

What determines investment? A critical survey of post-Keynesian empirical studies

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Abstract

This paper surveys the post-Keynesian literature on investment functions to take stock of where we are in understanding investment behaviour. A special focus is laid on the critical assessment of empirical studies. It is found that empirical studies regularly fail to fulfil qualitative requirements regarding methodological clarity and the meaningfulness of insights, such that empirical evidence is often unreliable. According to the assessment pursued in this work, we can say with some certainty that demand dominates other determinants of investment, but realised profits, interest rates, and uncertainty also play a role. There is some indication that financialisation negatively affects investment in the US, in France, and the UK.

1. Introduction

„The search for a proper specification of a thing called ‘investment function’ is indeed reminiscent of the search for a will-o’-the-wisp.” (Kurz, 1991, p. 429)

While this observation is more than genuine, it has not kept economists, notably heterodox ones, from pursuing the search for investment functions, i.e., a functional relationship between investment on the one side and some determinants and parameters on the other side. Investment is not only an important component of GDP, but is also its most volatile one, and it is closely connected to business cycles. It must be seen as important driver of economic activity, which crucially determines employment and is accordingly essential for economic prosperity. It comes thus as no surprise that understanding the determinants of investment is a major goal for some economists.

In post-Keynesian economics, investment behaviour is considered to be a highly relevant research topic, which is indeed rich and insightful. It is commonly understood that the so-called *Say’s principle* does not hold, and that investment is determined independently of savings. The determinants of investment are understood to be largely autonomous, such that investment itself becomes an

important driver of economic dynamics. For example, in post-Keynesian models of growth and distribution, the specific form of the investment function determines the very outcome of the model. Therefore, understanding investment determinants is of major interest within post-Keynesian economics. While certainly the macroeconomic perspective is prevalent in post-Keynesian economics, investment also plays a crucial role in the microeconomic theory, where the firm's investment decision, and how it is influenced, constitutes a large part of the theoretical foundations.

While the theoretical discussions that surround investment are plentiful and interesting by themselves, we must remember that a primary ambition of economics is to understand and explain real-world economic mechanisms in order to implement useful policies for prosperity and the well-being of the population. For this ambition, substantiating theories with empirical evidence is highly common. Quantitative indication can provide a useful basis for the judgement of the validity and reliability of theories and enables economists and policymakers to promote or criticise economic policies. However, since empirical estimations are highly flexible on the one hand, and prone to limitations regarding explanatory power on the other hand, it is very difficult to obtain conclusive results by referring to empirical evidence. Indeed, the empirical work on investment functions is characterised by strong diversity, both in the hypotheses tested, and in the conclusions that are drawn. While there is no guaranteed way to overcome the difficulty that inconclusive results create, it is still desirable for economists and policymakers to form judgement as to which empirical evidence is reliable. For this, a scrutinising analysis based on the clarity of the tested hypotheses, the meaningfulness of insights, and the *economic significance* of the estimations is helpful.

This work aims to take stock of where we are in understanding investment behaviour, to survey the many arguments that are brought forward regarding investment functions, and to potentially provide a better foundation to answer the demanding question: what determines investment? The focus will be laid entirely on post-Keynesian literature, to make use of the comprehensive research that is done in this field.¹ Because empirical evidence plays a crucial role both for substantiating theoretical arguments and for policy advice, a critical assessment of post-Keynesian estimations of investment functions stands in the centre of analysis. Special attention will be given to the quality of these works in terms of methodological clarity and the economic relevance of their insights for understanding investment determinants. The survey will be structured as follows: The subsequent part will briefly introduce and summarise the relevant discussions about investment determinants in post-Keynesian theory, and the third part will summarise and assess a selection of post-Keynesian econometric works

¹ It must be noted that post-Keynesian theory, but especially post-Keynesian empiricism exhibits a strong bias towards advanced economies. Wilfully or not, this means that this survey must be seen as a very preliminary contribution to understanding investment behaviour, since large parts of the world are left out of the analysis.

according to qualitative criteria. The last section concludes and thereby indicates the possible answers that can be given to the question of investment determinants.

2. *Postkeynesian theory*

The very basis for a post-Keynesian theory of investment and accumulation is the assumption of an underutilised capital stock. In fact, this assumption is essential to many post-Keynesian theories², because it allows for the possibility that increases in demand will not automatically lead to price increases. For short-run considerations, this is the very basis of the Kaleckian model for output and employment (see Lavoie, 2014, pp. 291–315), which establishes the principle of effective demand. This principle is also extended to long-run considerations, where the accumulation of capital stock and thus investment plays a crucial role. Almost all variants of the post-Keynesian growth model are based on three equations: one for income distribution, one for saving, and one for investment. The earliest versions of the growth model come from Dutt (1984), Taylor (1983), and Rowthorn (1981), and are crucially influenced by Steindl (1976). The investment functions in these models contain the profit rate and capacity utilisation as explanatory variables. Steindl (1976, p. xiv) argues that when capacity utilisation is below the “desired” level (that is, an average planned level over booms and slumps), this acts as a deterrent to investment. The dominant investment function in these first models of growth and distribution may be formally expressed as

