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Alex COAD

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Neoclassical vs Evolutionary Theories of Financial Constraints: Critique and Prospectus ^{*}

Alex Coad ^{*†‡}

^{*} Centre d'Economie de la Sorbonne, Equipe MATISSE, Univ. Paris 1 – CNRS

[‡] LEM, Sant'Anna School of Advanced Studies, Pisa, Italy

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Abstract

Complicated neoclassical models predict that if investment is sensitive to current financial performance, this is a sign that something is ‘wrong’ and is to be regarded as a problem for policy. Evolutionary theory, on the other hand, refers to the principle of ‘growth of the fitter’ to explain investment-cash flow sensitivities as the workings of a healthy economy. In particular, I attack the neoclassical assumption of managers maximizing shareholder-value. Such an assumption is not a helpful starting point for empirical studies into firm growth. One caricature of neoclassical theory could be “Assume firms are perfectly efficient. Why aren’t they getting enough funding?”, whereas evolutionary theory considers that firms are forever struggling to grow. This essay highlights how policy guidelines can be framed by the initial modelling assumptions, even though these latter are often chosen with analytical tractability in mind rather than realism.

APPROCHES NÉOCLASSIQUES ET ÉVOLUTIONNISTES DES CONTRAINTES FINANCIÈRES

Résumé: Des modèles néoclassiques complexes prédisent que si l’investissement réagit à la performance financière du moment, c’est un problème qui doit être corrigé. La théorie évolutionniste, quant à elle, fait référence au principe de ‘la croissance du plus fort’ pour valider une corrélation positive entre investissement et cash-flow, y voyant le signe du bon fonctionnement de l’économie. Nous critiquons, en particulier, l’hypothèse néoclassique des managers rationnels et maximisateurs. Une telle hypothèse n’est pas un bon point de départ pour étudier l’investissement. Une caricature de la théorie néoclassique pourrait être: ‘Supposons que les firmes soient parfaitement efficaces. Pourquoi ne reçoivent-elles pas un financement suffisant?’, alors que l’approche évolutionniste considère que les firmes luttent pour croître. Cet article met l’accent sur les effets de la politique d’intervention: ils dépendent des hypothèses de départ, même lorsque celles-ci ont été choisies en fonction de critères d’existence d’une solution mathématique et non pas de critères plus réalistes.

JEL codes: L21, G30

Keywords: Financial constraints, firm growth, evolutionary theory, neoclassical theory, investment

Mots clés: Contraintes financières, croissance des firmes, théorie évolutionniste, théorie néoclassique, investissement

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[†] *Corresponding Author:* Alex Coad, MATISSE, Maison des Sciences Economiques, 106-112 Bd. de l’Hôpital, 75647 Paris Cedex 13, France. *E-mail:* a.coad@sssup.it.

1 Introduction

This paper is a critical survey of the “contradictory and inconclusive evidence from almost two decades of cash-flow sensitivity and Euler equation tests” (Whited 2006: 498). I highlight the differences between competing theoretical perspectives on firm growth, and also the rather different policy implications that emerge from them. The three perspectives are the neoclassical q -theory of investment (and the related Euler equation approach – see Chirinko (1993) and Schiantarelli (1996) for surveys), the ‘imperfect capital markets’ theory (following on from Fazzari et al. (1988); see Hubbard (1998) for a survey), and also an evolutionary viewpoint that I develop by considering the contributions of writers such as Nelson and Winter (1982), Metcalfe (1998) and Dosi (2000).

How does firm investment/growth react to current-period financial performance? How *should* it? Should investment-cash flow sensitivities be interpreted as evidence of financial constraints? The standard q -theory prescribes that the only significant regressor in investment regressions should be marginal q (proxied by average q). However, for a variety of reasons the empirical results have been disappointing. More recent work on investment highlights the additional explanatory power of current cash-flow, and attributes this to information asymmetries and market imperfections. In contrast, evolutionary theory predicts that it should not be surprising that firm growth responds to current financial performance; in fact, this is what the ‘replicator dynamics’ model of industry evolution would predict.

It is perhaps surprising that the neoclassical and evolutionary approaches have diametrically opposed theoretical predictions. Previously, it had been claimed that the evolutionary attempts to relax the restrictive neoclassical assumptions led in any case to the same neoclassical ‘equilibrium’ solution concepts (Friedman (1953), Winter (1971), Rubin (1983)). Whilst neoclassical studies expect that current financial performance (proxied by cash flow) should have no influence on investment, they are puzzled to observe that it does in fact have a significant influence. Evolutionary economists, on the other hand, apply the principle of ‘growth of the fitter’ to the data in the hope that the most profitable firms will grow, but they are nonetheless humbled by their weak results.

