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The complex inequality-innovation-public investment nexus

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Abstract: In this paper, we deal with the complex relationship connecting inequality to innovation, and the ways through which public investment can affect it. We first stress that inequality and innovation may interact in many different ways. The positive relation that part of the economic theory often assumes to exist between (initially) rising inequality and improving innovation performances emerges as only one among many other far less virtuous dynamic trajectories. We then analyze the specific case of the US. We put emphasis on the possible perverse effects that the financialization of the US economy may have on the inequality-innovation nexus. We note that the US developmental State - very often neglected by the economic literature - can effectively mitigate such undesirable outcomes. According to our interpretation of recent developments in the US economy, the widespread belief in the positive pro-innovation effects of fierce cutthroat remuneration systems may prove to be ungrounded.

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1. The complex relationship between innovation and inequality

In the last decades, a heterogeneous body of literature has developed trying to assess the existence of a direct link between inequality and innovation and between public investment and innovation. As for the first point, some authors focus on how innovation affects inequality. Their findings are conflicting at the very least. Antonelli and Gehringer (2013) find that higher innovation performances (as measured by patent counts) reduce income inequality as captured by the Gini index. According to them, innovation reduces income inequality because it fosters productivity and economic growth, so that wages increase and rentiers' income decreases (due to a larger available capital stock). Second, in the long run a highly innovative economic environment reduces inequality by increasing competitive pressures on good markets, then squeezing the duration and amount of quasi-rents accruing to innovators.

This evidence notwithstanding, Antonelli and Gehringer logic can be easily reversed. Aghion (2002) and Acemoglu (2002) claim that the skill-based nature of (process) innovations introduced in the last decades has been the main driver of increasing wage and income inequality. More in general, in developing countries innovation also lead to the structural change of the economy, thus initially increasing inequality as a modern highly productive industrial sector emerges alongside traditional low-productivity activities.[1]

The picture gets even more complicated if one thinks that the innovation-inequality nexus does not run one way. There exist sound theoretical reasons to believe that inequality feedbacks on innovation through several channels. A long-standing strand of literature claims that higher income and wealth inequality are required in order to stimulate innovation (Lazear and Rosen, 1981; Lippmann, Davis and Aldrich, 2005). Acemoglu et al. (2012) argue that the US "cutthroat"

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[1] This is the logic behind the dualistic development model proposed by Arthur Lewis. According to Lewis (1954, p. 56), "Development must be [initially] inegalitarian because it does not *start* in every part of the economy at the same time".

remuneration system is somehow necessary to push ahead the technology frontier and trigger off radical innovations. In a sense, they build their model on the theory of "varieties of capitalism" originally put forward by Hall and Soskice (2001), according to which radical innovations are more likely to be introduced in liberal market-based and relatively unequal economies than in cooperative more equalitarian systems.[2] Hopkin, Lapuente and Moller (2014) provide empirical evidence at odds with the supposedly pro-innovation properties of cutthroat remuneration systems. Taking into account OECD countries, they show that highly equitable social systems like Scandinavian economies perform better than the US if innovation performances are measured by the "Global Innovation Index" (GII).[3] Hall and Soskice (2001), and Acemoglu at al. (2012) focus their analyses on industrialized economies. Weinhold and Nair-Reichert (2009) analyze a larger sample also including emerging and backward economies. They conclude that a more equitable income distribution is positively (rather than negatively) correlated to innovation via its positive effects on the functioning of domestic institutions. Some other works compare the successful development experience of newly industrialized East Asian countries with respect to lagging-behind Latin American economies. A more equal income and wealth distribution in East Asian countries has favored human capital formation, technological knowledge accumulation, structural change and, finally, innovation (Arocena and Sutz, 2003). On the contrary, strong élites and polarized income and wealth concentration in Latin America have contributed to create an unfavorable economic environment characterized by structural inertia, persistently low R&D efforts, and disappointing innovative performances (Cimoli and Rovira, 2008).

As for the role of public investment in supporting and steering innovation, the economic literature has extensively stressed how, in the US, government-funded military-related R&D activities eventually had significant spill-over effects on the civil sector of the economy, very often

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[2] See Taylor (2004), and Akkermans, Castaldi and Los (2009) for a critique of the "varieties of capitalism" theory.
[3] See the Global Innovation Index website at https://www.globalinnovationindex.org/content.aspx?page=GII-Home.

supporting economic recovery from slumps and counteracting long-run productive declines (see Cypher, 1987). Mazzucato (2013) takes inspiration from such a literature and stresses the entrepreneurial role often played by public institutions rather than private agents. According to Mazzucato, a significant amount of private sectors' innovations eventually came to light thanks to previous direct State engagement in path-breaking innovations. In several cases, State intervention did not fix any market failure, but rather put effort in research on a potentially revolutionary technology that the private sector would never take into consideration because of the high risks at stake. State intervention often created profit and "value-extraction" opportunities that had been eventually exploited by private actors (Lazonick and Mazzucato, 2013).

Our work does not intend to add another piece to the already largely inconclusive empirical literature on inequality and innovation. Our attempt is rather to build a simple theoretical framework in order to capture at least part of the several different ways through which inequality, innovation and public investment may interact, and possibly lead to radically different development paths. In this sense, our paper primarily aims at stressing that there is not a unique and universal law connecting innovation to inequality, and vice versa. According to a well-established concept in institutionalist economics[4], the way inequality and innovation feedback among each other, and shape the development process, is *country-specific* and *context-specific*. Such specificity induces different countries to follow different path-dependent virtuous or perverse development trajectories leading to not-a-priori-foreseeable development outcomes. The first part of our paper tries to conceptualize the high degree of cross-country heterogeneity that characterizes the relation between inequality and innovation, and the ensuing development process.

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[4] See O'Hara (2002) on the central role of path-dependency, cumulative causation, history and institutional peculiarities in the economic analysis of Veblen, as well as of other non-neoclassical economists such as Myrdal and Kaldor. See Hall and Ludwing (2010) on Veblen's *rejection* of any neoclassical-type convergence unavoidably leading to a "meliorative trend in the course of events". See Cypher (2015) on Celso Furtado's historically contextualized analysis of the peculiar *underdevelopment* process afflicting Latin American countries.

Secondly, but in relation with the previous point, our work also tries to give a simple representation of the peculiar innovation and development pattern that has characterized the US in the last three decades. We provide an alternative story with respect to the well-know idea according to which the high (and increasing) level of inequality registered in the US since mid 1970s is a sort of necessary although bitter pre-requisite to spur innovation. In alternative to the perspective put forward by Acemoglu et al. (2012) among others, we show how high innovation and rising inequality in the US can be totally uncorrelated, and actually result as coincidental consequences of third omitted variables, i.e. past and present committed public efforts in the R&D sector, and more recent institutional changes in the financial sphere of the economy. In this sense, our narrative of the current US innovation-inequality model casts serious doubts on the sustainability of such new institutional arrangements, as well as on the asserted virtues of unequal but (allegedly) more innovative liberal market-driven economies.

This work is organized as follows. Section 2 presents our simple inequality-innovation theoretical framework. We show how the many different context-specific forces shaping the relationship between inequality and innovation may lead to radically different development paths. Section 3 provides a simple representation of the current US inequality-innovation pattern, which is alternative to the "more-inequality-feeds-more-innovation" paradigm pinpointed by Acemoglu et al. (2012). Section 4 concludes and discusses some implications for future research that emerge from our analysis.

2. A simple theoretical framework on inequality-innovation clusters and heterogeneous development paths

In Figure 1, we plot the 2012 values of the GII index[5] (horizontal axis) with the most recent data available of the Gini Index (vertical axis) for a sample of 67 countries. What emerges is a snapshot of current huge cross-country differences in terms of innovation-inequality patterns, and of the lack of a clear relationship between inequality and innovation at worldwide level. Yet, what Figure 1 also suggests is the existence of a sort of country clustering around a number of sub-groups. In the bottom-left part of Figure 1, lie some backward countries where persistent difficulties to ignite a sustained development process and scarce innovation capacities are associated to basically low levels of inequality, at least with respect to emerging and middle-income economies. Most of Latin American economies lie in the top-left section of the graph. Although innovation performances remain disappointing, inequality reaches much higher levels, actually the highest worldwide (together with South Africa, "SA"). Finally, most of the developed (European) economies are clustered in the bottom-right section of Figure 1. In this case, high domestic innovation capacities combine with the lowest level of inequality worldwide. South Korea belongs to this group too, whereas a fast-growing emerging economy like China lies in the middle. In terms of innovation, it performs better than the least developed countries and other developing economies, Latin American ones in particular. However, inequality in China is still much higher than in most developed countries. Following Taylor (2004) and Hopkin, Lapuente and Moller (2014), Figure 1 confirms the peculiarity of the USA among the set of developed nations. The USA belongs to the group of the most innovative economies worldwide, even though it is not the most innovative

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[5] See Table A.1 in Appendix A for the full list of countries reported in Figure A.1.

according to the 2012 GII index. US inequality, however, is much more pronounced than that observed in other similarly developed economies.

