Review of Financial Economics 23 (2014) 131–140

Contents lists available at ScienceDirect

Review of Financial Economics

journal homepage: www.elsevier.com/locate/rfe

The output gap and expected security returns

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ARTICLE INFO

Article history:
Received 16 January 2014
Received in revised form 24 April 2014
Accepted 28 April 2014
Available online 5 May 2014

JEL classification:
E44
G17

Keywords:
Market returns predictability
Output gap
Real-time data
MIDAS regression
Beta-weighting scheme

ABSTRACT

This paper analyzes the impact of the output gap on market excess returns. The output gap is usually defined as the deviation of output from potential output that is indicated by the trend output. However, this study departs from the common approach of calculating the output gap based on a simple trend line. It uses a flexible data-driven weighting scheme, and it uses only the available information that corresponds to each forecasting origin to derive the output gap. Overall, the proposed output gap is a strong predictor of U.S. market excess returns.

1. Introduction

The goal of this paper is to analyze the impact of the output gap, that is, fluctuations in the aggregate output level of an economy, on future market excess returns. Following the well-known Taylor's rule (Taylor, 1993), this gap is believed to be one of the important determinants for the federal funds rate.[1] Such a rate is generally manipulated in order to regulate macroeconomic variables like inflation, unemployment, and gross domestic product (GDP), but its impact on the financial sector can hardly be over-emphasized. There is a long-standing debate regarding the appropriate measurement of the output gap. The debate revolves around the question of how potential output should be measured, as there can be no directly available data for a potential output. The common practice is to measure the output gap by fitting a single trend line for actual output with equal weights to each period's output. The output gap is the deviation of the actual output from the trend output. We cannot, however, forget that underlying economic conditions change with time.

In general, a period's output is more closely related to the adjacent periods' output than the distant periods' output, and the common measure of the output gap uses future information because it is based on a trend line that is fitted to the full sample of the data and hence, it suffers from look-ahead bias, to which the recent literature pays close attention (Welch & Goyal, 2008). These two observations make a case for considering distance weighting in calculating the output gap. Because of look-ahead bias, the use of a common measure of the output gap as an ex-ante predictor in a real-time forecasting framework is questionable. Since the output gap is widely used in determining many macroeconomic policies, such as Taylor's rule (1993), Okun's law (1962), etc., it is important to investigate its derivation in an ex-ante set-up that can also effectively account for the changing nature of the economy. The objective of this study is to provide a flexible data-driven ex-ante measure of the output gap and then to test its predictability for market excess returns.

This study proposes a new measure of the ex-ante output gap, the weighted average output gap (WAgap). The WAgap at any point t is equal to the (log of) output at t minus the distance-weighted average of the (log of) output data until the period $t-1$. The weighting scheme on the prior output data is based on a single parameter beta distribution where the weighting parameter is estimated within a Quasi-Maximum Likelihood Estimation (QMLE) framework that will be explained in detail in the next section. Throughout this analysis, the output gap is

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[1] Taylor's rule determines the targeted federal funds rate based on the output and inflation gaps. It follows from the rule that a tight monetary policy or a high federal funds rate should be adopted in times of positive gaps. Given some simplifying assumptions, the rule can be stated as

$$i_t = \pi_t + r_t^* + a_\pi(\pi_t - \pi_t^*) + a_y(y_t - \bar{y}_t)$$

where i_t is the federal funds rate, π_t is the actual inflation rate, π_t^* is the desired rate of inflation, y_t is the log of real output, $\bar{y}_t$ is the log of potential output, r_t^* is the assumed equilibrium real interest rate, a_π is the coefficient of the inflation gap, and a_y is the coefficient of the output gap (a_π and a_y should be positive according to the rule).

http://dx.doi.org/10.1016/j.rfe.2014.04.001
1058-3300/

derived on the basis of the latest vintage industrial production (IP) series at each forecasting origin. By definition, vintage data are available to investors at the time of a forecast. Therefore, this study uses data that are available in real-time.[2]