This paper also emphasizes that policy recommendations are sensitive to the initial assumptions made by the economist. It is misleading and potentially harmful to derive policy implications from complicated mathematical models, that are constructed from assumptions that are chosen not for their economic relevance but because they ensure mathematical tractability.

In Section 2 we review the three theories – q theory, imperfect markets theory, and evolutionary theory. We then discuss these three theories (Section 3) and also compare the policy recommendations that emerge from them (Section 4). Section 5 concludes.

2 A review of the three theories

2.1 q theory

q -theory states that firm-level investment should be determined by future prospects of return. Assuming that stock prices can accurately summarize future profits, the viability of investment opportunities can be determined by the firm’s value of marginal q (i.e., market value of assets / book value of assets). However, data on marginal q are difficult to obtain, and are usually proxied by average q . Average q has been shown to be a valid proxy for marginal q when four assumptions are met (Hayashi 1982): that firms operate in perfectly competitive product

Table 1: An example of a neoclassical q model: How Blundell, Bond, Devereux and Schiantarelli (1992) derive the regression equation

Equation	Description
(1)	Intertemporal capital market arbitrage condition
(2)	Solving (1) on an infinite horizon
(3)	Defining the discount factor β over an infinite horizon
(4)	Substituting for dividend payments in the firm's stock market value
(5)	Defining the firm's after tax net revenue
(6)	First-order condition for investment
(7)	The evolution of the shadow price of capital
(8)	Rearranging (6) to obtain marginal q
(9)	Rearranging (8) assuming a quadratic functional form for adjustment costs
(10)	Rewriting marginal q assuming linear homogeneity of production and adjustment costs
(11)	Expressing the expected depreciation allowances on an infinite horizon
(12)	Expressing the expected present value of all cash flows associated with debt
(13)	Regression equation

and factor markets, that firms also have linear homogenous production and adjustment cost technologies, that capital is homogenous, and that investment decisions are separable from other real and financial decisions. Assuming that firms seek to maximize shareholder value and possess 'rational expectations', it is possible to take the first-order condition of a mathematical model as the basis for a regression model. In this final model, q should be the only predictor for investment (Chirinko 1993).

As an example of an empirical study based on the neoclassical q model, Table 1 shows how Blundell et al. (1992) derive their regression equation. This Table illustrates how the interpretation of the empirical results obtained from regression analysis of their equation (13) is framed by a rather long list of previous assumptions. Empirical analyses such as these could be deemed as 'hyper-parametric' because their results are only open to identification within the straightjacket of a complicated mathematical model. Perhaps unsurprisingly, we observe that "Q models have not been noticeably successful in accounting for the time series variation in aggregate investment" (Blundell et al 1992: 234).

An alternative to the q model is the Euler equation model. The Euler equation describes the optimal path of investment in a parametric adjustment costs model. Although it is derived from the same dynamic optimization problem as the q -theory model, it has the advantage of avoiding the requirement of measuring q . "It states that the value of the marginal product of capital today, net of adjustment costs, must equal the cost of a new machine minus the cost savings due to the fact that the firm can invest less tomorrow and still maintain the capital stock on its optimal path" (Schiantarelli, 1996:75). As an example of a Euler equation study, Table 2 describes how Whited (1992) arrives at their regression equation after a lengthy theoretical introduction. (For other examples of Euler equation studies, see Bond and Meghir (1994), Galeotti et al. (1994) and Bond et al. (2003).) Again, we direct the reader's attention to how the regression results are placed squarely in the context of the preceding mathematical models. Any interpretation of the results as evidence of 'suboptimal' behaviour is thus precluded.

Empirical research into investment decisions based on q models, and the related Euler equation models, have typically produced disappointing results (Barnett and Sakellaris, 1998).

Table 2: An example of a Euler equation model: How Whited (1992) derives the regression equation

Equation	Description
(1)	Equilibrium expression for the value of the firm's shares
(2)	Solving (1) to obtain the firm's time zero market value
(3)	Evolution of the capital stock
(4)	Expression for cash inflows and outflows
(5)	Dividends must be non-negative
(6)	Transversality condition restricting a firm's borrowing
(7)	First order condition for the firm's maximization problem - choice of capital stock
(8)	First order condition for the firm's maximization problem - choice of borrowing
(9)	Borrowing constraints
(10)	Rewriting the first-order condition in (8)
(11)	Substituting (10) into (7)
(12)	Marginal product of capital
(13)	Quadratic form for adjustment costs
(14)	Differentiating (13), inserting into (7), and substituting (12) into (7) to obtain the regression equation