$$g^i = \gamma + \gamma_u u + \gamma_r r \quad (1)$$

where g^i denotes the rate of accumulation, u denotes capacity utilisation and r the rate of profits. γ_u , γ_r are positive parameters, and γ is a positive parameter representing autonomous investment that captures Keynes’ famous *animal spirits*.³ The essence of the resulting canonical Kaleckian growth model is that an exogenous redistribution towards wages increases consumption demand, which, thanks to a higher degree of capacity utilisation promotes investment and gives rise to a new steady state, which is characterised by a higher degree of capacity utilisation, a higher realised profit rate, and a higher rate of accumulation (Lavoie, 2014, pp. 164–367).

² The assumption of an under-utilised capital stock is especially relevant for more contemporary theories, based on the works of Kalecki, whereas post-Keynesians who are more loyal to Keynes himself (such as P. Davidson or V. Chick) assume a production function that retains properties of a neoclassical production function, which contains diminishing returns and implicitly, full utilisation of the capital stock (compare e.g. Lavoie, 2014, chapter 5). The “old” post-Keynesians (J. Robinson, N. Kaldor, L. Pasinetti), contrary to the Kaleckian strand, set their analysis normally in a competitive environment, where capacity utilisation is fixed at its normal level (Lavoie, 2014, p. 348).

³Lavoie (2014, pp. 361–367) shows that the same results are obtained with an investment function that only depends on capacity utilisation in the form:

$$g^i = \gamma + \gamma_u (u^e - u_n)$$

where u^e denotes expected capacity utilisation and u_n denotes normal or standard capacity utilisation.

This simple variant of the growth model was criticised by some authors, most famously by Bhaduri and Marglin (1990) and Kurz (1990), on the grounds that the investment function (1) above fails to account for the effect of income distribution properly. The problem is, they say, that “a given rate of profits will produce the same level of investment as results from high capacity utilisation and a low profit margin or from low capacity utilisation and a high profit margin.” (Bhaduri and Marglin, 1990, p. 380). Alternatively, they assert that “it is plausible to argue that a lower profit margin/share would weaken the incentive to invest” (Bhaduri and Marglin, 1990, p. 378). The rate of capacity utilisation dominates the investment function (1) above, since

$$r = \frac{\pi u}{v}$$

where π is the profit margin or profit share and v is the capital to full-capacity-output ratio.⁴ They argue that a correct investment function ought to contain the profit *share* as in equation (2):

$$g^i = \gamma + \gamma_u u + \gamma_r \pi \quad (2)$$

This criticism has important implications: The “rosy” result of higher real wages and higher profit rates at the same time (satisfying both workers and capitalists) that is obtained from the canonical Kaleckian model becomes only a possible, not a built-in inevitable scenario. The discussion among post-Keynesians regarding the right form of the investment function is thus a very serious one and it promoted an extensive amount of empirical work trying to find evidence for either the dominance of the effect of capacity utilisation or the effect of the profit share.

Capacity utilisation in the long run

Another long-lasting debate within post-Keynesian economics, concerns the adjustment process of capacity utilisation to its normal level in long-run analysis. In the Kaleckian model of growth and distribution, the rate of capacity utilisation is always endogenous, but some economists argue that a proper long-run model must provide a mechanism that ensures the return of capacity utilisation to its normal level (Auerbach and Skott, 1988; Committeri, 1986; Kurz, 1986).⁵ Some of the suggested models that provide such a mechanism are relevant for a theory of investment, because they rely on behavioural narratives for investment functions. A comprehensive summary can be found in Lavoie (2014, pp. 387–410).

Duménil and Lévy (1999) develop a macro model where investment, in the long-run, must also depend negatively on the interest rate. It is argued that inflation triggers a response by the monetary

⁴ This follows Weisskopf’s (1979) decomposition of the profit rate.

⁵ The implications of this criticism are substantial, because when capacity utilisation is not endogenous, but fixed at the normal level, the conflict between wages and profits, or workers and capitalists, cannot anymore be alleviated by changes in capacity utilisation.

authorities (i.e., raising the interest rate), which exerts negative influence on investment expenditures. As we will see in part 3 of this paper, the influence of the interest rate is regularly controlled for in empirical studies of investment functions, but rarely found to have overwhelming effects on investment. Similarly, Shaikh (2009) argues that entrepreneurs or managers correctly anticipate changes in demand and thereby bring back capacity utilisation to its normal level. Oversimplifying the argument, “rational expectations” are introduced into the investment function. This approach was criticised by Franke (2015) on the grounds that firms cannot be expected to have perfect foresight.

