology shocks for the economy. Three types of shocks are identified: technology specific, sector-specific and economy-wide. At last, the need for a variety of different regulation tools to contain these different shocks is discussed based on properties of the R&D operator.

A central policy issue in the battle against HIV in many countries, such as Sub-Saharan Africa (SSA) countries, is whether and when high-prevalence countries might become autonomous in designing and implementing their own intervention policies against the disease. The aim of the research proposed by Gori, Manfredi, and Sodini is twofold. First, it develops a framework for explaining economic development within a general equilibrium growth model with endogenous fertility and endogenous mortality forced by the threat of a persistent, deadly, infectious disease (*e.g.*, HIV/AIDS) in SSA. Second, it aims at shedding new light on the interplay between foreign aid and endogenous domestic public policies in SSA countries severely afflicted by HIV. Consequently, it investigates the demographic and macroeconomic implications of an intervention policy where the overall amount of resources devoted to the battle against HIV/AIDS is the sum of an exogenous component representing foreign aid and an endogenous public expenditure. Based on the assumption that these policies allow the same degree of HIV control, the authors show the emergence of quite different responses in terms of key demo-economic variables. These effects mainly pass through the fertility response to the evolving epidemic conditions.

Byrska, Krawiec, and Szydlowski study the impact of financial intermediation on economic growth. To do so they use the simplest model of economic growth in the form of an autonomous dynamical system with a financial sector (represented by banks) and a real sector (represented by households and firms). Households can save money only through banks that, in turn, offer

investment loans to firms. The authors assume that financial intermediation services are fully described by a (financial-intermediation-) technology that depends on the share of labour employed by banks. The crucial assumption of the model is the dependence of investments carried out by firms not only on savings accumulated by banks but also on the financial intermediation technology. The obtained dynamical system is a three-dimensional one. The paper analyzes the existence of a saddle-path-solution associated with financial intermediation. Using the methods of the dynamical systems, the authors study the stationary states of the system and their stability. It is found that the equilibrium is a saddle with an incoming separatrix lying on one of the two-dimensional invariant submanifolds. The existence of a saddle-node bifurcation is also formally established.

Macroeconomics traditionally considers growth and business cycles as two separate areas of analysis. However, much empirical evidence shows that business cycles affect investment, in particular in R&D, with the potential to affect long-run growth, as well. What are then the consequences for the conduct of monetary policy? Early endeavors to study optimal monetary policy, while factoring in the relationship between short-run dynamics and long-run growth, were done adopting as a framework of analysis the AK model with knowledge spillovers. In other words, any R&D activity by firms was ruled out by assumption. The contribution by Annicchiarico and Pelloni fills this gap in the literature. They study optimal monetary policy in a prototypical New Keynesian model extended by incorporating in it an R&D sector leading to an expansion in the variety of the intermediate goods, and compare the results with those obtained when the expansion occurs exogenously. The authors consider the Ramsey policy and find that significant deviations from zero trend inflation are optimal, irrespective of whether growth is exogenous or endogenous. This is striking because in New Keynesian settings optimal trend inflation is almost always found to equal to zero. Optimal monetary policy is found to be counter-cyclical in response to both

technology and public spending shocks, however the intensity of the policy reaction depends on whether the creation of new goods is driven by costly R&D or happens exogenously. Overall, the moderate short-run variations of prices around the non-zero trend inflation observed in response to shocks indicate inflation targeting as a robust policy recommendation.

The paper by Cova, Notarpietro, Pagano, and Pisani addresses the secular stagnation hypothesis from a global supply-side perspective and provides a quantitative assessment of one of the suggested policy measures aimed at reinvigorating economic growth. The authors evaluate how an increase in public infrastructure investment in the main advanced economies affects global growth and welfare under alternative monetary policy stances by simulating a five-region New Keynesian model of the world economy, calibrated to the United States, the Euro area, Japan, China, and the rest of the world. The most crucial aspect of the adopted approach is the modelling of fully endogenous long-run global growth via research and development (R&D) accumulation. In more detail, the novelty of the paper relies in: (a) The quantitative assessment of the supply-side version of the secular stagnation hypothesis, along with the possible counter-setting policy measures at international level; and (b) The development of a multi-country New Keynesian model of the global economy featuring endogenous growth. The conclusions are threefold. First, unfavorable technology developments may have played a nontrivial role in the global growth slowdown. Second, the secular stagnation can be effectively counterbalanced by coordinating global fiscal and monetary measures encouraging R&D accumulation. Third, coordinated measures provide a larger welfare gain relative to a unilateral fiscal expansion.

The paper by Zheng, Huang, and Yang investigates the effects of monetary policy on long-run economic growth via different cash-in-advance (CIA) constraints on R&D within a Schumpeterian growth model with vertical and horizontal innovations. The relationship between inflation and

growth depends on the relative extents of: (1) The CIA constraints, and (2) The diminishing returns to the two types of innovation. The model can generate a mixed (*i.e.*, monotonic or non-monotonic) relationship between inflation and growth, given that the relative strength of monetary effects on growth across different CIA constraints and the relative strength of R&D-labor-reallocation effects across different diminishing returns vary with the nominal interest rate. This paper contributes to the literature by quantitatively showing that in the empirically consistent cases where horizontal R&D is subject to larger diminishing returns than vertical R&D and where the CIA constraint on horizontal R&D is sufficiently larger than that on vertical R&D, an inverted-U relationship between inflation and growth may emerge.

The paper by Catullo, Giri, and Gallegati presents an agent-based model (ABM) reproducing a stylized credit network that evolves endogenously through the individual choices of firms and banks. The authors introduce in their framework a financial stability authority in order to test for the effects of different prudential policy measures designed to improve the resilience of the economic system. Their approach allows to shed some light on the relationship between micro– and macro–prudential policies, a relatively unexplored topic within the blooming literature on the prudential regulation. In general, the topic is relevant because micro– and macro–prudential policy objectives may diverge (Angelini *et al.*, 2012, Alessandri and Panetta, 2015, and Osinski *et al.*, 2013). For instance, during downturns, macro–prudential policy may be oriented at softening banks' capital requirement in order to avoid a credit crunch. On the contrary, micro–prudential policy may aim at consolidating the financial position of banks by tightening the capital requirements. The authors address this conflictive dichotomy by setting up a policy experiment in which micro and macro policies interact inside an ABM framework. Simulations show that a combination of micro– and macro–prudential policies reduces systemic risk, but at the cost of increasing banks' capital volatility. Moreover, the agent-based methodology allows to implement an alternative meso–

regulatory framework that takes into consideration the connections between firms and banks. This policy targets only the more connected banks, increasing their capital requirement in order to reduce the diffusion of local shocks. The results support the idea that the meso prudential policy is able to reduce systemic risk without affecting the stability of banks' capital structure.

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