The explanatory power is typically rather low (Blundell et al., 1992). Unfortunately, though, the discrepancy between the expected results and the actual results is usually attributed to 'measurement error' instead of 'theoretical error'. Also, contrary to the theory other variables enter significantly into the investment equation, such as lagged q (Chirinko, 1993) cash flow (Fazzari et al., 1988), and output (Blundell et al., 1992). Furthermore, the implied adjustment costs of investment are generally so high that they seem economically implausible (Schaller, 1990). Different versions of the same underlying theory (i.e. q models and Euler equation models) sometimes give quite different results (Whited, 2006). It has also been suggested that tests of the q -theory of investment have been outperformed by simpler 'accelerator' models of investment (Whited, 1992).

We can conclude from the preceding discussion that the q -theory of investment performs unsatisfactorily. However, we don't exactly know why. Estimation of regression equations such as (13) in Table 1 is not just a test of a single null hypothesis, but instead it is essentially a joint test of the whole series of previous assumptions. The failure of the model to produce results in line with the theory could be due to the failure of any of these assumptions. One problem is that average q may not be a good indicator of expected future profit (Chirinko 1993, Erickson and Whited 2000, Gomes 2001). This may occur if the stock market is not perfectly efficient at foreseeing a firm's fortunes or allocating resources. Furthermore, the denominator of q includes only fixed capital, and regrettably it does not include those elements that are truly valued by shareholders and that cannot be easily bought or sold on asset markets, such as management skill, human capital or R&D capital. Furthermore, q may not be a good predictor of investment if managers are boundedly rational, or if they just don't choose to grow on the basis of maximizing shareholder value. q may also fail to predict investment if the other assumptions mentioned above do not hold.

2.2 Imperfect markets theory

In the light of the disappointing performance of q -models, Fazzari et al. (1988a; FHP88 hereafter) consider US manufacturing firms that are listed on the stock market,¹ include cash flow into the investment equation and observe that it is significant. They follow up their analysis with a lengthy (if not tedious) robustness check, which reinforces their findings. Why is cash flow a significant determinant of investment? Predictions based on the neoclassical model (which is built on a large number of unreasonable assumptions such as perfect competition, perfect foresight, perfectly efficient financial markets, managers that are selfless and optimizing, linear homogenous production technologies etc) do not allow for cash flow to be a predictor of investment. The real reason why cash-flow is significant is not really known. For example, in an uncertain environment it could be that combining cash flow and average q may yield a better proxy for marginal q than just average q alone. If firms are unable to predict the future, they may prefer to base their investment decisions on current-period indicators rather than speculative stock-market indices.² Alternatively, it could be because firms are wary of becoming dependent on external finance.³ It could also be because managers are reluctant to distribute dividends and prefer to spend free cash flow on additional investment projects (Jensen, 1986). However, *the interpretation that FHP88 chose to give is that any sensitivity of investment to cash-flow is due to financial constraints*. The authors associated any such sensitivity to catchphrases such as ‘market imperfections’, ‘asymmetric information’, and the ‘lemons’ problem. In other words, any dependence of investment on cash-flow is seen as a welfare-reducing policy problem, a failure of the capital markets, a source of inefficiency akin to the problems raised in Akerlof (1970) and Stiglitz and Weiss (1981).

One caveat of the FHP88 analysis is their choice of sample of firms. As they introduce the concept of ‘financial constraints’, they explain that small firms should be subject to such constraints whereas larger firms should not: “only the largest and most mature firms are likely to face a smoothly increasing loan interest rate ... Small and medium-sized firms are less likely to have access to impersonal centralized debt markets. ... during periods of tight credit, small and medium-sized borrowers are often denied loans in favor of better-quality borrowers.” (FHP88: 153).⁴ However, it is perhaps ironic that their final sample consists of large firms that are quoted on the stock-market. The authors do this because they require values of Tobin’s q for these firms. However, the snag is that these firms can hardly be

¹FHP88 had originally intended to study small firms, as is evident from the following quote: “Conventional representative firm models in which financial structure is irrelevant to the investment decision may well apply to mature companies with well-known prospects. For other firms, however, financial factors appear to matter in the sense that external capital is not a perfect substitute for internal funds, particularly in the short run” (FHP88:142). However, given the requirement to obtain observations on market value (for calculating q), the final sample contains only listed firms. This may be somewhat ill-appropriate, because these firms have already reached a certain size.

²Note that Whited (2006) uses cash flow as a proxy variable for investment opportunities.