A third contribution to the topic comes from Skott (1989). The formalised idea is similar to the Duménil-Lévy-mechanism described above, but instead of monetary policy, it is the managers’ or entrepreneurs’ response to employment that brings about the change in investment behaviour. In other words, in the long run, investment depends negatively on the employment rate.

An approach that is well-received by post-Keynesians is the idea of an endogenous normal rate of capacity utilisation. Following Lavoie (1996), the normal rate depends on short run actual rate, and is not a unique value, i.e., there is hysteresis. This approach has striking implications for investment theory, since it renders the above “extensions” to the Kaleckian investment function irrelevant and reinforces the perception that short-run determinants of investment matter

Monetary considerations

In addition to the long-standing debate about the role of the rate of profit and the profit share described above, monetary aspects in connection with investment behaviour are also a much discussed topic among post-Keynesian economists. The most famous contributions to the monetary side of macroeconomics come from M. Kalecki with the *Principle of increasing risk* and H. Minsky with the *Financial instability hypothesis*. Following these theories, the leverage of firms is a crucial element influencing investment dynamics. The *financial instability hypothesis*, for example, is based on different levels of corporate indebtedness and the associated financial fragility (Minsky, 1978). It is argued that high levels of indebtedness deter investment, due to the increasing risk that is brought about by ever-rising leverage. Insofar, there is a negative causal relation between indebtedness and investment.

In general, the influence of monetary aspects and financial markets in macroeconomic investment functions is often presented in the form of interest payments (or the interest rate) or a market value

to capital ratio (Tobin's Q^6). The latter is likely to have a positive impact on investment; however, one can find contradictory theories on the impact of financial market valuations within the literature.⁷

Investment in the post-Keynesian theory of the firm

Financial aspects are closely related to more microeconomic perspectives of investment determinants, which can create a certain vagueness in respective theories. In most explanations, the role of financial elements is a restrictive one. Financial aspects of investment functions are usually related to the question of whether and how a company can finance investments, and not what drives them to undertake an investment in the first place. This perspective plays a key role in the post-Keynesian theory of the firm.

Among post-Keynesian economists there is a general agreement that the overall goal of firms is power – over their economic, social, and political environment. The esteemed post-Keynesian economist Joan Robinson explains firms' need for growth as follows:

“Anyone who is in business naturally want to survive [...] and to survive it is necessary to grow. When a business is prosperous it is making profits; for that very reason it is threatened with competition; it would be feckless to distribute the whole net profit [...]; part must be ploughed back in increasing capacity so as to supply a growing market, to prevent others coming in, or to diversify production if the original market is not expanding. [...] Thus each has to run to keep up with the rest.” (Robinson, 1971, p. 101)

Businesses usually want to invest but carrying out this desire is limited by the availability of financial resources, such as profits. From this perspective, profits get a character of necessity, unlike in a macroeconomic perspective, where profits are seen as a measure of profitability, and thus as an “incentive” for investment. This is in fact not a very surprising insight, since the limitation of financial resources only exists at the microeconomic level, while at the macroeconomic level, there cannot be a general lack of financial resources (that is, a lack of overall savings). This qualitative difference explains why, above all, empirical studies that consider financial aspects in estimations of investment functions regularly fail to test clear hypotheses and thus provide unreliable interpretations.⁸

Financialisation

In post-Keynesian economics, there is a growing amount of research and literature on the topic of financialisation. In particular, empirical studies that investigate investment functions are increasingly set in a financialisation framework. Typically, financialisation of the non-financial corporation is

⁶ *Tobin's Q* ratio represents the stock market value relative to the replacement cost of tangible capital (Lavoie, 2014, p. 440), and is also known as Kaldor's valuation ratio (Kaldor, 1966).

⁷ See for example Lavoie (2014, S. 442) and Arestis et al. (2012).

⁸ The connection between microeconomic and macroeconomic theory is a difficult issue in post-Keynesian economics, which is seldomly addressed and not easily resolved (Schoder 2017).

identified as the “increased activity of non-financial businesses on financial markets” (Stockhammer, 2004, p. 720), with a shift in the portfolio composition towards financial assets, rising dividend payouts, and large share buy-backs as possible features (Davis, 2017, pp. 2–4). The most fully developed microeconomic explanation linking financialisation to investment is the increasing orientation towards shareholder value. It is argued that “in the name of ‘shareholder value’, the past two decades have witnessed a marked shift in the strategic orientation of top corporate managers in the allocation of corporate resources and returns away from ‘retain and reinvest’ and towards ‘downsize and distribute’” (Lazonick and O’Sullivan, 2000, p. 18). While the post-war era was characterised by a largely autonomous management which prioritised expansion over profits, the “shareholder revolution” – e.g., with performance-based pay schemes for managers – realigned managers’ priorities with those of shareholders who primarily aim for profits. When a growth-profit trade-off is faced, this realignment leads to lower investment (Stockhammer, 2004, p. 720). To narrow this argument down even more, we can argue that profits and investment become disconnected, i.e., profits lose impact as a determinant of investment. However, defining financialisation, especially for estimation purposes, is a difficult task, and the measures used to represent financialisation differ greatly (see also Davis, 2017).