[Figure 1]

One could reply to our interpretation of Figure 1 that such cross-country differences may depend on the different level of development characterizing the economies taken into account. Nonetheless, a broad historical perspective on development successes and failures may confirm that such differences are not the mere result of transitory phases of a common development process, but rather signs of hysteresis in the evolution of the variables at stake, and of the institutions that contribute to determine them. This is the case of the countries entering the bottom-left group in Figure 1, most of them included in the UN list of the least developed countries since the beginning of the 1970s and apparently stuck in a long-lasting poverty trap. The same can be said for Latin American countries, where high inequality, unsatisfactory innovation performances, and evidence of an uncompleted development processes stand out as widely recognized facts.[6] European continental and Northern countries, finally, constantly perform as highly innovative developed economies with strong welfare systems and low inequality levels. In a way, Figure 1 may be seen as a perhaps rough proof that the relationship between inequality and innovation could be affected by the kind of institutional path-dependence first development economists identified as source of diverging development paths, and that new inequality-innovation patterns may emerge as a consequence of institutional and structural breaks.

Such a wide variety in cross-country inequality-innovation patterns makes cross-country empirical analyses hardly effective. Therefore, let try to think about a theoretical framework that

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[6] See Palma (2011, 2014) on the persistence of extremely high levels of inequality in Latin America and South Africa.

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may help to describe at least part of the several ways through which innovation and inequality coevolve and shape the development process.

As for the effects innovation can have on inequality, let take inspiration from some of the original path-breaking theories in the field of development economics. Indeed, following Lewis (1954), Kuznets (1955) and Furtado (1964) among others, innovations in poor economies initially consist in the emergence of a few modern (more productive and technology advanced) productive activities into largely pre-industrial and pre-capitalist economic systems. Depending on the institutional environment they operate in, and on the ensuing incentives/constraints to productively invest their rewards, emerging entrepreneurs/innovators can reinvest profits and trigger off a self-sustaining process of capital accumulation, improving productivity and even rising incomes. At the incipient stages of the development process, this mechanism is likely to determine an increase in wealth and income disparity.[7] Nevertheless, if strong and widespread enough, this process will boost economic development and the structural change of the economy. The accumulation and diffusion of technological knowledge, the adoption of better production techniques, the emergence of wider innovation opportunities, and the ensuing traverse towards middle-advanced stages of development eventually alter the innovation-inequality nexus. A negative link now takes form. This shift in the innovation-inequality pattern hinges on technological spillovers from industry to agriculture, the changing balance of bargaining power between antagonist factors taking part in the production process, and on the spread of innovation opportunities that makes markets more competitive and dynamic, monopolistic positions weaker and monopolistic rents short-lived. Equation (1) tries to formalize such a development trajectory in the simplest way possible:

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[7] According to Kanbur (2012, p. 12), "the dynamics of development identified by Kuznets and Ahluwalia continue to be present in the actual experience of individual countries, and are being confirmed by the time series evidence that has accumulated since the work of these two pioneers". See Bresser-Pereira (2014) for a historical analysis of the evolution of inequality across the different stages of capitalism development. Note his point on the initial increase in inequality due to the move to capital-using techniques.

$$iq_{t+1} = f\left(\underbrace{in_t}_{+/-}\right) \qquad (1)$$

With $\dfrac{\partial iq_{t+1}}{\partial in_t} > 0$ if $in_t < \bar{\imath n};$ $\dfrac{\partial iq_{t+1}}{\partial in_t} < 0$ if $in_t > \bar{\imath n}$

In equation (1), we assume a time lag to separate the occurrence of innovations (in_t) from their effects on inequality (iq_{t+1}) to emerge. In addition to this, $\bar{\imath n}$ stands for the "Lewis-type" turning point, with further progress in the innovation capabilities and the ensuing development process reducing instead of increasing inequality.

Changing inequality very likely feedbacks on innovation dynamics giving rise to an *endogenous cumulative* process. The specific economic context we deal with, say the current level of inequality, its main causes, and the broad set of local institutions and rules driving economic agents' decisions, relevantly influences how this process unfolds. Many different scenarios are possible.

First, a kind of virtuous process may take place in which initially rising inequality may spur innovation. Both macro and micro mechanisms may be at work. At macro level, initial income and wealth concentration in a few hands may favor investment and capital accumulation, if the prevailing incentives are such that economic resources are reinvested in the real sector of the economy and in R&D activities, and "financial wheeling and dealing do not obstruct the industrial system through unsustainable share returns [and] short-term rather than long-term investment horizons (O'Hara, 2002, pp. 88 – 89)". At micro level, Acemoglu, Robinson and Verdier (2012) stress the well-know idea that "technological innovations require incentives for workers and entrepreneurs [so that…] this implies greater inequality and greater poverty (and a weaker safety net) for a society encouraging innovation (Acemoglu, Robinson and Verdier, 2012, p.4)". The

economic relationship then runs from (current) inequality to (current) innovation and may take a upward sloping form, as assumed by equation (2.a):

$$in_t = g(\underset{+}{\underbrace{iq_t}}) \qquad (2.a)$$

The steepness of equation (2.a) does matter. A flat and positively sloped equation (2.a) means that the existing institutional/economic framework stimulates economic actors to exploit the opportunities opened and respond to the incentives created by the initial rise in inequality. Accordingly, investment and innovative efforts will surge. Should equation (2.a) be rigid, this would represent a static economic environment, in which income and wealth concentration nether finance not incentivize innovation, and the ensuing social mobility and economic structural change.

Despite of the arguments just outlined, the constant advancement in innovation capabilities requires the widespread diffusion of technological knowledge. Castellacci and Natera (2013) analyze a sample of 98 countries including both developed, emerging and underdeveloped economies in order to understand how innovation and absorption capacities evolve all along the building up of national innovation systems. They find out that innovation and absorption capacities are positively co-integrated in the prototype traverse of an economy from the initial state of underdevelopment and lack of innovation to the stage of fully advanced innovative countries. The diffusion of technological knowledge and the improvement of a country's absorption capacities require significant households' investments in higher education. These can take place only if a fair degree of equality is achieved within the economy.[8] A second alternative scenario emerges with

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[8] See Galor and Zeira (1993, p. 51), on the "importance of having a large middle class for the purpose of [supporting] economic growth" through the ensuing larger opportunities to accumulate human capital.

respect to the previous one in which, from a certain point onwards, the economy will require a reduction in inequality to foster innovation even further. A backward-bending arm in the inequality-to-innovation relationship may emerge, as shown in equation (2.b):[9]

$$in_t = g(\underset{+/-}{\underbrace{iq_t}}) \qquad (2.b)$$

With $\frac{\partial in_t}{\partial iq_t} > 0$ if $iq_t < iq^*$; $\frac{\partial in_t}{\partial iq_t} < 0$ if $iq_t > iq^*$

Several developing economies show persistently high levels of income and wealth (originally land) inequality inherited from the past. This is the case of most Latin American countries, in which persistently high inequality is the outcome of the well-established monopolistic control of a few modern industrial and service sectors, as well as of abundant natural resources. In such a context, at macroeconomic level, high inequality impedes any significant innovation-driven structural change to take place and to radically modify the social structure of the economy (Furtado, 1964; Arocena and Sutz, 2003). Domestic industrialization is far from complete or is reverted by episodes of premature de-industrialization. The overreliance on natural resource exports fails to address recurrent external balance constrain problems. At social level, the room for innovation-induced social mobility remains narrow. In our framework, a throughout negative relationship between inequality (iq_t) and innovation (in_t) emerges, as assumed in equation (2.c):

$$in_t = g(\underset{-}{\underbrace{iq_t}}) \qquad (2.c)$$

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[9] Following Hatipoglu (2012, p. 243), "firms tend to innovate more as a result of a decrease in inequality when inequality is too high […and] that there are significant non-linearities [between inequality and innovation] at mid- to high-range levels of inequality".

