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An empirical application of the EVA® framework to business cycles

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ABSTRACT

Following financial concepts like duration and economic value added (EVA®) we estimate the impact of interest rate movements on firms that are more and less *roundabout*. We find that firms that are more roundabout, that is, work with expected cash-flows with higher *duration*, are more sensitive to interest rate movements. To the extent that monetary policy is able to move the discount rate used by investors, monetary policy changes the relative present value of any investment project and therefore affects resource allocation. We show evidence that this effect is present in the U.S. in the years prior to the subprime crisis.

1. Introduction

In this paper we apply the EVA® framework and financial concepts like duration to business cycles, in particular to the 2008 subprime mortgage crisis. The application of financial tools used to analyze firm's performance and value bond cash-flows has rarely been applied to macroeconomics. On the contrary, the traditional way to understand macroeconomic cycles relies heavily on aggregates such as output, unemployment, investment, and price level indicators. In this paper we offer a financial application of macroeconomic disaggregation.

It is well known that the traditional macroeconomic model-setting composed exclusively of aggregates is inadequate for a complete understanding the 2008 crisis. Because of this inadequacy several scholars have turned to the Mises-Hayek, or Austrian, Business Cycle theory (ABCT), to help explain it (Borio & Disyatat, 2011; Calvo, 2013; Diamond & Rajan, 2012; Hume & Sentance, 2009; Lal, 2010; Leijonhufvud, 2009; Ohanian, 2010).[1] Most of this literature, however, falls short when pointing to empirical evidence that is distinctive to the ABCT. Specifically, it is not easy to provide evidence to show that during a period of easy monetary policy marginal investment occurs in projects that are *too roundabout*, meaning that they are too capital-intensive and have too long an investment period to be sustainable at the equilibrium or Wicksellian natural rate of interest. We call this effect produced by monetary policy on the length of investment[2] or degree of roundaboutness the ABCT-effect. The ABC can be summarized as a business-cycle that occurs owing to Wicksell-effect distortions when interest rates are pushed outside their equilibrium levels.

The challenges to an empirical study of the ABCT are well known. Macroeconomic data is simply not available in a way that allows one to easily assess the empirical significance of the ABCT thesis.[3] Nonetheless, some studies point to the presence of the ABCT-effect in the U.S. as well as internationally in the years prior to the 2008 crisis (Cachanosky, 2014b, 2015b; Hoffmann, 2010; Young, 2012). None of these studies, however, rely on a financial approach to this problem. Following Cachanosky and Lewin (2014, 2016) we use the EVA® framework to study the presence of the ABCT-effect in the 2008 crisis.

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[1] Hoffmann (2010) is an exception. See also Caballero (2010). For a review of the renewed interest in the ABCT see Cachanosky and Salter (2016).

[2] A convenient and consistent measure of this is provided by the concept of duration (D) found in the financial literature and discussed below.

[3] Some examples of empirical work in this area are Keeler (2001); Lester and Wolff (2013); Luther and Cohen (2014); Mulligan (2005, 2006, 2013), and Young (2005). As far as we can tell, this is the first empirical work using EVA® to assess this particular theory.

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In the next section we present the financial framework and its relation to business cycles. In section three we discuss the points in favor of and against the ABCT interpretation of the subprime crisis. In sections four and five we present stylized facts and an econometric model to assess the presence of ABCT-effects respectively. Section six concludes. The appendix provides a table of the abbreviation used in this paper.

2. The EVA® framework and business cycles

The market value (price) of an investment project is the present-value of its discounted cash-flow. Formula 1 shows the free-cash-flow (FCF) calculation in discrete time.

$$V = \sum_{t=0}^{\infty} \frac{FCF_t}{(1+WACC)^t} \tag{1}$$

where V is the market value of the expected cash-flow, t is the time period, *FCF* is the expected free cash-flow,[4] and *WACC* is the weighted average opportunity cost of capital. If the project is financed exclusively with a loan from the bank, then the *WACC* equals the interest rate charged by the bank. But in the presence of multiple investors the opportunity-cost of capital is the weighted average of all the investors' opportunity-costs. For simplicity it is assumed that the *WACC* is the same for each period of the project. This simplification, instead of assuming different discount rates per period, does not affect the implications of the paper. It can be shown that formula 1 is mathematically equivalent to formula 2 (Koller, Goedhart, & Wessels, 1990, pp. 697–699).

$$V = K_0 + \sum_{t=1}^{\infty} \frac{(ROIC_t - WACC) \cdot K_{t-1}}{(1+WACC)^t} = K_0 + \sum_{t=1}^{\infty} \frac{\text{EVA}_t}{(1+WACC)^t} \tag{2}$$

where *ROIC* is the rate of return over invested capital and K is the financial capital invested by the firm. EVA® stands for *economic value added*, the excess of the rate of return over the opportunity cost of capital times the amount of capital invested. EVA®, then, is another term for economic profits. Given that K_0 represents the initial value of capital, $V - K_0 = MVA$ where *MVA* stands for market value added (to the capital already owned). *MVA* is the expected value added for the investors and is the present-value of future expected economic profits.

$$MVA = \sum_{t=1}^{\infty} \frac{(ROIC_t - WACC) \cdot K_{t-1}}{(1+WACC)^t} = \sum_{t=1}^{\infty} \frac{\text{EVA}_t}{(1+WACC)^t} \tag{3}$$