3. *Evaluation of empirical studies*

The empirical literature on investment functions typically aims to provide new insights into investment behaviour and to clarify the role of certain determinants of investment. In the wide range of empirical investigations, the post-Keynesian intuition that resources are not fully utilised and that quantity effects play a major role is shared, even though the focus of different works vary greatly. To allow for a detailed and coherent analysis of the empirical evidence for investment determinants that is brought forward, a selection of post-Keynesian studies is made, based on a clear commitment to post-Keynesian foundations and suitability for comparison in terms of methodology.

From the literature, we must realise that despite the fact that there are serious theoretical debates about the relevance of these variables (as explained above) – whether it is profit rate vs. profit share or the debate around normal capacity utilisation – these discussions are hardly reflected in empirical works. In most studies, capacity utilisation is explicitly included in the estimated investment function to capture cyclical factors of demand. It is typically proxied by sales or similar measures, and largely detached from theoretical disputes regarding its “normal” value. Its impact is normally found to be large and positive. Profits also appear prominently, and they are commonly seen to primarily represent internal financial resources and the exposure to financial risk, reflecting Kalecki’s principle of increasing risk.

Apart from these two very “traditional” variables, there are different variables of interest introduced to estimations of investment functions. There are studies interested in the role of net stock issuance, of internal finance (as an independent determinant⁹), or uncertainty, and a rather large amount of literature is interested in the impact of financialisation as additional factor. Table 1 below summarises the selected econometric studies, reports the variables in use, some information on the estimation techniques, and the main conclusions that are drawn by the authors.

Overall, it seems that capacity utilisation plays a significant role, and also the previous period’s investment, which, from an epistemological point of view, is unfortunate, because it tells us little about investment determinants, apart from “animal spirits”. There is evidence for the depressing effect of uncertainty, and for the negative impact of financialisation as proxied by financial payments, financial incomes, and shareholder value for some countries. Where do these results leave us in terms of understanding investment behaviour? Can we use these rich sources of empirical evidence to substantiate theoretical arguments, and to formulate policy advice? Though it seems that empirical evidence can be easily consulted, it is crucial to carefully analyse the empirical evidence in more detail to fully understand the weight of the arguments brought forward.

⁹ That is, independent of output or demand variables (Fazzari and Mott, 1986, pp. 184–185).

Table 1: Summary of selected empirical studies

Author(s)	Location and time frame	Hypothesis tested	Level and method of analysis	Explanatory variables*	Main conclusion
Alexiou (2010)	G7 economies, 1972-2005	Testing the empirical merits of the post-Keynesian doctrine	Aggregate level, panel estimation with <i>system</i> GMM	Profit rate*, capital stock*, GDP*, capacity utilisation*	Importance of capital stock, GDP, capacity utilisation and profits is confirmed.
Hecht (2014)	China, France, Germany, UK, India, Japan, USA, 1998-2008	Does net stock issuance affect investment positively?	Firm-level, panel estimations with GMM	Past investment, sales*, profits*, stock of internal finance*, net stock issuance*, debt, dividends*, GDP growth, animal spirits, Tobin's q*	Net stock issuance has an independent positive effect, stock measures of internal finance are relevant, aggregate demand determines firm-level investment.
Arestis et al. (2012)	France, Germany, Italy, Australia, Belgium, Denmark, Canada, Austria, Spain, US, UK, Norway, 1970-2010	Testing an accelerator model that accounts for uncertainty and conventions	Aggregate level, panel estimation with <i>system</i> GMM (+within-groups estimator, LSDV)	Past investment, GDP growth*, capacity utilisation*, profit share*, interest rate*, uncertainty*, stock market*	Key determinant is expected growth rate of demand, uncertainty has a negative effect.
Stockhammer and Grafl (2010)	US, UK, Germany, Netherlands, France, 1960-2005	Does increased (financial) uncertainty negatively affect investment?	Aggregate level, time series estimations with ECM	GDP, interest rate, uncertainty	Uncertainty has a negative effect for the US and the Netherlands, smaller than demand effects but bigger than interest rate effects.
Fazzari and Mott (1986)	US, 1970-1982	Does investment depend positively on capacity utilisation and profits and negatively on interest expenses?	Firm-level, cross-section time series estimations with GLS	sales*, profits (internal finance)*, interest expenses*, gross plant	Internal finance has an independent positive effect, capacity utilisation is important, interest rates have a negative effect.