³David Packard, of Hewlett-Packard, relates how he was reluctant to become dependent on external sources of finance: “I often helped my father in looking up the records of those companies that had gone bankrupt. I noted that the banks simply foreclosed on firms that mortgaged their assets and these firms were left with nothing... The firms that did not borrow money had a difficult time, but they ended up with their assets intact and survived... From this experience I decided our company should not incur any long-term debt. For this reason Bill [Hewlett] and I determined we would operate the company on a pay-as-you-go basis, financing our growth primarily out of earnings rather than by borrowing money” (Packard, 1995:84).

⁴A wealth of evidence on this topic is provided in Beck et al. (2005). In particular, they observe that while financial constraints are significant for small firms in developing countries, they are not important for large firms in developed countries.

described as small. In fact, FHP88 acknowledge this, observing that even the smallest firms in their study are “still large relative to US manufacturing corporations in general”. I therefore suggest that problems of asymmetric information, which affect smaller firms much more than larger firms, is not a useful interpretation for investment-cash flow sensitivities in their study of large listed US firms.

Following on from their empirical findings, FHP88 elaborated upon the implications for policy. They underlined the importance of investment opportunities being foregone due to credit market imperfections. As a consequence, they prescribed policy intervention to provide finance for liquidity-constrained firms. They also highlighted the influence of average tax rates (and not just marginal tax rates) on investment in financially-constrained firms (see also Fazzari et al., 1988b). However, in the hurry to provide an interpretation for investment-cash flow sensitivities, they seemingly overlooked other relevant dimensions of the issue. In particular, in the panel discussion following the target article, Blinder (1988) remarked that the possibility that ‘managerial waste’ of resources in unprofitable growth is dismissed quite precociously. Other members of the panel were critical of other aspects of the paper, such as the empirical methodology.

FHP88 has since spawned a large stream of subsequent literature and is nowadays often branded as a ‘seminal paper’. The original FHP88 regression strategy has been replicated and extended on a large number of datasets. As one author remarked, “[t]he last two decades have seen a flood of empirical studies of the effects of external finance constraints on corporate investment” (Whited 2006: 467). Among this large body of research, we can mention Hu and Schiantarelli (1992), Oliner and Rudebusch (1992), Whited (1992), Gilchrist and Himmelberg (1995), Hadlock (1998) and Carpenter and Petersen (2002) for US firms, Hoshi et al (1991) for Japanese firms, Schaller (1993) for Canadian firms, Galeotti et al. (1994) and Fagiolo and Luzzi (2006) for Italian firms, Bond et al. (2003) for European firms, Audretsch and Elston (2002) for German firms, Lamont (1997) for US oil companies, and Himmelberg and Petersen (1994) and Bougheas et al. (2003) for sensitivities of R&D investments to cash flow.

A common theme of these studies is that, whenever investment (or firm growth) is associated with changes in cash flow, this is presented as ‘bad news’. It is implicitly assumed that any investment-cash flow sensitivities are signs of financial constraints, that investment opportunities have been foregone, and also that these investment opportunities would have been ‘optimal’.⁵ An interpretation based on market imperfection is evoked, and policymakers have frequently been urged to intervene to help constrained firms to grow.

However, the FHP88 approach to investment research has recently met an extensive criticism by Kaplan and Zingales (1997, 2000).⁶ To begin with, Kaplan and Zingales present a theoretical model to show that any sensitivity of investment to cash flow should not be interpreted as evidence of financial constraints. (See also the theoretical model by Alti (2003).) They also re-examine the original FHP88 database in conjunction with a scrutiny of annual company reports of these companies, and observe that the highest investment-cash flow sensi-

⁵Consider the following example: after observing that investment-cash flow sensitivity is higher in the UK than for several other European countries, Bond et al. (2003) somehow come to the conclusion that “the market-oriented financial system in the United Kingdom performs less well in channeling investment funds to firms with *profitable* investment opportunities” (p162, emphasis mine). Ignoring for the time being the tenuous link between investment-cash flow sensitivities and financial constraints, the presumption that foregone investment opportunities would have been ‘profitable’ here is totally unnecessary and lacks any empirical justification. At best it is unhelpful; at worst, misleading. It is pure speculation that, I argue, emerges from spending too much time working with mathematical models of rational optimizing managers.

⁶See also Fazzari et al. (2000) for a reply.

tivities actually belong to those firms that seem to be the *least* financially-constrained. Indeed, ‘wrong-way’ differential investment-cash-flow sensitivity has also been found by a number of other researchers, such as Gilchrist and Himmelberg (1995), Kadapakkam, Kumar and Riddick (1998), Cleary (1999) and Erickson and Whited (2000). One notable example mentioned by Kaplan and Zingales (2000) is that, in 1997, Microsoft would have been labelled as ‘financially constrained’ according to the classification schemes of Fazzari et al. (1988, 2000) even though it had almost \$9 billion in cash, corresponding to eighteen times its capital expenditures!