This is the EVA® framework we use in this paper. In corporate finance this is mostly used in preference to *FCF* for two reasons. First, it allows one to track economic profits (EVA) for each period. This is not possible in the traditional *FCF* representation because the cash-flow is not represented in terms of economic profits *per* period. Second, because $FCF = NOPAT - NI$, it is possible that a positive EVA value in any given period is paired with a negative FCF in the same period inviting confusion about the performance of the project in any given period. Succinctly, EVA is a cleaner estimate of firm performance when looking at particular periods and not only at the present-value.[5]

It is well known that associated with a series of cash-flows and a present-value for any multi-period project there is a measure of the average time for which one must wait to earn a dollar from the investment in the project known as Macaulay duration (D) or its closely related measure, modified duration (*MD*.) Duration is a value-weighted measure of average time "involved" in the project and as such provides a unique opportunity to operationalize the concepts of "long-term" *versus* "short-term" investments as articulated in the ABCT.[6] Formula 3 can be combined with D to provide for three essential investment properties key to the ABCT. (1) It is forward looking, (2) it captures discount rate sensitivity, and (3) resource allocation in different period of time (K). Characteristic number three is not present in the *FCF* formulation and *MVA* allows us to track the allocation of resources across time and firms.

Different cash-flows have different values of D, and therefore the value of some investment projects are more sensitive to movements in the discount rates than others. It can also be shown that the present-value of cash-flows with higher values of K are more sensitive to movements in the discount rate (Cachanosky and Lewin (2014, p. 659)). In other words, present-values of longer cash-flows and higher values of financial capital are paired with higher interest rate sensitivity. And D is what drives the ABCT-effect.

If different projects have different expected cash-flows, and therefore different values of D, it follows that movements in the discount rate will affect the relative present-values of said projects in favor of projects with higher D (more roundabout). The natural or Wicksellian interest rate is the one that results in projects with an optimal D (not too short, not too long).[7] Note that it is possible to have an interest rate different from its natural level and have full employment of resources but assigned to projects with the *wrong* value of D. This is a *time* inconsistency problem, not an unemployment problem.

Starting from equilibrium, assume two types of project, high-D (HD) and low-D (LD). Then resources are allocated in an optimal aggregate D ($\hat{D}^*$). Therefore, if there is a monetary policy successful in moving downward the discount rate used in the market the estimated (expected) present-values of *HD* projects rise more than those of *LD* projects.[8] This change in relative prices signals that resources should be reallocated from *LD* projects o *HD* projects thus increasing $\hat{D}$ beyond $\hat{D}^*$.

$$\hat{D} = D_{HD} \cdot w_{HD} + D_{LD} \cdot w_{LD} \tag{4}$$

where $\omega_j = \frac{MVA_j}{MVA}$, $j = \{HD, LD\}$. If the discount rate is below its natural level, then the price change signals the reallocation of resources such that $\hat{D} > \hat{D}^*$ as the weight of resources allocated to *HD* projects rises and the weight of resources allocated to *LD* projects falls, and similarly for the *MVA* of each type of project.[9]

[4] $FCF = NOPAT - NI$; where *NOPAT* stands for net operating profits after taxes and *NI* stands for net investment.

[5] EVA®, a trademark of Stern Value Management, is used in corporate finance as a way to estimate economic profits and calculate management compensation, it became popular in the 1990s. EVA® in itself it a re-arrangement of the well-known FCF estimation. To name a few, some companies that apply EVA® are General Electric, Coca-Cola, Microsoft, Merck, IBM, Procter & Gamble, Inter, AT&T, Wal-Mart Stores, Boeing, Time Warner, and Apple (Fernandez, 2002; Tortella & Brusco, 2003).
Certainly there are other uses of the EVA® framework, like the estimation of value drivers to track which components of the cash-flow add more value to the firm. See Ehrbar, 1998; Koller et al. (1990); Stern, Shiely, and Ross (2003); Stewart (1991), and Young and O'Byrne (2000).

[6] As originally conceived, the ABCT attempted to make use of Böhm-Bawerk's (1884) average period of production (*APP*). It turns out that Böhm-Bawerk's formula is an inadequate measure insofar as it puports to be a purely physical measure of time and yet time itself has to be valued – interest is inevitably involved. Hicks (1939) independently came up with a construct that measures time in value-weighted terms which he called the "average-period" (*AP*) and which is identical to Macaulay duration (D). See Lewin and Cachanosky (2014) and Osborne (2005, 2014).

[7] On the Wicksell or natural rate of interest see Anderson (2005); Garrison (2012), and Williams (2003).

[8] It could be argued that central banks have little impact on market interest rates. This, of course, begs the question of why central banks target a market interest rate. It is different to say, however, that in the long-run central banks cannot control real interest rates than to say that their effect is null in the short-run. The problem is that the short-run might be long enough. As an example, there are two empirical ways to show that central banks do have the power to move interest rates away from their equilibrium values. One is Taylor (2009), who shows how the Federal Funds rate deviated the Federal Funds rate from the Taylor rule target between 2002 and 2006. Another way is to compare the Federal Funds rate with estimations of the natural or Wicksellian interest rate, from which the Federal Funds rate also deviates as shown in Fig. 1 below (Laubach & Williams, 2003; Selgin et al., 2015).

[9] The rational expectations objection to this effect fails on the ground that real, tangible wealth effects are produced favoring *HD* projects, and also that expectaions are not single-valued and systematic errors will be made, see the discussion in Cachanosky (2015a).

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