Seo et al. (2016)	South Korea, 1990-2010	Does financialisation or liberalisation explain the slowdown in investment in South Korea?	Firm-level, panel estimations with GMM	Past investment, profits*, debt*, financial payments*, financial profits*, uncertainty*	Liberalisation plays a bigger role than financialisation in explaining the investment slowdown, since the uncertainty measures are negative and significant.
Orhangazi (2008a)	US, 1972-2003	Does financialisation depress investment in the US?	Firm-level, panel estimations with GMM	Past investment, profits*, sales*, debt*, financial payments*, financial incomes*	Negative implications of financialisation for (large) firms' investment behaviour is confirmed.
Orhangazi (2008b)	US, 1961-2004	Does financialisation depress investment in the US?	Aggregate level, time series estimations with OLS	Past investment, capacity utilisation*, profit rate*, financial payments*, financial profits*, debt*	financialisation constrains investment, financial profits and financial payouts have a negative effect.
Stockhammer (2004)	US, UK, France, Germany, 1960s-1990s	Does financialisation (shareholder value orientation) explain the slowdown in investment?	Aggregate level, time series estimations with PAM and ADL	Past investment, capacity utilisation*, profit share*, rentier's income share*, cost of capital*	Financialisation constrains investment in the US and in France, and potentially in the UK, but not in Germany.
Tori and Onaran (2018)	UK, 1985-2013	Does financialisation depress investment in the UK?	Firm-level, panel estimations with GMM	Past investment, retained earnings*, financial payments*, financial incomes*, firm size*	Financialisation has a negative effect due to adverse effects of financial payments and financial incomes for UK publicly listed firms.

* lagged values

Looking at the above selection of studies, it becomes clear that investment behaviour is investigated from a variety of perspectives, with strong differences not only in the hypotheses tested but also in the results obtained and the conclusions that are drawn. When we consider the theoretical discussions about the specific form of “the” post-Keynesian investment function and the underlying mechanisms, the empirical evidence that is presented is crucial in supporting or dismissing certain arguments. In addition, econometric works are an important foundation for policy advice. For both these purposes, it is imperative to choose the reference studies carefully, keeping in mind the numerous weaknesses econometric studies may exhibit.

As a general caveat, it must be said that “estimation of investment functions is a tricky and difficult business and the best posture for any of us in that game is one of humility” (Eisner, 1974, p. 101). Since investment theory is complex and sometimes conflictive, finding a clear and testable hypothesis is not easy, and less so finding conclusive results. In the words of Robert Chirinko, “no single study, regardless of the generality of the specification nor the richness of the data, will deliver ‘the’ definite test” (1993, p. 1907). Understanding this, we must be aware that the possibility of settling theoretical arguments on the basis of econometric research is unlikely.

This reinforces the need for somehow assessing the reliability of econometric studies to find clarity in the understanding of investment behaviour. While a purely objective assessment is hardly achievable, in the following pages I will attempt to provide an assessment of the previously selected studies based on relevant and sensible criteria. These criteria are chosen specifically to relate economic theory to empirics, and to attain a certain coherence for investment theory, which may prove useful for policy advice. Three broad criteria are given, the first being the consistency and coherence of the underlying theory and the derived model specification, the second being the appropriateness and completeness of the estimation technique, and the third criterion is the *economic* relevance of the obtained results.

Consistency of theory and specification

For a reliable empirical investigation, it is vital to have a clear and suitable foundation in economic theory to derive a testable hypothesis. Any lack of clarity in the underlying mechanisms of the investment function can lead to misinterpretation of the results. In particular, the ad-hoc inclusion of explanatory variables undermines the usefulness of empirical studies for the understanding of real-world mechanisms. When there is no theoretical explanation of the causal relationship between variables, statistical significance of explanatory variables does not improve our understanding of investment determinants.

Assessing the selected studies carefully in this respect, it is found that the study by Alexiou (2010) suffers from a severe lack of consistency between theory and model specification. The variables in use

rarely relate to the beforehand emphasised importance of uncertainty, animal spirits, the attitude towards money, conventional behaviour, and the availability of finance and the related importance of debt. Instead, the relevance of the actually used variables remains unexplained, such that it is unclear why capacity utilisation, GDP, and the capital stock – virtually representing the same accelerator mechanism – are expected to exert independent influence on investment expenditures.¹⁰ Since there is no testable hypothesis derived from his theoretical considerations, the estimated investment function is unable to confirm or contradict the underlying theory. Similarly, in Hecht (2014), it remains unsettled why “microeconomic demand” (capacity utilisation) and “macroeconomic demand” (GDP growth) should independently influence investment decisions at the firm level.