2.3 Evolutionary theory

The basic evolutionary prediction is that expansion of operations should be the domain of the ‘fitter’ firms (but not necessarily only the ‘fittest’). In contrast, the weakest should decline and exit. Furthermore, evolutionary economics stresses the importance of the Simonian notion of ‘bounded rationality’. A firm’s future is not known, it cannot be ‘rationally anticipated’, and its course can be changed by luck or human will. As a result, a firm cannot make its investment decisions on discounted expected future returns on an infinite horizon. Instead, its investment is determined by the firm’s current financial performance. The existence of any significant explanatory power of market value (reflected in Tobin’s q) over and above that of current financial performance does not undermine the fundamental relationship between growth and current profitability, instead it would probably be welcomed as supplementary information.

The dependence of firm growth on current period financial performance, or in evolutionary terms ‘selection via differential growth’, has its roots in Alchian (1950) and has been formalized in a number of analytical models (see e.g. Winter (1964, 1971) and Metcalfe (1993, 1994, 1998)) and also simulation models (see, among others, Nelson and Winter (1982), Chiaromonte and Dosi (1993), Dosi et al. (1995), Marsili (2001) and Dosi et al. (2006); see also Kwasnicki (2003) for a survey). The ‘backbone’ of these evolutionary models is the mechanism of ‘replicator dynamics’, by which growth is imputed according to some broad measure of ‘fitness’ or ‘viability’ (usually the operating margin). This mechanism can be presented formally by Fisher’s ‘fundamental equation’, which states that:

$$\delta x_i = \alpha x_i (F_i - \bar{F}) \quad (1)$$

where δ stands for the variation in the infinitesimal interval $(t, t + \delta t)$, x_i represents the market share of firm i in a population of competing firms, F_i is the level of ‘fitness’ of the considered firm (i.e. operating margin), α is a parameter and \bar{F} is the average fitness in the population, i.e. $\bar{F} = \sum_i x_i F_i$. It is straightforward to see that this equation favours the above-average firms with increasing market share, whilst reducing that of ‘weaker’, less profitable firms.

Empirical investigations of the evolutionary principle of ‘growth of the fitter’ are nonetheless surprisingly scarce. To my knowledge, the only two such studies of evolutionary flavour are Coad (2005) for French manufacturing firms and Bottazzi et al. (2006) for Italian firms.⁷ These studies regress growth on operating margin, whilst including controls for other potentially significant factors. It should be noted, however, the regression methodology is slightly different from those studies reviewed above. First of all, firm growth is measured in terms of sales growth rather than investment in fixed assets, because evolutionary theory emphasizes the important role of firm-specific capabilities and intangible capital (rather than fixed tangible

⁷See also Dosi (2005) for scatterplots of growth vs profitability for Italian manufacturing firms.

assets) in economic change. Furthermore, operating margin is used instead of cash-flow as a measure of current-period financial performance: these two indicators are nonetheless closely related.⁸ Table 3 presents the regression equations investigated in the different theoretical approaches.

3 A comparison of these theoretical perspectives

A major difference between the neoclassical and evolutionary frameworks resides in the use of mathematics. Neoclassical economics has developed a far more impressive mathematical toolkit. For example, in the paper of Blundell et al. (1992) the regression equation is presented as equation number (13) after being derived from a standard model of a perfectly competitive profit-maximizing firm (see Table 1). We only arrive at the regression model after making a long list of assumptions, some of which are frankly quite unrealistic.⁹ In my view, a regression strategy of this type is rather ‘over-cooked’ and should be seen as a ‘semi-empirical’ analysis, because the interpretation of the regression results is greatly overshadowed by theoretical prejudices. Instead of ‘letting the data speak’, the data is gagged and bound, the soundtrack is noisy and the main source of interpretation comes from the subtitles. Neoclassical economics may well have gained the comparative advantage in theoretical modelling, but in doing so it has had to sacrifice some of the realism of its basic assumptions – I argue that this places it at a *disadvantage* for empirical work.