Depending on the specific institutional setting that shapes the interaction between innovative efforts and inequality (i.e. how equation (1) matches with the alternative versions equation (2) may assume), a wide range of different development paths emerge in the innovation-inequality space. They are portrayed in Figures 2.a, 2.b and 2.c.

Figure 2.a depicts the kind of virtuous interaction between inequality and innovation envisaged by Acemoglu et al. (2012). In Figure 2.a, point A stands for the kind of poverty trap that seems to afflict those backward economies in the bottom-left cluster in Figure 1. Point *B*, on the contrary, represents the high level of innovation capabilities developed by the advanced western economies and by a bunch of East Asian countries positioned on the rightward side of Figure 1. What is most, if the existing socio/economic context induces economic agents to respond vigorously to investment and innovation opportunities created by the degree of original (increasing) income and wealth concentration, the economy may move from point A to point B. A virtuous "technology traverse" and a successful development process take place, leading the economy to develop high innovation capabilities. [10] Consistently with Kuznets' inverted U curve hypothesis, inequality first increases and then decreases along the unfolding of such a "happy-end" development process.

[Figure 2.a]

The development path described in Figure 2.a is only one among the several different evolutions an economy may follow. Indeed, no automatic forces exist causing a "meliorative trend" to take place. Rather, developing countries may find hard to replicate the successful development traverse

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[10] The formal conditions for such a virtuous process to take place read $\left|\frac{\partial in_{t+1}}{\partial in_t}\right|_A = \left|\frac{\partial g(.)}{\partial f(.)}\frac{\partial f(.)}{\partial in_t}\right|_A > 1;$ $\left|\frac{\partial in_{t+1}}{\partial in_t}\right|_B = \left|\frac{\partial g(.)}{\partial f(.)}\frac{\partial f(.)}{\partial in_t}\right|_B < 1,$ and $iq_{t=0} > iq_A.$

advanced economies historically went through. Following Furtado (1964), underdevelopment may well emerge as an autonomous self-feeding process instead of being the initial stage of an unavoidable move towards a fully developed innovative and more equalitarian economy. Figures 2.b and 2.c display some alternative far less virtuous scenarios (than that portrayed in Figure 2.a).

First, in Figure 2.b economic actors are insensitive to the opportunities created by the original *low* income and wealth concentration. Economic resources remain idle, productive investments low, and innovative efforts are absent. The lack of innovation eventually impedes the transition toward a highly dynamic and innovative economy, whilst it makes underdevelopment an enduring condition (see point A in Figure 2.b).

Figure 2.c shows what we have labelled a perverse Latin American inequality-innovation pattern. Here, is the *high* level of initial inequality and the connected perverse functioning of local socio-economic institutions that impede any strongly innovative and more egalitarian economy to develop. The historical uneven distribution of economic resources and social opportunities characterizing Latin America eventually turns out as the most relevant obstacle to innovation and progress.

[Figure 2.b]

[Figure 2.c]

3. Inequality, innovation and public investment in the US: An alternative story to the mainstream

In the top-right part of Figure 1, the USA stands out as an outlier with respect to other advanced economies. On the one hand, they still perform well in terms of innovation. On the other hand,

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inequality in the USA has increased hugely since mid 1970s, and it is now much higher than that registered in other developed countries.

Acemoglu et al. (2012) interpret the current US inequality-innovation profile according to the well-know risk-incentive argument. Higher inequality is the price to pay in order to create an innovation-prone economic environment, since that larger income differentiation and increasing (relative) rewards reaped by innovators are the most powerful incentives to radical innovation. In this paper, we criticize such an interpretation of the current US inequality-innovation pattern both on a theoretical and empirical level.

As to the theory, the heterodox evolutionary/institutionalist literature severely criticizes the mainstream approach to innovation that characterizes the analysis put forward by Acemoglu et al. (2012). First, innovation manifests itself as a fundamentally *uncertain* event, on which it is often impossible to build up any reliable probability distribution. Such a radical uncertainty implies that relative prices and unknown rewards can hardly guide strategic decisions of innovative firms. Second, innovation is a *collective* phenomenon that *cumulates* on the existing stock of knowledge (Cimoli et al., 2009). Innovation derives from the interaction between different stakeholders inside a given firm; from the interaction among firms in complex production networks; from the interaction between firms and public institutions such as universities and other public R&D agencies. Within this framework, we cannot stimulate innovation by simply adopting a more cutthroat remuneration system. Innovation depends on a much wider range of institutions, first and foremost those public institutions performing and/or financing breakthrough innovations that are too costly and uncertain to attract the interest of private actors.

From an empirical point of view, Acemoglu et al. (2012) take the time evolution of patent counts (per million inhabitants) in a few industrialized countries in order to empirically back the supposed USA leadership in radical innovations with respect to other more equalitarian

economies. Their choice, however, is debatable. First, more patents do not necessarily mean more path-breaking innovations. Indeed, the relevant increase in US patents Acemoglu et al. (2012) observe may simply result from the spread of strategic behaviours aiming to protect firms' knowledge from imitators, to create new rent opportunities, and to improve public perception of the innovative character of a given firm. Indeed, several analyses stress that the observed run to patent offices does not correspond to more innovation but may rather obstacle it, and that an increasing part of patented innovations by private corporations have negligible implications on the real economy, (Mazzoleni and Nelson, 1998; Mazzucato, 2013). Secondly, the allegedly positive relationship between rising inequality and increasing patents/innovation capacities may be the result of a *spurious* regression. These two phenomena appear as strictly related, but they are actually coincidental outcomes of changes affecting *omitted* institutional third variables.

In this paper, we underpin such an alternative heterodox evolutionary/institutionalist perspective, which on the one hand connects the observed rise in inequality to the increasing financialization of the US economy, and on the other hand explains US innovation capabilities by taking into account the role of the so-called "entrepreneurial State".

Cypher (2003) well describes the process of financialization of the US economy by reporting the long list of financial innovations that, in the last three decades, have aimed at creating new (and riskier) credit opportunities, as well as at inflating stock prices on financial markets. Zalewski and Whalen (2010) show that the IMF financialization index reaches in the US the highest level worldwide. This reflects the extraordinary relevance of financial institutions such as investment banks, and the centrality of financial motives in guiding investment decisions of US corporations.

Both heterodox institutionalist contributions (Zalewki and Whalen, 2010; Lazonick, 2013; Galbraith, 2012) and some more mainstream works (Piketty, 2014) see increasing inequality in the

US as a direct consequence of the financialization of the economy. The rise in top executives' rewards due to the realization of astonishing capital gains explains a great deal of deeper income inequality in the US. This fact, in turn, has been favoured by the extensive deregulation of stock options and share buybacks, which has permitted top managers to speculate on financial markets and to manipulate equity prices for their own benefits.

Besides this, the financialization of the US economy has led to the re-emergence of an economic environment that closely resembles that described by Veblen at the beginning of the previous century. Taking inspiration from Cypher (2003, p. 79) in his description of Veblen's perspective on finance-driven economic organizations, the US currently works as an economy in which "the focal point had shifted: [the] traffic in vendible capital [as opposed to created and traded 'vendible products'] is the pivotal and dominant factor in the modern situation of business and industry". Following Lazonick (2009), financialization and the diffusion of the "shareholder value-orientation" ideology have induced the US business sector to move from an "old business model (OBM)" to a "new business" one (NBM).

Under OBM, a central pillar of corporations' management was the reinvestment of retained profits in R&D activities and in the accumulation of physical capital and technological knowledge. The main goal was the *creation* of value through in-house innovation taking the form of new higher-quality products and/or more efficient production processes. The results of innovation were distributed among firms' stakeholders. On the one side, firms' shareholders got dividends. On the other side, workers benefitted from higher real wages, stable employment, and career opportunities.

In the "new business model (NBM)", the search for capital gains on financial markets through large stock buybacks, and the distribution of sizeable dividends to shareholders have become the new mantra of top executives (Lazonick and Mazzucato, 2013).

An expanding body of literature empirically demonstrates that, under NBM, corporations' resources diverted towards financial markets may have crowded-out R&D activities and productive investments (Stockhammer, 2004; Orhangazi, 2008; van Treek, 2008; Milberg and Shapiro, 2013). Pollin (1996, p.55) emphasizes that "borrowed funds are used disproportionately to finance speculative and compensatory spending […rather than] to finance productive spending", this fact exacerbating the instability and fragility of the US economy. This is also what emerges from Figures 3 – 8.[11] Following Milberg and Shapiro (2013), Figure 3 shows the increasing interest of nonfinancial corporations in the accumulation of financial assets rather than productive ones. In Figure 4, we plot nonfinancial corporations' R&D expenditures over internal funds against the total amount of dividends paid and share buybacks. On the one hand, dividends paid and share buybacks skyrocketed in the years preceding the worldwide financial crisis and quickly recovered in the aftermath. On the other hand, R&D expenditures decreased, although not monotonically, since the peak reached at the end of the dot.com bubble. Since the beginning of 2000s, an overall *negative* correlation equal to – 0,11 links productive investments in R&D to finance-oriented uses of internal funds.