The work of Arestis et al. (2012) on the accelerator principle under uncertainty also exhibits serious shortcomings in terms of coherence between theory and estimation. While they explain that conventions play a crucial role for the behaviour of agents in the face of fundamental uncertainty, the specification of their investment function fails to clearly represent this issue. They apply conventional levels to “those variables that capture the presence of uncertainty in the model” (2012, p. 260), and by doing this, it becomes practically impossible to say whether they test the effect of uncertainty on investment, or the role conventions play in investment behaviour. Econometric estimations are incapable of providing evidence for such an ambiguous hypothesis. A related problem is encountered by Seo et al. (2016), where they (2016) set up their empirical estimations to test two hypotheses at a time (a financialisation and a liberalisation hypothesis). While this itself causes no obstacle, their “financialisation hypothesis” also implicitly consists of two questions: is shareholder value orientation the reason for increased financial payments, and are increased financial payments the reason for decreasing investment? Consequently, interpretation of the results requires additional assumptions, which is not made explicit.

Overall, many of the selected empirical studies suffer from a lack of clarity in their tested hypotheses and in the theoretical embeddedness, which severely harms their explanatory power and their usefulness for understanding investment behaviour. Alexiou (2010), Hecht (2014), Arestis et al. (2012), and Seo et al. (2016) do not fulfil basic requirements in this respect.

Estimation technique

The second criterion, the appropriateness and completeness of the estimation technique, is a delicate one, because estimations are generally very flexible and there is no clear “right” or “wrong”. Many decisions regarding estimation methods are made on the basis of specific data issues that arise during

¹⁰ Even though he refers to Kalecki in justifying his inclusion of the capital stock, where the expected theoretical influence is a negative one, Alexiou finds a positive influence, which is left uncommented.

the work in progress and are therefore difficult to evaluate. Often, the question of how econometric problems are treated is a question of style and willingness to compromise. Therefore, only a broad and preliminary assessment based on more obvious and eclectic characteristics will be provided.

Empirical studies investigating macroeconomic phenomena typically rely on aggregate data, so researchers are confronted with obstacles such as non-stationarity and autocorrelation. These issues generate additional challenges for linear regressions and carry the potential for spurious regressions. Non-stationarity and autocorrelation also create challenges for microeconomic studies using panel data, even though the typically larger datasets alleviate these problems. However, when the panel data covers a larger time span (as was the case in most firm-level studies of our selection), a good estimation strategy still includes tests for non-stationarity and autocorrelation, and respective treatment.

Regarding microeconometric studies, the often employed *GMM* (Generalised Method of Moments) is not suited for time series exhibiting unit roots, since it renders the instruments invalid, and causes problems for inference (see Arellano and Bond, 1991). Therefore, testing for unit roots and reporting respective results is advisable, especially when the time dimension of the data set is large. This potential problem can be seen in Tori and Onaran (2018) and Orhangazi (2008a), for example, where they do not test for unit roots before running regressions.¹¹ In addition, the traditional *difference* GMM “hinges heavily on the lack of serial correlation” (Hujer et al., 2005, p. 3), and higher-order autocorrelation may lead to invalid instruments and thus inconsistent estimates. Tori and Onaran (2018), whose second order autocorrelation tests are not always convincing, stick to the *difference* GMM approach, even though a *system* GMM technique may deliver more reliable estimates due to its preferable characteristics in the face of weak instruments (Blundell and Bond, 1998, 2000).

Some problems regarding estimation technique are specific to individual studies, with Arestis et al. (2012) as mentionable example. Inspired by Lavoie et al. (2004), they apply a HP filter (Hodrick and Prescott, 1980) to identify their normal or conventional values for capacity utilisation, long-term interest rates, exchange rates, and oil prices (Arestis et al., 2012, p. 259). However, the HP filter is not useful for the detection of a “normal value”, as was discussed by Skott (2012). The HP filter, in essence, “smooths the series, attaching as much weight to future observations as to past” (Skott, 2012, p. 132), which is inconsistent with the logic of “normal” values. This means that variables of primary interest in their study are wrongly measured, which makes the econometric estimations highly unreliable.

¹¹ Tori and Onaran’s panel covers about 30 years, but “the average period for which all the variables are available is 6-9 years” (Tori and Onaran, 2018, p. 12, footnote 14), so it is not fully clear if this criticism applies.

This brief assessment of estimation techniques and potential problems leads to the conclusion that three studies have to be interpreted with very special care and are therefore ill-suited as empirical evidence for real-world behaviour of investment or theoretical arguments. These are Arestis et al. (2012) due to their questionable use of the Hodrick-Prescott filter, Orhangazi (2008a) due to a large time dimension in a difference GMM approach with no tests for unit roots, and Tori and Onaran (2018), also for the latter reasons, but paired with possible autocorrelation issues.