Another difference between the aforementioned theoretical standpoints is the choice of relevant time horizon. Neoclassical q theory assumes that agents can accurately foresee the future and that they maximize on an infinite time horizon. Current decisions are neither influenced by past nor present values, but respond only to (rationally anticipated) future developments. In fact, the ‘imperfect capital-markets’ literature pioneered by FHP88 only emerged as an ‘ex-post rationalization’ of empirical work which showed that, contrary to the theoretical predictions, investment decisions are influenced not exclusively by expectations of the future but also by current financial performance. Evolutionary economics, however, acknowledges bounded rationality and limited plasticity in firm behaviour (i.e. limited plasticity in production, firm-specific capabilities, investment rules, cognition etc.) and prefers to explain current decisions in terms of past decisions that are embodied in current production routines.

A further difference concerns the characterization of the firm. In the neoclassical view, firms are assumed to be rational optimizers, with an implicit ‘optimal size’ to which they strive. Once they reach the ‘optimal size’, firms are satisfied and grow no more. In the evolutionary perspective, however, firms struggle against each other for growth opportunities, ‘firms exist to grow’, and their growth is limited only by their ability to finance such growth. (However, we need not assume that all firms have the same propensity to grow (Coad, 2005).) As a result, whilst a neoclassical might accept the statement: “If the information asymmetries

⁸Cash flow can be defined simply as “an ambiguous term that usually means cash provided by operations” (Horngren 1984: 776). More specifically, the difference between cash-flow and gross operating income is a question of adding taxes and removing depreciation and amortization. Bougheas et al. (2003) use net profit as a proxy for cash-flow. Other studies (e.g. Bond et al., 2003) build their cash flow variable from an operating margin variable, by subtracting taxes and adding depreciation.

⁹These assumptions include: the firm operates in a perfectly competitive industry, maximizes shareholder wealth, faces convex adjustment costs, has a linear homogenous production function, satisfies a capital market arbitrage condition, and optimizes on an infinite horizon (Blundell et al. (1992:236-9)). I expect that such a combination of many unrealistic assumptions may interact multiplicatively to considerably reduce the validity of the results.

Table 3: Types of regression equations associated with the different theoretical perspectives

Theoretical approach	Basic regression equation	Remarks
<i>q</i> -theory (e.g. Blundell et al., 1992)	$(I/K)_{it} = \alpha + \beta_1 q_{it} + \varepsilon_{it}$	If the assumptions hold, investment should be entirely explained by <i>q</i>
Euler equation (e.g. Bond et al., 2003)	$(I/K)_{it} = \beta_1 (I/K)_{i,t-1} - \beta_2 (I/K)_{i,t-1}^2 - \beta_3 (\Pi/K)_{i,t-1} + \beta_4 (Y/K)_{i,t-1} + \varepsilon_{it}$	Investment dynamics should follow the optimal investment path in the context of parametric adjustment costs. Marginal costs of investment in time <i>t</i> are set equal to marginal costs of foregone investment in <i>t</i> + 1. Theory predicts that $\beta_1 \geq 1, \beta_2 \geq 1, \beta_3 > 0$ and $\beta_4 \geq 0$. If the Euler equation regressions perform poorly, one explanation could be that firms are financially constrained.
Fazzari et al. (1988)	$(I/K)_{it} = \beta_1 q_{it} + \beta_2 (CF/K)_{it} + \varepsilon_{it}$	Any explanatory power of cash flow over and above that of <i>q</i> indicates financial constraints
Fagiolo-Luzzi (2006)	$(\Delta S/S) = \beta_2 (CF/S)_{it} + \varepsilon_{it}$	Cash flow taken as a proxy for financial constraints. Any sensitivity of sales growth to cash flow should be interpreted as financial constraints
Evolutionary approach (e.g. Coad (2005))	$(\Delta S/S) = \beta_2 (OM/S)_{it} + \varepsilon_{it}$	Sales growth should be associated with operating margin according to the principle of 'growth of the fitter'

Notes: *I* is investment for firm *i* at time *t*, *K* is fixed assets, *q* is Tobin's *q*, *Y* is output, *CF* is cash flow, $(\Delta S/S)$ is the growth rate of sales, *OM* is operating margin, ε is the residual error term. $\Pi_{it} = p_{it}F(K_{it}, L_{it}) - p_{it}G(I_{it}, K_{it}) - w_{it}L_{it}$ (see Bond et al. (2003: 156)).

could be eliminated, financing constraints would disappear”,¹⁰ the evolutionary economist acknowledges that firms would always seek to grow until their financial condition prevents them from growing further. Evolutionary firms are thus eternally financially constrained, irrespective of information asymmetries, simply because they would always prefer to be a little bit bigger than they currently are.