[Figure 3]

[Figure 4]

Beyond this, Arore et al. (2015) stress that the US private business sector has significantly changed how it allocates R&D expenditures between basic and applied research, and development. On the one hand, financialization-induced overemphasis on short-run profitability, together with globalization and heavier competition from emerging economies, China in particular, seem to have

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[11] In Figures 3-8, data on financial variables (i.e. dividends, share buybacks and nonfinancial corporations' profits and internal funds) are taken from Federal Reserve Bank of Saint Louis' flow of funds. Data on R&D expenditures are taken from US National Science Foundation.

led US corporations' to focus on development and patenting. On the other hand, US corporations have considerably downsized basic and applied research, which is by definition far less remunerative in the short run. Figure 5 displays such diverging trends. Figure 6 also shows that, when US business total R&D expenditures (over profits) have increased in the last thirty years, during the run up to the "dot.com" crisis for instance, such increases mainly consisted in more development activities. No significant changes (or far less remarkable increases) took place as far as basic and applied research is concerned.

[Figure 5]

[Figure 6]

Following Arora et al. (2015) and Singer (2014), these trends are of concern for the long-run evolution of the US economy. Basic and applied research provides economic actors with the technological knowledge on which product and process innovations eventually hinge on. Accordingly, the progressive disengagement of US firms from such activities may seriously endanger the US technological leadership and future productivity dynamics.

In such a possibly gloomy scenario, it is worth wondering if US institutions may counteract such worrisome trends. Indeed, the institutionalist literature on the technological spill-overs of US government military expenditures, as well as on the "entrepreneurial State", vigorously stresses how US public institutions played a crucial role in funding, nurturing and breeding innovation in the past. In the 1950s and in 1960s, US governmental agencies invested huge amount of resources to support and develop a widespread network of universities, research institutes, labs, firms and industrial consortia engaged in "beyond-the-horizon" research. Such efforts created the technological basis that has subsequently allowed for the introduction of myriads of innovations in the computer, software, information and communication, and biotech industry in the 1980s and

1990s. Most of the radical innovations in the those sectors would have never come to light without the initial big push provided by US public authorities. Although hidden under the rubric of defence expenditures and behind the rhetoric of market fundamentalism, a "Developmental Network State (Block, 2008)" has been effective and operative in the US as much as (or even more than) it was in many other developed economies (Lazonick, 2013; Mazzucato, 2013).

In line with the neoliberal ideology, public authorities' financing of R&D activities has decreased considerably since the end of the 1960s on. Whilst it amounted to 1,6 percent of US GDP in 1970, it was equal to 0,7 percent in 2014. No doubt, this trend is worrisome (Singer, 2014). Yet, some other facts may provide a more optimistic picture, and suggest that US public institutions can still play a role in feeding US technological improvements. Figure 7 shows that Federal financial obligations to support R&D activities have increasingly focused on basic and applied research, whilst much less emphasis has been given to development. In 2011, federal investments in basic research were more than 2 times higher than the corresponding figure for the private business sector (whilst they were equal to the 87 percent only in 1953), and represented almost the 70 percent of overall US expenditures in basic research. This fact may at least partially offset the opposite trends observed in the case of the US business sector. [12] Figure 8 shows the evolution through time of federal funds devoted to the Small Business Research Investment (SBIR) Program. In 2014, SBIR program still amounted to 2,2 billion dollars only, i.e. 0,02 percent of US GDP. Yet, in 2014 SBIR funds over GDP were more than twelve times higher than they were in 1983. Even further, the number of supported firms has increased seven fold. These trends are all the more important since that basic and applied research seems to have been increasingly

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[12] Following Block and Keller (2012) and Fontana *et al*. (2012), since 1970s records from annual awards acknowledged by R&D Magazine to the best 100 annual innovations show a remarkable increase in the share of prizes recognized to governmental organizations, spin-offs emanating from universities' research centres, as well as collaborations including public institutions.

outsourced by large corporations to small and medium firms and start-up, which in turn need initial public support to develop their research programs.

[Figure 7]

[Figure 8]

In terms of our simple theoretical framework, the financialization of the US economy entails multiple consequences on the prevailing inequality-innovation pattern, since that it directly affects inequality, as well as the allocation of corporations' resources between unproductive financial purposes and productive investments. We portray such possible consequences in Figure 9.

[Figure 9]

First, in a highly financialized US economy, equation (1) may shift upwards. For any given level of innovation, the level of inequality inside the economy will be higher due to the current institutional setting and economic philosophy favouring an uneven distribution of economic resources, and of the output of innovative efforts, through financial market mechanisms.

Second, financialization practices may radically reshape equation (2), i.e. the incentivizing or dis-incentivizing effects inequality may exert on innovation. In the virtuous scenario portrayed in Figure 2.a, we assumed a positive nexus connecting inequality to innovation. However, the arguments presented in this section suggest that the financialization of the US economy, and the ensuing exacerbating inequalities, may have a negative impact on innovation. First, the diffusion of financial practices diverting corporations' resources away from R&D activities towards financial operations likely jeopardizes corporations' ability to introduce new products with higher quality standards and at lower costs. Second, the polarization of economic resources and, consequently, of education, training and professional opportunities (see Piketty, 2014) can

[21]

obstacles the wide diffusion of technological competencies that are a prerequisite for the absorption and spread of innovations. In Figure 9, a throughout negative and leftward-displaced inequality-to-innovation nexus may emerge in the US (see the dashed *grey* downward-sloping line). This nexus closely resembles the perverse inequality-to-innovation relation that characterizes the highly unequal Latin American countries.[13]

The final effect of these changes on the innovation performance of the US economy is possibly harsh. In Figure 9, the US economy might eventually move from the virtuous "old-business-model" development path (point E_{OBM}) to a far less favourable "*future* new business model" (point E_{FNBM}). In point E_{FNBM}, higher inequality does not contribute to better innovation performances. On the contrary, the US innovation capacity is significantly lower.

The engagement of US public authorities in R&D activities might certainly mitigate and compensate such an undesirable outcome of the prevailing US business model. Indeed, the increasing US public authorities' focus on basic and applied research, as well as more emphasis on the support of small innovative firms, may induce public involvement in innovation activities to perform the pro-active role it has historically played, and help the USA to *maintain* high US innovation performances even in presence of myopic strategies from the side of private businesses. In Figure 9, the positive effects of past and present public-funded R&D efforts on domestic innovation capabilities are mirrored by the position of equation (2). Although private sector forces might tend to shift it to the left, public innovation policies may contribute to preserve its rightward position (see the dashed *black* downward-sloping curve). Accordingly, the US economy might eventually follow a sort of "intermediate" development trajectory leading to point E_{NBM}.

What is most, contrary to the market-friendly perspective embraced by Acemoglu at al. (2012), Figure 9 portrays an economic scenario in which US innovation performances are not the

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[13] Following Palma (2011, p. 125), "with neo-liberal globalization, there is some distributional 'Latin-contagion' going on. It is fairly clear Latin America is now exporting some crucial features of its political settlement and distributional outcome in the US".

result of free market forces and of a cutthroat remuneration system stimulating innovation. Current free market forces, as governed by the financialization of the US business sector, would rather jeopardize US innovation and, at the same time, increase inequality. It is the public support to innovation that may still play a fundamental role in order to contrast a private sector-driven decline in US innovation capacities. Following Singer (2014), should the neoliberal project of further downsizing public engagement in R&D activities be successful, such a decline might turn out to be inexorable.

4. Conclusions

The empirical literature on the relation between inequality and innovation is largely inconclusive. A brief cross-country analysis of inequality-innovation interactions reveals that a well-established universal pattern does not exist. The way inequality and innovation feedback among each other is likely country and context-specific.

The very simple theoretical framework we present in this paper aims at describing at least part of such a huge heterogeneity in the inequality-innovation patterns characterizing different sets of countries. It also provides a different interpretation of the current US inequality-innovation pattern with respect to the well-known "(rising) inequality-feeds-(more) innovation" paradigm. Private business sector's investments in the US are increasingly governed by financial purposes. The financialization of the US economy may both lead to higher inequality and, in the future, lower innovation. In the last decades, US public investments in R&D have partially compensated for the increasing disengagement of private corporations from basic and applied research. Public support to R&D may thus continue to play a decisive role to feed US innovation capabilities, like it did in the past. Accordingly, the neoliberal agenda aiming at squeezing any public participation

to economic activities, R&D activities as well, represents a serious threat to the US technological leadership.