Economic significance of the estimations

A major obstacle for using empirical studies to back up theories of investment is an epistemological one, with very practical consequences. As soon as empirical studies enter the economic scientific field, there is a need to address the question of whether the empirical relationships we investigate are indeed meaningful to understand the working of the economy. D. McCloskey and S. Ziliak have argued for decades that in mainstream and heterodox schools alike, there is too much focus on statistical significance in empirical studies, and too little focus on *economic* significance, even though the latter is what allows economists to develop meaningful arguments and theories. Traditional tests of significance only test for existence, for an effect different from nil, but tell us nothing about how large an effect really is, about its *economic* meaningfulness. Since statistical significance is then neither a sufficient nor necessary condition for economic significance, we should instead focus on confidence intervals and *real* errors (via Gosset's error bars) in empirical studies in economics (Ziliak and McCloskey, 2008, p. 249).

Since in the selected set of literature most studies fail to concentrate on the guiding principle of "size matters", there is simply little to say about the economic significance of many estimations. Only four out of the ten papers investigated allow for better insights into the economic significance of their estimations, and this is only rudimentary. Therefore, we must take a cautious approach to forming our judgement in this respect. First of all, we will conceive that those studies which do address the topic of economic significance are better suited as empirical support for theory and policy advice than those which do not. Second, for all studies, we will emphasise that the derived conclusions must be in line with the actual empirical results, and that any claim that is not sufficiently substantiated by the estimations must be deemed unreliable. Whenever the size of an estimated coefficient is noticeably small, a conclusion based on them must be additionally scrutinised. Hecht (2014), for example, strongly emphasises the evidence he found in support of internal finance and net stock issuance. While economic evidence is not presented, we can derive from his results that in fact the *ceteris paribus* impact of past investment is much larger than the coefficients he emphasises and given its performance in other studies of investment behaviour, can be expected to explain much more of actual investment variation. The interpretation of his results is therefore potentially misleading.

Four of the ten studies do however (at least partly) address the question of economic significance. Fazzari and Mott (1986, p. 181) report the long-term elasticities evaluated at sample means. This simply gives marginal effects, which is not the same as “economic significance” as explained above, but it improves the meaningfulness of their estimates. Stockhammer and Grafl (2010) address the economic significance by standardising the coefficients to make their variation comparable (Stockhammer and Grafl, 2010, p. 562), and Stockhammer (2004), referring to McCloskey and Ziliak, provides calculations of the economic significance of his financialisation variable. Tori and Onaran (2018) engage in considerations of economic significance for all their variables (Tori and Onaran, 2018, p. 17).

In short, there are several studies (Alexiou, 2010; Hecht, 2014; Arestis et al., 2012; Seo et al., 2016; Orhangazi, 2008a, 2008b) that do not consider economic significance, and their results should therefore be taken with a pinch of salt. In addition, the conclusions drawn are sometimes misleading and not fully in line with the actually reported results. On the other hand, four studies do provide estimations of economic significance, namely Fazzari and Mott (1986), Stockhammer and Grafl (2010), Stockhammer (2004), and Tori and Onaran (2018).¹² Consequently, their studies offer a better basis for empirical support for theoretical arguments and policy advice.

Summary of the assessment of post-Keynesian empirical studies

Based on the qualitative assessment, we are at least partially able to distinguish between more reliable and less reliable empirical studies in the field of investment determinants. While no single criterion allows for acceptable judgements regarding the reliability of studies, considering the outcomes of all criteria together may lead to a selection of useful empirical studies. Table 2 below summarises the assessment of the selected studies according to the outlined criteria (with the acceptable use of measures in a separate column).

¹² They, however, do not truly fulfil the requirements as laid out by Ziliak and McCloskey (2008), since they do not present confidence intervals nor – with the exception of Stockhammer and Grafl (2010) – error bars.

Table 2: Assessment of studies based on qualitative criteria

Author	Consistency of theory and model specification	Acceptable use of measures	Suitability and completeness of estimation technique	Economic significance addressed
Alexiou (2010)	X	X	✓	X
Hecht (2014)	X	✓	✓	X
Arestis et al. (2012)	X	X	X	X
Stockhammer and Grafl (2010)	✓	✓	✓	✓
Fazzari and Mott (1986)	✓	✓	✓	✓
Seo et al. (2016)	X	X	✓	X
Orhangazi (2008a)	✓	✓	X	X
Orhangazi (2008b)	✓	X	✓	X
Stockhammer (2004)	✓	✓	✓	✓
Tori and Onaran (2018)	✓	✓	X	✓

According to the introduced criteria, some studies are not reliable enough to either base policy advice on or to refer to as empirical evidence for or against a theoretical argument. These are Alexiou (2010), Hecht (2014), Arestis et al. (2012), Seo et al. (2016), and Orhangazi (2008a, 2008b). While Arestis et al.'s study is found to not satisfy any of the criteria, because there is a lack of consistency between theory and their model specification, their estimation technique is problematic, and there is no indication for the economic significance of their findings, the other studies mostly fared well at least in the suitability and completeness of their estimation technique. However, for Alexiou (2010), the lack of a testable hypothesis is crucial for its unreliability, for Hecht (2014), the misleading interpretation weighs considerably, and Orhangazi's (2008a, 2008b) failure to address economic significance impedes the trustworthiness of the results. Hecht's (2014) study exhibits shortcomings in the theoretical foundations and the interpretation of the results, which together is problematic.

