



Innovation and Finance: a Stock Flow Consistent Analysis of Great Surges of Development

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Authors: Andreosso-O'Callaghan, B., Lenihan, H. and McDonagh, T.

SYNOPSIS

We analyse the process of development triggered by the emergence of a new and innovative productive sector into the economic system by using a Post Keynesian Stock Flow Consistent (PK-SFC) model.

The model depicts a multi-sectorial economy composed of consumption and capital goods industries, a banking sector and two households sectors: capitalists and wage earners. It provides an explicit representation of the stock market.

In line with the Schumpeterian tradition, our work highlights the cyclical nature of the development process and stresses the relevance of the finance-innovation nexus, analyzing the feed-back effects between the real and financial sides of the economic system.

In this way, we aim at setting the basis of a comprehensive and coherent framework to study the relationship between technological change, demand and finance along the structural change process triggered by technological innovation.

Introduction and Background

Almost a century ago, Joseph Schumpeter (1912, 1939) argued that boom and bust cycles, inherent to the rise of innovation, are an unavoidable consequence of the way in which a capitalistic economy evolves and assimilates successive technological revolutions. In most macroeconomic models, technological change is treated as an exogenous stochastic shock that simply affects some coefficient of the aggregate production function. Put simply, innovation comes from somewhere else, outside of modern macroeconomic models, ignoring Schumpeter's insights. We would like to change this.

There are several fields of research that contributes to the background literature which informs our work. A first source of inspiration is represented by the literature on technological revolutions (Perez, 2002), technological paradigms (Dosi, 1982), and techno-economic paradigms (Freeman and Perez, 1988). The common thread between these concepts drawn from different disciplines is the idea that the diffusion of new technologies induces a profound change in the productive, organizational, and institutional structure of the whole economy, triggering a process of structural change. In turn, this usually exerts significant effects on investment behaviors, labor market, wealth and income distribution, thus effecting the reproduction conditions and the stability of an economic system.

Our work obviously owes much to the rich evolutionary modeling literature focusing on innovation and finance. However, evolutionary models have mainly focused on the supply side of the economy and have begun to include demand and distributive issues only recently. The Post-Keynesian school of thought has, on the other hand, often concentrated on demand

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A full copy of the paper can be obtained from the authors at:

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(or rather lack thereof) and distributive issues. Sadly only a handful of Post Keynesian authors have tried to embed innovation in their models as an endogenous factor. In particular, the impact of radical technological breakthroughs, capable of changing the entire structure of an economy as described by Schumpeter and his followers, has been almost neglected.

Issues and Questions Considered

The paper focuses on the introduction of a bundle of new, more productive investment goods, that is, of a new kind of capital good. The literature on 'Great Surges of Development' (Perez, 2009, 2010) has highlighted the centrality of the nexus between finance and innovation, focusing on the role played by financial capital during the successive stages of a techno-economic paradigm, and suggesting that financial instability may arise as a consequence of innovation dynamics.

Contextually, we provide an analysis of financial markets both from the point of view of firms, looking for funding, and from the point of view of investors, seeking remunerative opportunities-, which may help to identify the potential sources of financial instability, in particular during periods of radical technological change.

The financial side of our model is largely inspired by the results obtained by the ever growing empirical literature analyzing the relationship between finance and investment. The common thread of these works has to be found in the observation that firms' financial structure is likely to affect their investment policies.

Solid arguments have been provided in favor of a pecking order theory of finance (Myers, 1984). In the presence of imperfections in capital markets, the cost of external finance (like equity and loans) is usually high. This higher costs affect in particular young and innovative firms investing in R&D, due to the lack of collateral and the unavoidable difficulties in evaluating ex-ante their future profitability potential (Hubbard, 1998). So, firms rely first of all on their retained earnings to finance investment, and resort to external financing only after they have exhausted their internal resources.

While we assume that firms use internal funds as preferred source of finance, we adopt a more agnostic attitude in the definition of firms' preferences over the two sources of external finance: equities emissions and bank credit. Their shares over total external finance are then endogenously determined as a function of the rate of interest applied by banks on loans, which roughly captures the cost of credit, and past capital gains, which proxies the dependence of equity finance on stock prices dynamics in line with the observations of Brown and Petersen (2009).

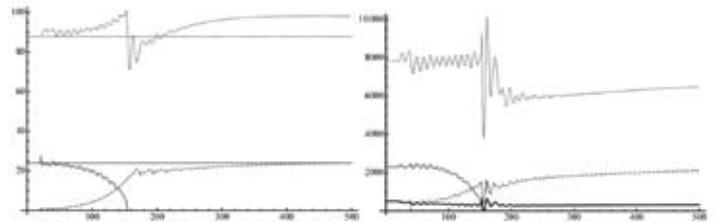
Methodology

The PK-SFC approach is based on the seminal works of Wynne Godley and James Tobin. SFC models are consistent in that every monetary flow, in accordance with the double-entry book keeping logic, is recorded as a payment for one sector and a receipt for another sector, and every financial stock is recorded as an asset for a sector and a liability for another sector. Flows and stocks are recorded in matrices where the different sectors composing the economy are represented in their columns, while the rows show the different types of flows/stocks for each period. For consistency

to hold, the sums of flows and stocks along each column and each row of the matrices must be nil.

Outcomes and Findings

Our results show that the process of Schumpeterian competition between the two capital sectors is going hand in hand with the process of structural change of the economy. The complex interaction between the process of structural change taking place in the real economy and the evolution observed on financial markets is highlighted.



Left: Real output by sector: consumption sector (dotted), traditional (solid) and the innovative (dashed) capital sectors. Dashed lines are original levels.

Right: Market capitalization by sector: consumption sector (dotted), old (solid) and new (dashed) capital sectors, cash holdings (black).

The dynamics of the model is driven by two fundamental processes: (i) the replacement of the old capital by a new, more productive capital (left figure) and (ii) financial instability arising from the emergence of a new sector (right figure). The first process is rather slow as the innovative sector is slowly building its own productive capacity, while selling the remaining part of its output to the consumption good producers.

The second process is rather short. The wealth and income effects due to the introduction of new money are directly realized by both household sectors and this drives short demand cycles. Three shocks drive the financial dynamis: (i) the introduction of the new demand of labor and capital goods by the inovators, (ii) the entrance of innovative firms into the stock market, and (iii) the traditional sector bankruptcy, creating a massive loss to banks.

Financial volatility is transmitted to the real sector via two behaviors: the consumption decision by capitalists which is based on real wealth and disposable income and the investment function where Tobin's q impacts firms decision to increase or not their production capacity. In turn real economy affects financial dynamics via gross and distributed profits on one hand, and via changes in nominal wealth on the other.

Summary of our findings

Innovation is important in modern economies, and in this paper we show how a newly-introduced productive sector affects not only consumption and production but also finance, income distribution and labour markets. Innovation changes everything, and it does so within the model, exactly as Schumpeter suggested 102 years ago.

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