Our analysis has relevant methodological implications. First, due to the pre-eminence local institutional factors have in shaping the mutual evolution of inequality and innovation, future analyses should adopt a context-specific perspective, and depart from searching for universal inequality-innovation rules. Case studies may help to grasp those specific factors that contribute to explain why some countries have been capable to ignite a virtuous development process leading to a highly innovative more egalitarian economy, while others have not. Second, private sectors' innovation has been often the long-run indirect result of public investment in R&D activities undertaken several years, often decades, before. Public investment in innovative/path-breaking technologies takes a long time to payoff. If so, econometric analyses that try to ascertain how public R&D investments affect the innovative capabilities of the private sector may fail to provide a correct picture of the development of national innovation systems and of national innovation capacities. Econometric analysis, although important, must be integrated into a wider historical and anecdotal study of specific country-contextualized inequality-innovation patterns.

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Appendix A

Table A.1 – List of 67 countries reported in Figure 1 (with corresponding code when explicit).

Country	Code	Country	Code
Angola	-	Mali	Mali
Argentina	Arg	Mexico	Mex
Australia	-	Morocco	Mor
Austria	-	Mozambique	Moz
Bangladesh	-	Nepal	-
Belgium	Bel	Netherlands	Neth
Bolivia	Bol	New Zealand	-
Brazil	Bra	Niger	Nig
Burundi	-	Nigeria	-
Cambodia	Cam	Norway	Nor
Canada	-	Pakistan	Pak
Chile	Chi	Paraguay	Par
China	China	Peru	Per
Colombia	Col	Philippines	-
Czech Republic	Czr	Poland	Pol
Denmark	Den	Romania	Rom
Egypt	Egy	Russian Federation	-
Ethiopia	Eth	Slovakia	Slk
Finland	Fin	Slovenia	Slo
France	Fr	South Africa	SA
Germany	Ger	South Korea	S.Kor
Greece	Gre	Spain	Sp
Guinea	Gui	Switzerland	Swz
Hungary	Hun	Sweden	Swe
Iceland	Ice	Thailand	-
India	Ind	Tunisia	-
Indonesia	Indo	Turkey	Turk
Ireland	-	Ukraine	Uck
Israel	Is	United Kingdom	UK
Italy	-	United States of America	USA
Japan	Jap	Uruguay	Urg
Jordan	Jor	Venezuela, Bolivarian Rep.	Ven
Kenya	Ken	Viet Nam	Viet
Malaysia	Mal		

Figures

Figure 1 – Current inequality (Gini Index) and innovation performance in 67 countries
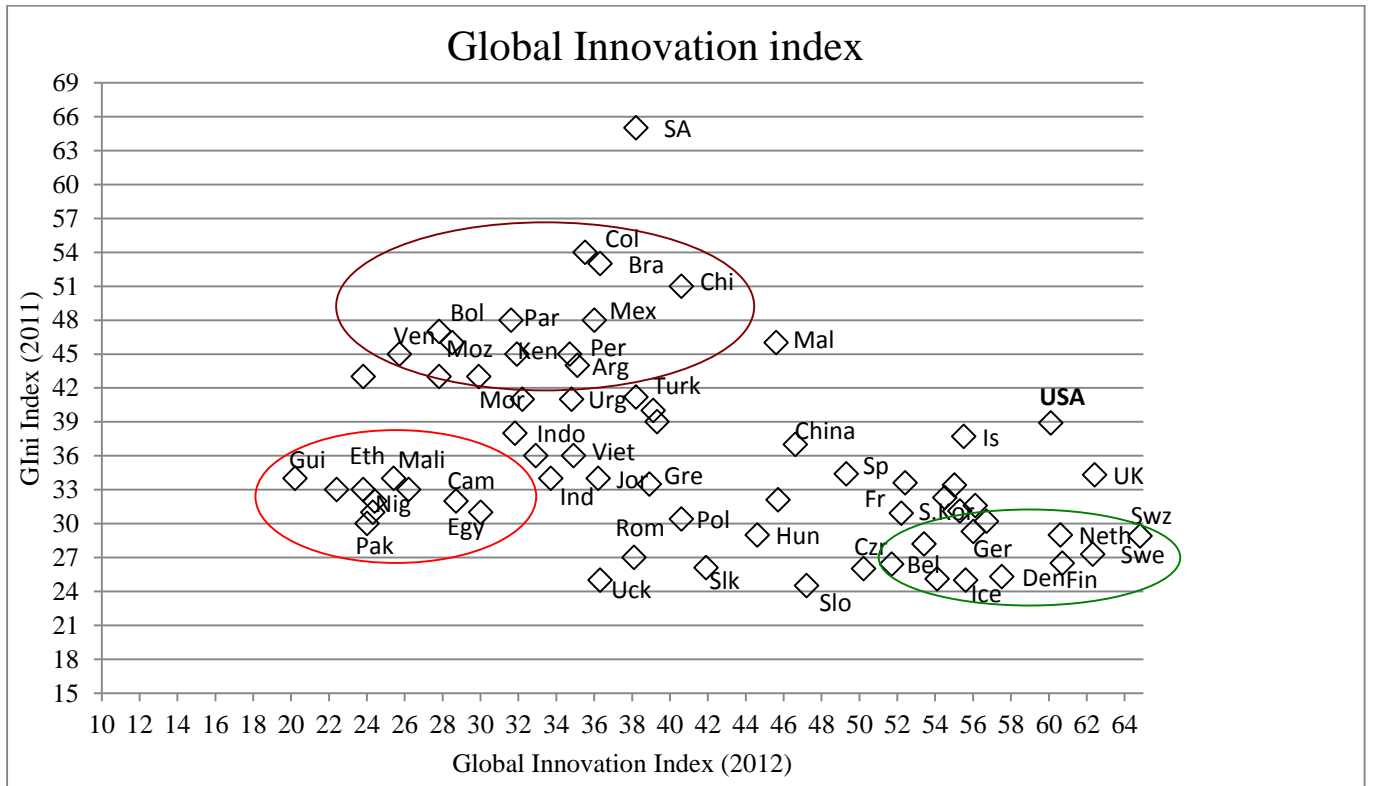
Source: Data on inequality from World Bank World Development Indicators dataset (2014) and OECD poverty and inequality indicators dataset. Data on GII from the 2012 Global Innovation Index Report.

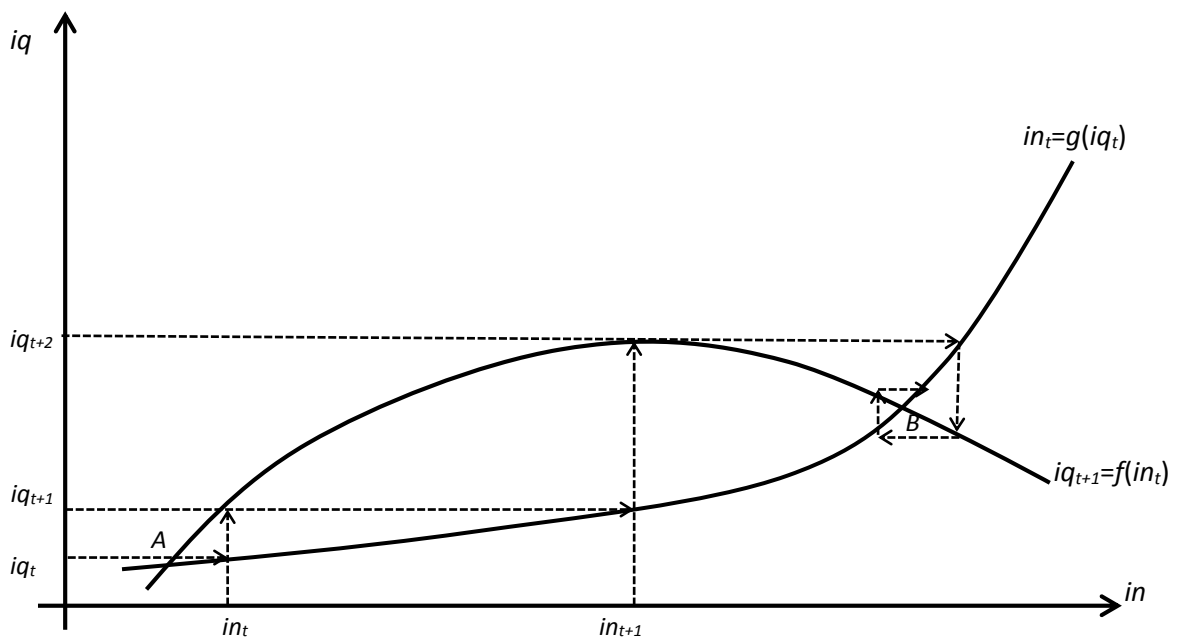Figure 2.a – Virtuous dynamics in the inequality-innovation space