Predictions from evolutionary economics are also in line with those originating in the behavioural finance literature. Consider the empirically-based ‘financial pecking-order’ theory (Myers, 1984), which supposes there is an imperfect substitutability of internal and external sources of finance. In this view, firms are quite willing to spend free cash flow on investment projects but are much less enthusiastic about having to resort to external finance. As a result, changes in cash flow would be positively associated with changes in investment. Furthermore, evolutionary economics is able to accommodate ‘managerial’ theories of firm growth (see e.g. Marris, 1964), which posit that managers attach positive utility to their firm’s size. In this perspective, managers pursue growth even when this is not in the interest of shareholders. Growth is thus maximized subject to certain constraints (i.e. a minimum value for the firm’s shares). Under these circumstances, investment will respond positively to improvements in current financial performance. Relatedly, the ‘agency problem’ of free cash flow (Jensen, 1986) should be mentioned. This theory predicts that managers will be reluctant to distribute available cash flow as dividends but will prefer to spend it on investment projects (even if these are likely to generate low returns).¹¹ Recently, however, attempts have been made by mainstream economists to introduce these afore-mentioned ‘behavioural finance’ considerations into the FHP88-based financial constraints literature (see the promising work by Goergen and Renneboog (2001) and Degryse and De Jong (2006)).

One of the dangers of the evolutionary approach is the ‘Panglossian’ notion that the evolutionary mechanism of selection transports the economy to an optimum. We should reject the kind of optimality arguments found in Friedman’s (1953) discussion of Alchian (1950), whereby ‘natural selection’ which operates via the weeding out of the weakest firms yields an ‘optimal’ economy consisting only of firms who behave ‘as if’ they maximize. Selection of firms is certainly imperfect and in some cases it is even perverse. The economy is far from optimal, there is considerable room for improvement, and as a consequence there *is* a role for policy intervention. However, the main contribution of evolutionary economics is the acceptance that firm growth will always be constrained by available liquidity, and that the viability of perceived growth opportunities cannot be taken for granted. In many cases, any sensitivity of investment to cash flow will merely reflect the healthy workings of the economy. The evolutionary view therefore considers that the problem of financial constraints inhibiting investment has been exaggerated by the mainstream literature.

4 A comparison of the policy recommendations

In this essay it is argued that the neoclassical assumptions, that also form the basis of the ‘asymmetric information’ models, find their way into the policy conclusions. In particular, I criticize the assumption of perfectly rational, shareholder-wealth-maximizing managers. The motivations behind this choice of assumption are technical in nature and have little to do

¹⁰Taken from Lerner (1998: 776).

¹¹One difference between the ‘managerial’ and ‘free cash flow’ perspectives and the evolutionary perspective, however, is that the observed investment-cash flow sensitivities are signs of value-reducing investment in the first case but are more likely to be value-creating in the latter.

with the underlying economic reality; this assumption exists mainly to aid tractability of the mathematical construct. However, this assumption has an important role in the framing of the research question. In discussions of the empirical results, questions relating to the quality of manager's investment projects are no longer posed. Instead, when the q -model is observed to perform poorly and cash-flow is observed to be statistically significant, all too often buzzwords such as 'asymmetric information' and the 'lemons' problem are automatically applied. In many empirical studies, it appears to be implicitly accepted that firms should have the right to realize their investment opportunities, and that the government should intervene to make sure these firms get the finance they want. To sum up, one caricature of the neoclassical approach could be: "Assume firms are efficient. Financial-market imperfections prevent them from getting enough funding. Policy should intervene, perhaps by subsidizing firm investment."

A major caveat of the mainstream neoclassical literature is that it takes as a starting point the assumption that firms are perfectly rational and will invest only if this increases their long-term profits. Evolutionary economics, in contrast, discards assumptions of hyper-rationality and starts from the hypothesis that not all firms deserve to grow. This is in line with recent work (surveyed in Santarelli and Vivarelli (2006)) on the theme of excessive start-up (i.e. entry beyond the socially optimum level). Some theoretical contributions have related over-entry to over-optimistic forecasts of entrepreneurs (Dosi and Lovallo (1998), Camerer and Lovallo (1999) and Arabsheibani et al. (2000)). These articles go on to suggest that entry of over-confident low-quality entrepreneurs may even crowd out higher-quality entrepreneurs. Another factor contributing to over-entry is that marginal entrepreneurs can free-ride on the credentials of more able entrepreneurs, thus bringing down the average quality of the credit pool (de Meza and Webb (1987, 1999), de Meza (2002)). Marginal entrants should thus be discouraged from entering. This body of theoretical work also suggests that the use of internal finance to fund start-ups has beneficial effects on start-up survival rates (through 'incentive effects') and also plays a role in reducing moral hazard. As a result, it has been suggested that start-ups should not be subsidized.¹² Empirical evidence on excessive start-up should also be taken into consideration (e.g. Dunne et al. (1988), Bartelsman et al. (2005)). These studies highlight the waste associated with entry of new firms, by showing that a large proportion of entrants can be expected to fail only a few years.