Other studies proved to constitute a better basis for policy advice or theoretical arguments, according to our assessment. These are Fazzari and Mott (1986), Stockhammer and Grafl (2010), Stockhammer (2004), and Tori and Onaran (2018). The former three fulfil all criteria sufficiently to consider their results as reliable, while the latter has some shortcomings in the estimation technique. However, since these shortcomings are outweighed by strengths regarding the economic significance of their results, this study is still deemed relevant.

From this detailed investigation of empirical studies of investment functions we are able to ascertain which empirical observations can be relied upon to further our understanding of investment behaviour. From those studies that are deemed reliable according to the introduced criteria, it follows that we

are able to say with some certainty that animal spirits together with demand play a crucial role for investment (Stockhammer, 2004, p. 736; Fazzari and Mott, 1986, p. 182 and 184), which, unfortunately, is not a very exciting insight. Tori and Onaran (2018), and Stockhammer and Grafl (2010) confirm this emphasis on demand-based determinants, by showing the relatively strong effects of these variables. Apart from demand, we can conclude that finance plays an important role for investment behaviour, but secondary to demand. Fazzari and Mott (1986) show that internal finance and interest payments independently affect investment, which is confirmed by Tori and Onaran (2018). That interest expenses play a subordinate role is again confirmed by Stockhammer and Grafl (2010). While internal finance is important, Stockhammer (2004) shows that this is not due to expected profitability, as measured by the profit share. The negative influence of financialisation is also confirmed by Tori and Onaran (2018), but must be seen as fairly unimportant relative to other determinants, following Stockhammer's (2004) study. Finally, the post-Keynesian perception of uncertainty affecting investment seems empirically confirmed, however, the evidence is not overwhelming (Stockhammer and Grafl, 2010).

4. Conclusion

This work aimed to survey the post-Keynesian literature on investment functions to take stock of where we are in understanding investment behaviour and to potentially provide answers to the question: what determines investment? For this ambition, a special focus is laid on empirical works of investment behaviour, which is a rich and diverse field of research.

Combining the insights we gained from post-Keynesian theory and from empirical investigations, we must conclude that investment behaviour, in essence, remains a puzzle. There is disagreement among post-Keynesians about the role of profits, because they represent both demand and profitability. In addition, they represent the necessary financial means to finance investment, seen from a microeconomic perspective. In a Minskyan line of thought, debt is seen to influence individual firms' investment decisions, but unambiguous explanations are difficult to find. The only mostly uncontested hypothesis regarding investment determinants is that financialisation implies that firms decreasingly focus on growth, which has a depressing effect.

Empirical evidence may improve our understanding of which aspects of investment theory are truly relevant for real-world mechanisms, but unfortunately, even empirical studies do not provide clear insights. Among ten selected studies, many are not qualified to substantiate theory or let us derive a better understanding of investment behaviour, because careful analysis shows that they suffer from a lack of clarity in the theoretical foundations and the tested hypotheses, their econometric estimation technique is incomplete or inappropriate, and most importantly, the estimations are not

unambiguously *economically* significant. There are, however, some empirical works that do indeed allow us to improve our understanding of actual investment behaviour. They are clear and consistent about the theoretical underpinnings of their estimations, they pursue a careful enough and appropriate econometric technique, and above all, they ensure that they provide economically significant conclusions. These are, from our chosen set of literature the works of Fazzari and Mott (1986), Stockhammer and Grafl (2010), Stockhammer (2004), and Tori and Onaran (2018). Unfortunately, these studies, however reliable they are from a qualitative point of view, do not find perfectly conclusive results, and sometimes only provide limited support for the tested hypotheses. This means that after this survey, when we cannot speak with certainty, only some clarification on the determinants of investment is possible.

First of all, it is effective demand that drives business investment for the largest part. Profits seem to only matter as a result of demand, i.e., in the form of realised profits, because they constitute the financial means for investment. Profitability as such, usually measured by the profit share, does not greatly influence investment. The interest rate also only has a very mild effect on investment. Obviously, uncertainty does not create a benign climate for business investment, however, we cannot make claims as to how strongly it quantitatively affects investment. These answers can be given at least with some confidence for some highly developed countries, notably France, Germany, the Netherlands, the UK, and the US.¹³ The negative contribution of financialisation for investment can only be confirmed for France, the UK, and the US, but it must be acknowledged that this determinant seems to be much less relevant than demand.

As a result of this careful survey, we must admit that a proper “investment function” may indeed be reminiscent to a will-o’-the-wisp, and economists are well advised to humble themselves about the knowledge of investment determinants.

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¹³ These were the countries investigated by the aforementioned studies.

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