[28]

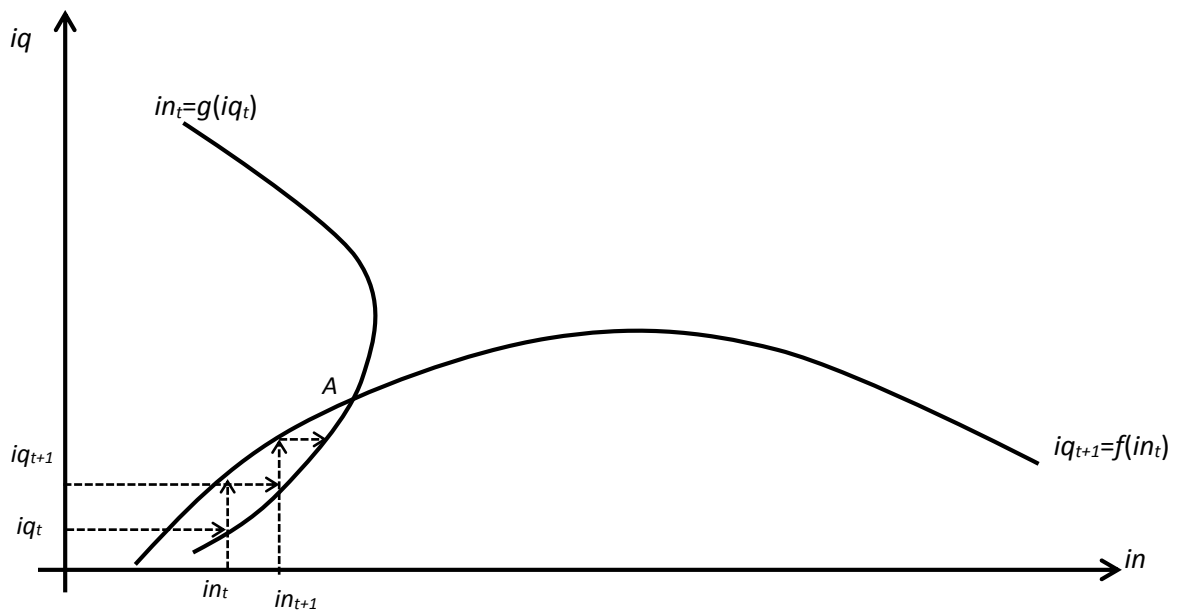Figure 2.b – A (relatively) low inequality-low innovation trap

Figure 2.c – A Latin American-type high inequality-low innovation trap
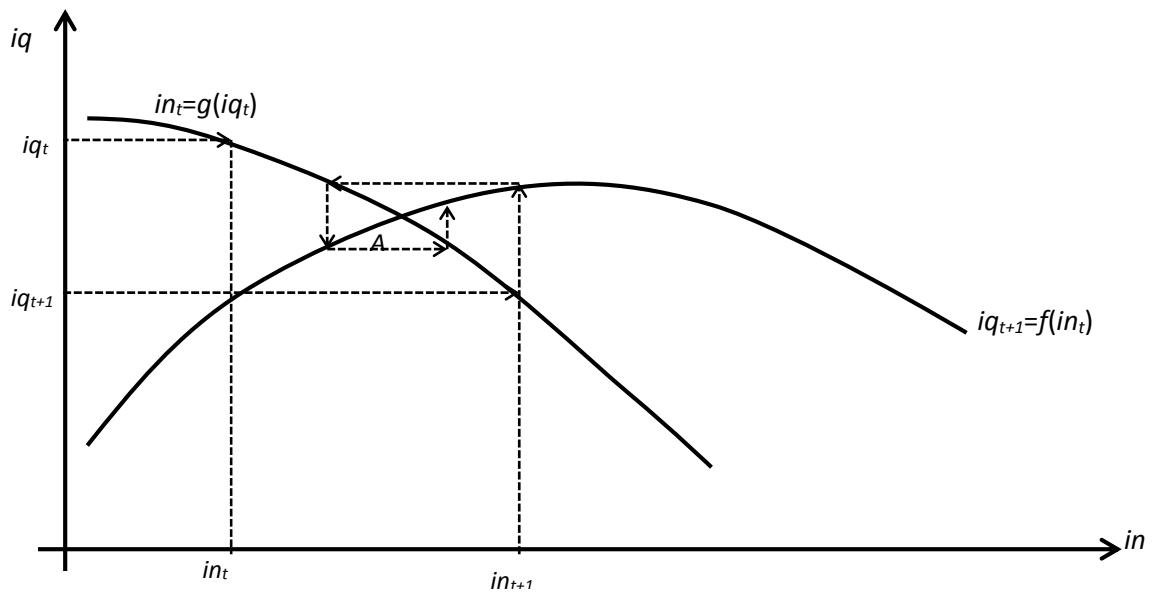
Figure 3 – Nonfinancial US corporations' financial assets over total assets, 1946 - 2014
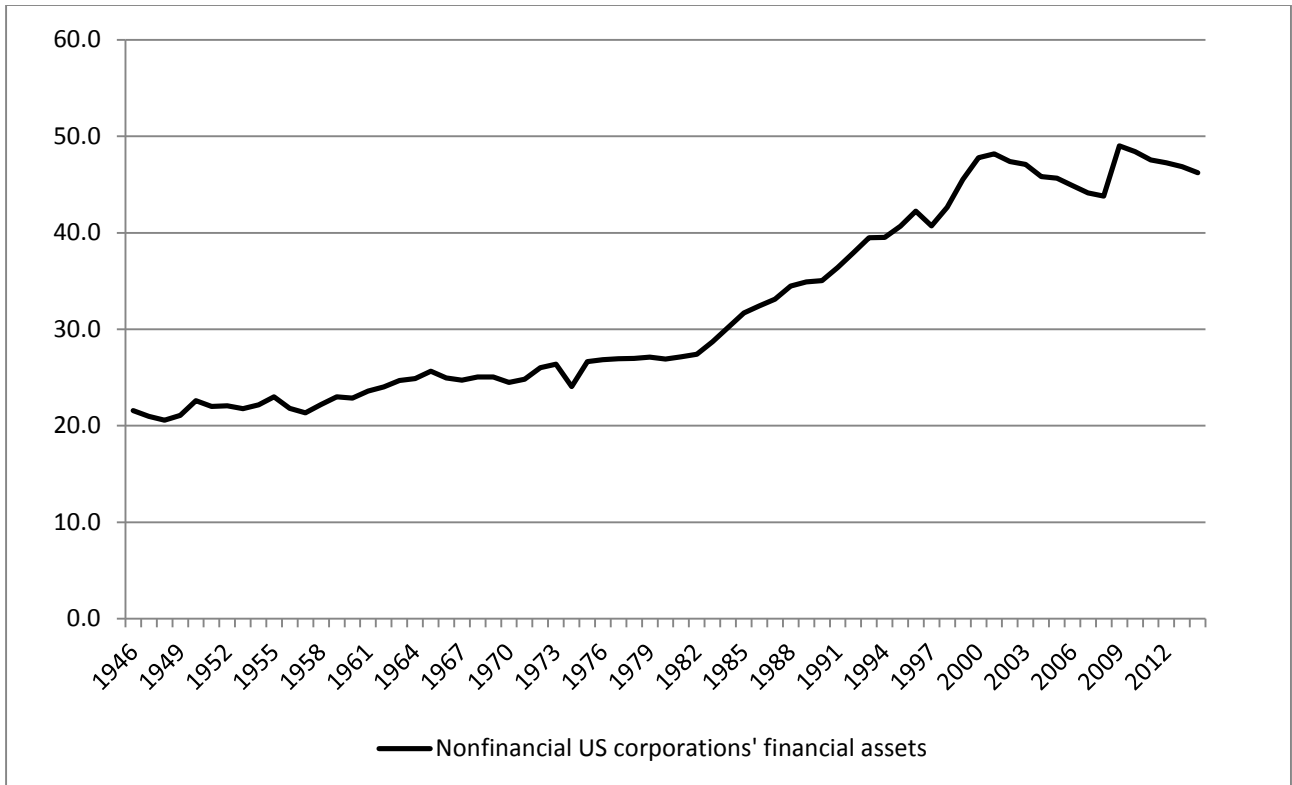
Source: Author's own computation