It is perhaps unsettling to observe that the recommendations emerging from the neoclassical literature have, to a certain extent, been able to guide policy. In the United States, for example, there have been public initiatives to provide finance to small firms that are suspected of being 'financially constrained'. According to Lerner (2002: 81-82), these "public venture capital programmes are often characterised by a considerable number of underachieving firms. . . . The end result can be a stream of government funding being awarded to companies that consistently underachieve." Levenson and Willard (2000) are also critical of schemes such as the provision of guaranteed loans to small firms.¹³ They remark that "there is no direct evidence that small firms are, in fact, credit rationed in formal capital markets" (2000: 84). Using data from a national survey in 1988-89, they calculate an upper bound for the share of small businesses that were credit-rationed as 6.36%, and conclude that "the extent of true credit rationing appears quite limited" (p83). Finally, it should be noted that apart from being a waste of funds, government initiatives to alleviate financial constraints also have the drawback of encouraging socially-wasteful rent-seeking behavior (Lerner 2002).

¹²de Meza and Webb (1999) even go on to suggest that entrepreneurs should be given incentives not to enter, or else that they should be taxed if they do enter.

¹³The Small Business Administration (SBA) provided \$2.8 billion in guaranteed loans to small firms in 1986 alone.

5 Conclusion

In the face of “mounting evidence that cash flow sensitivities are not interesting measures of finance constraints” (Whited 2006: 496), I develop an evolutionary opinion on the issue. As I survey the literature on financial constraints and firm growth, I document the failure of ‘hyper-parametric’ neoclassical models. I consider that perfect rationality has been overemphasized at the expense of more ‘behavioural’ and ‘managerial’ perspectives on growth. I maintain that it is not possible to talk about problems of limited finance for firm investment by starting from the assumption that firms invest only in profit-maximizing projects. The assumption that managers are rational and maximize shareholder wealth is not a good benchmark or reference point. A much more suitable starting point would be the evolutionary position that firms are heterogeneous, do not know how they will perform, and have a lot of discretion in their growth rates. Furthermore, it is meaningful to suppose that profitable firms have higher quality investment projects than less profitable ones. I also point out that, whilst the existence of any sensitivity of investment to cash-flow is interpreted as a policy problem for neoclassical economists, for their evolutionary counterparts who do not have such restrictive theoretical lenses it is merely a sign of a well-functioning economy. As a result, I suggest that the problem of asymmetric information leading to financial constraints has been exaggerated by much of the mainstream literature.

Neoclassical theory has the advantage of a developed theoretical apparatus. Evolutionary economics does not have such clear-cut mathematical models because it has preferred not to sacrifice realism for analytical tractability. In this sense, whilst neoclassical modelling may have the upper hand in theoretical modelling, evolutionary economics may have the advantage in empirical work. Indeed, if we try to apply complex neoclassical structural models to empirical analysis, we may quickly assume too much and lose sight of the ‘reality’ that the data is actually trying to tell us.

One caveat in this discussion is that we have not considered the varying importance of financial constraints over the firm’s life-cycle in a satisfactory manner. It is reasonable to suppose, if anything, that young small firms have a need for finance that exceeds their revenue, whereas older and larger firms have a revenue that exceeds their need for finance. In this way, young firms would be financially constrained whereas old firms would be more prone to ‘managerial’ phenomena associated with excess cash flow. However, both the neoclassical and the evolutionary perspectives on financial constraints, as presented here, have not taken this into account in an adequate way. FHP88, for example, forcefully argue that financial constraints have a visible impact on investment behavior, yet their sample consists of firms that have already entered the stock market, and thus have already reached a certain maturity. As a result, we may have overlooked the importance of financial constraints for young firms, even if financial constraints are of limited relevance for older firms. Evidence presented by Levenson and Willard (2000), however, suggests that financial constraints are quite limited even for small firms.

After the frequently negative tone of this confrontation between the neoclassical and evolutionary perspectives, it is nonetheless possible to salvage a handshake. One ‘stylized fact’ that emerges from both mainstream and evolutionary approaches is that firm investment and growth is, to a large extent, idiosyncratic. Firms have a considerable amount of discretion in their investment decisions and growth rates. This is a stumbling-block for both the q theory and evolutionary theory. There is still a great deal left to learn, and I conjecture that a more ‘behavioural’ approach to investment decisions would be a fruitful avenue for future research.

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