Figure 4 – Total nonfinancial corporations R&D expenditures, and dividends paid and share buybacks (as a share of internal funds), the US economy, 1946 – 2014.
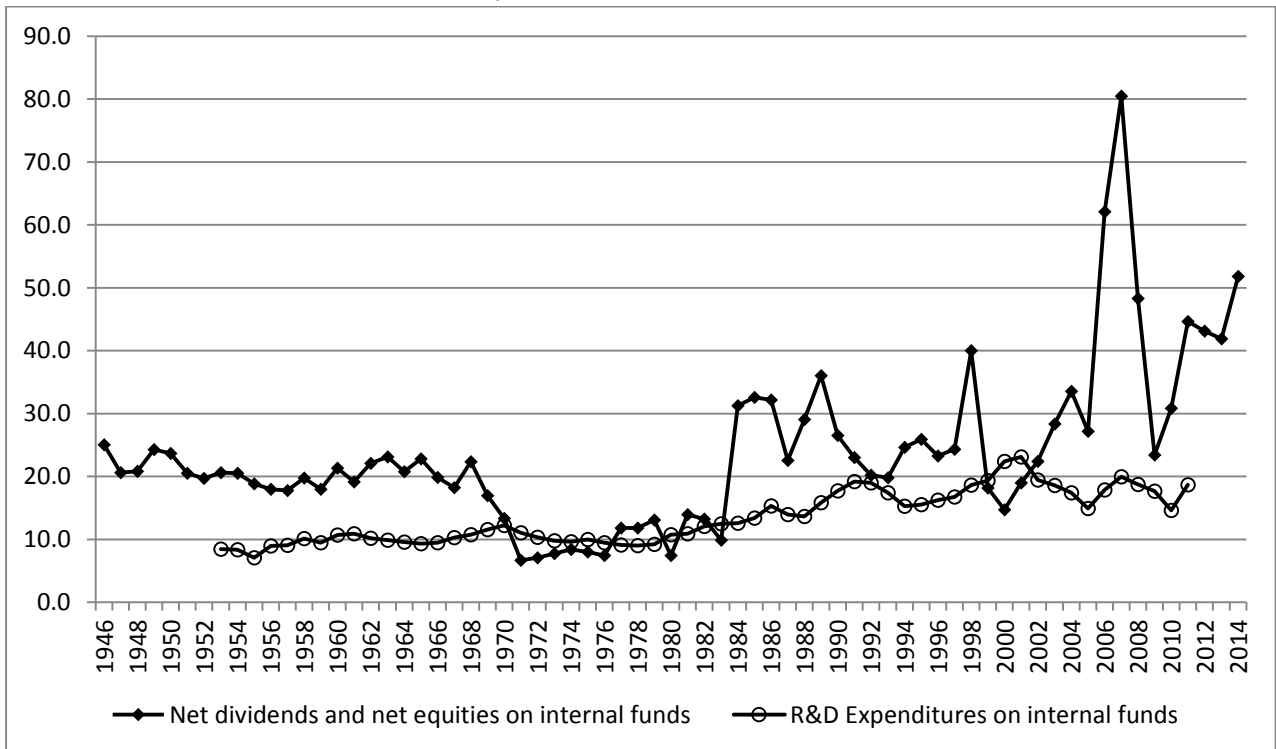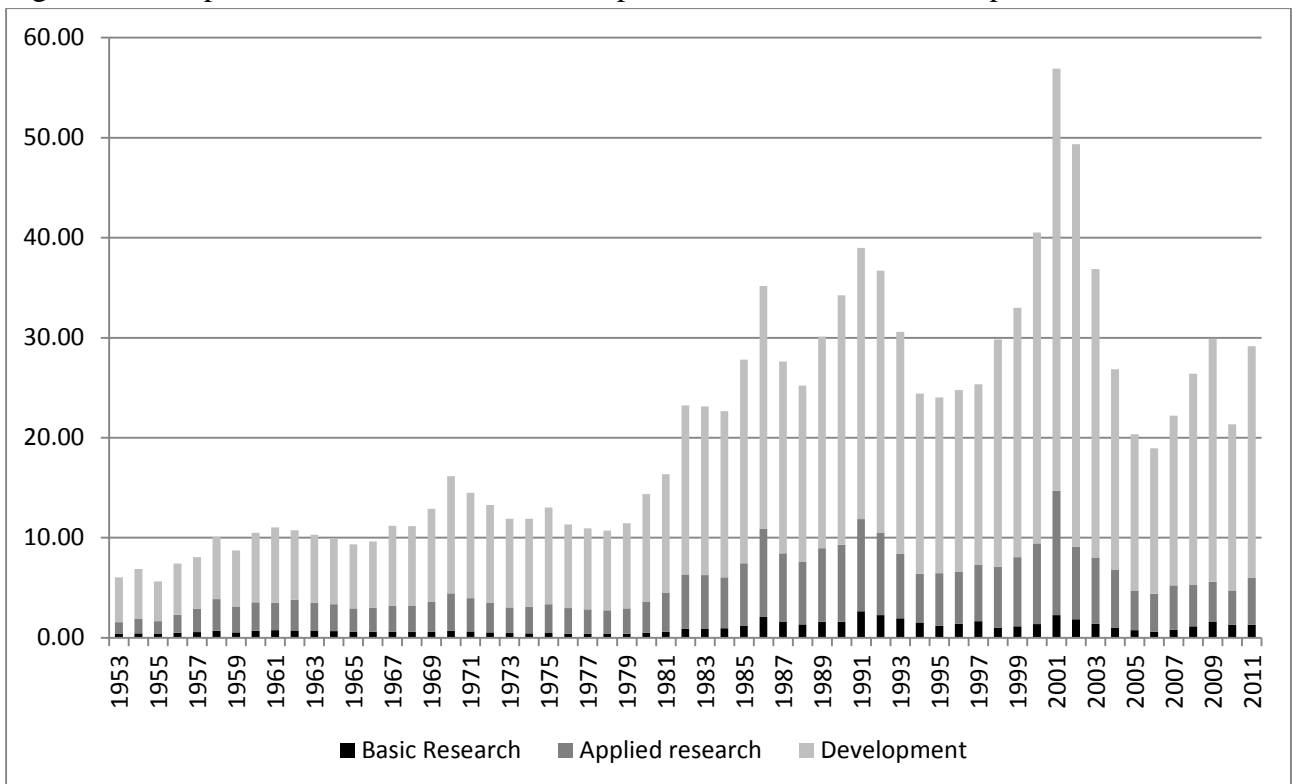

Source: Author's own computation.

Figure 5 – US business expenditures on basic research (BR), applied research (AR) and development (D) as a share of total business R&D expenditures, 1953 – 2011.
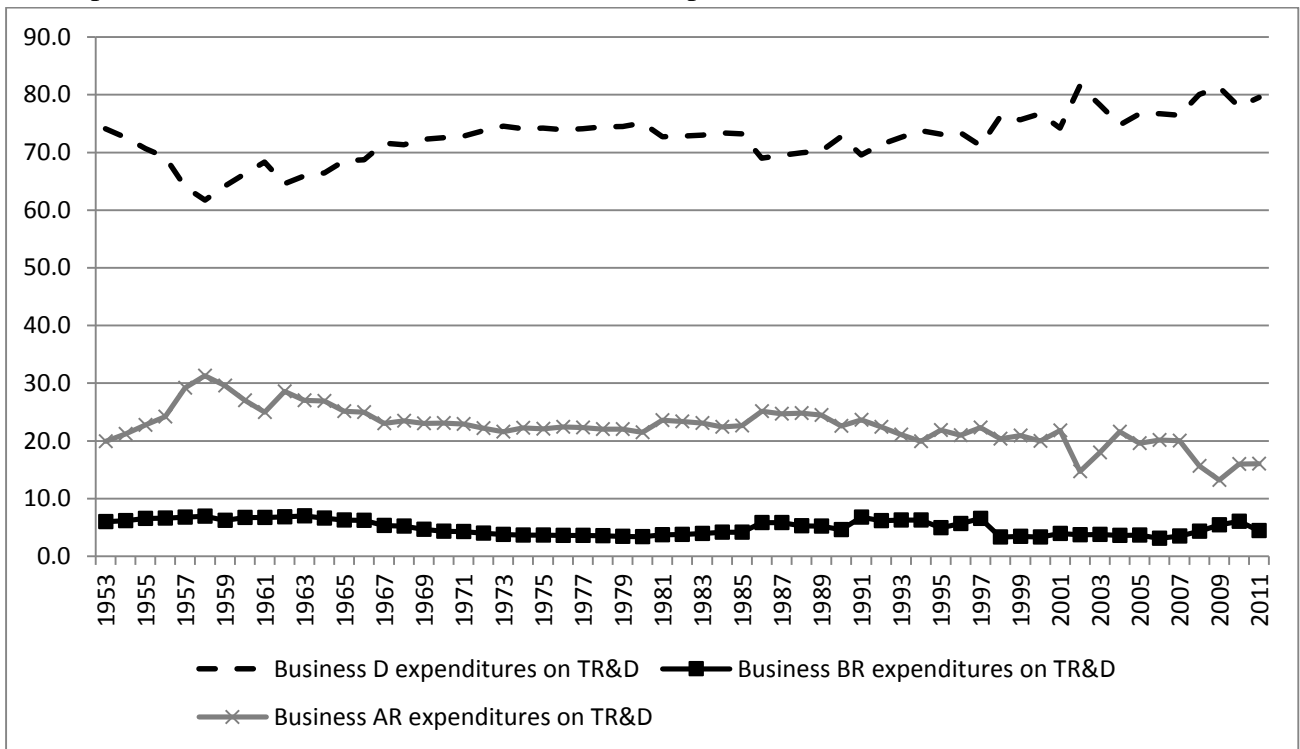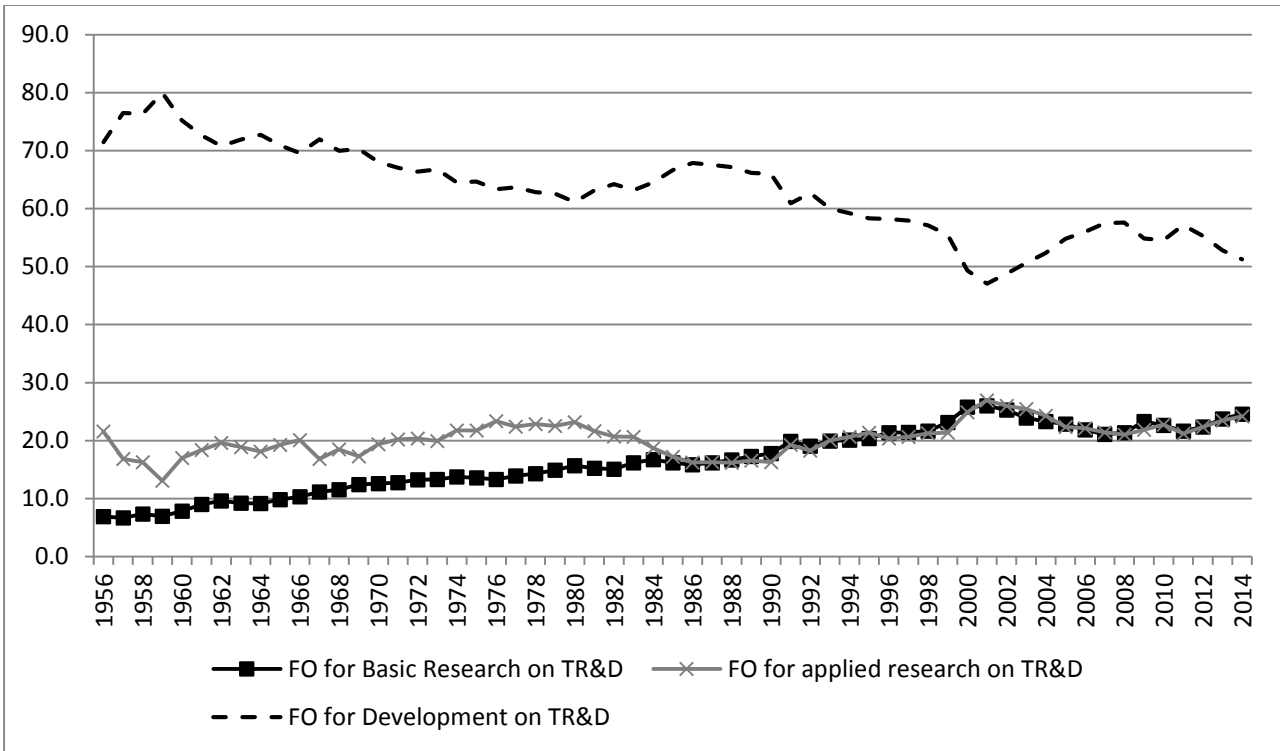

Source: Author's own computation.

Figure 6 – Composition of US business R&D expenditures over US Business profits, 1953 – 2011.
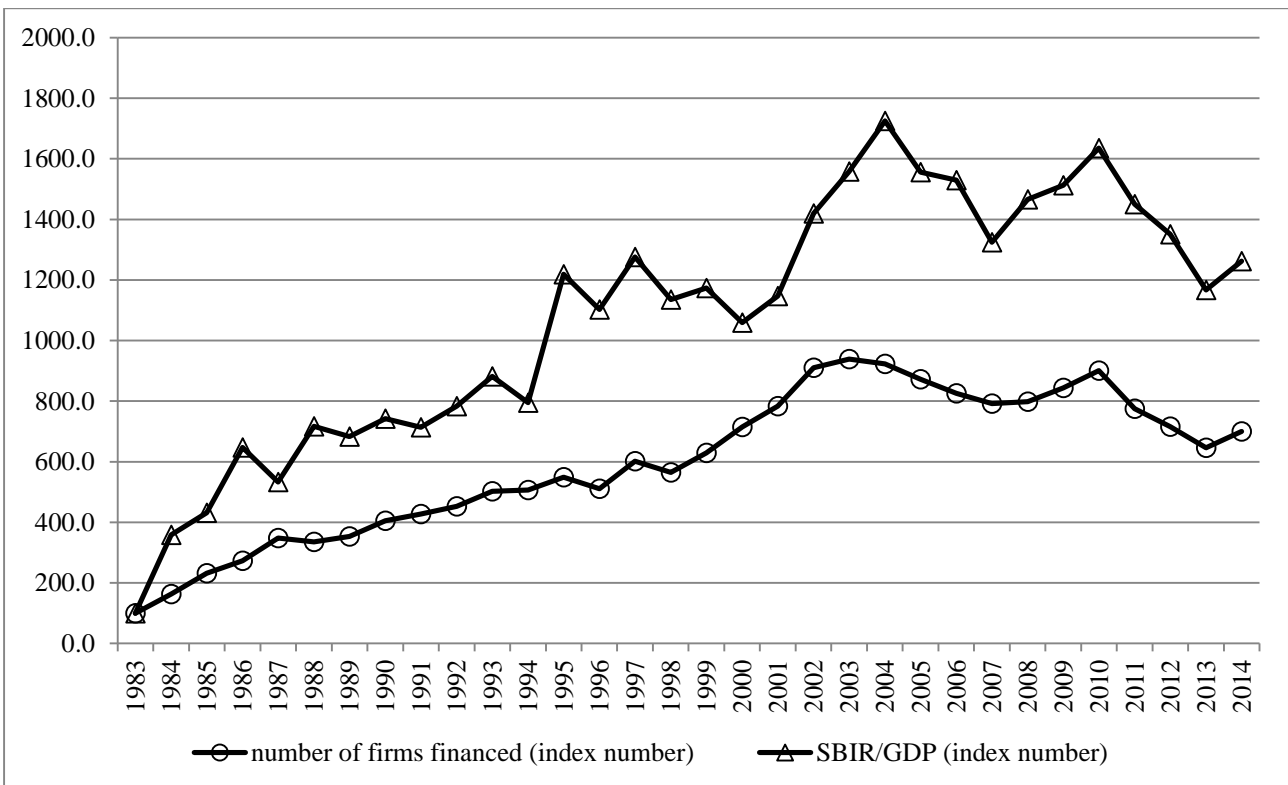

Source: Author's computation.

Figure 7 – Composition of Federal financial obligations in support of R&D activities, 1956 – 2014.

Figure 8 – Small Business Investment Research (SBIR) Program's funds (over GDP) and number of firms financed, index numbers, 1983 – 2014.

Figure 9 – Possible effects of financialization on inequality and innovation in the US