This study closely follows the extensive literature (for example, Cochrane, 1991; Cooper & Priestley, 2009; Lettau & Ludvigson, 2001; Rangvid, 2006; among many others) in which researchers investigate the relation between market returns and the macroeconomic variables such as GDP, IP, aggregate consumption, investment, etc. The main motivation behind earlier studies comes from a common observation that people demand more reward/return for holding risky assets during bad times, when the marginal value of wealth is high (Cochrane, 2005). Therefore, it is believed that expected market returns vary over time and are inversely correlated with business cycles. As the output gap increases during expansions and decreases during recessions, one can intuitively expect a negative relation between the (lagged) output gap and expected market excess returns.

Cooper and Priestley (2009) found that the common measure of the output gap (ex-post QTgap or FSgap) based on a single quadratic trend line fitted to a full sample of data has significant predictability for market excess returns. Their finding is important because it shows a strong connection between the real and financial sectors of an economy under an ideal framework in which agents have full information about the economy. This study confirms their results (see Appendix A) but finds that the ex-ante quadratic trend-based output gap (QTgap)[3] has no predictability for real market excess returns at different frequencies in the U.S. data.

Using monthly (quarterly and annual returns are determined from monthly returns) market excess return data from 1948:01 to 2010:12 and the vintage IP index data from 1947:12 to 2010:11, this study finds a negative and statistically significant relation between the market excess returns and the (lagged) WAgap at three frequencies.[4] However, predictability of the WAgap is much weaker during great moderation period of the U.S. economy.

The rest of this paper is organized as follows. Section 2 describes the methodology. Section 3 provides empirical analysis with a description of the data, and Section 4 concludes.

2. Methodology

2.1. Basic methodology

Understanding the variation of asset returns has been a constant study topic of financial researchers seeking to predict a broad-based stock index return or market return. The importance of such a prediction analysis lies in determining a benchmark of return that can act as a yardstick for the performance of various economic policies. A standard technique for predicting market returns is to conduct the following type of forecasting regression:

$$r_t = \mu + \gamma x_{t-1} + \epsilon_t \tag{1}$$

where r_t is the market return at period t, x_{t-1} is a lag predictor, and ϵ_t is a disturbance term. The market return is predictable by x if $|\gamma| > 0$. Different scholars have used a number of variables[5] as x_{t-1}, and still there is no consensus regarding the best predictors. That is to say, while most financial researchers agree that it is important to have a good forecasting model for aggregate stock returns, the question of which predictor(s) to use is still unresolved.

Broadly, predictors are of two types: financial variables and macroeconomic variables. The main goal of this study is to understand the nature of macroeconomic risk that can explain time-varied risk premiums; it exclusively focuses on an important macroeconomic variable, the output gap, which is by far the most prominent business cycle-indicating variable. According to many studies such as Cochrane's (2005), Cooper and Priestley's (2009), etc., one obvious advantage of using macroeconomic variables rather than financial variables such as dividend yields, pay-out ratios, etc., in the prediction of stock index returns is that macroeconomic variables do not suffer from stock mispricing or fads in prices. The idea that the lagged output gap contains useful information about expected market excess returns incorporates the fact that the perception of risk varies through business cycles.

2.2. Proposed methodology

This study expands the literature of predicting market excess return from the output gap in three important ways. First, it uses a data-driven flexible weighting scheme to derive the output gap. It argues that the calculation of the output gap based on equal-distance weights applied to various prior output data is restrictive because, in general, a period's output is more closely related to the adjacent periods' output than the distant periods' output, and the underlying economic conditions change with time. Second, based on recent literature (for example, Orphanides and van Norden (2002), Welch and Goyal (2008), Papell, Molodtsova, and Nikolsko-Rzhevskyy (2008, 2011) among others) this study uses only past/available information and estimates the output gap recursively at each forecasting origin under consideration. This sort of recursive estimation has appeal for real-life forecasting scenarios because an investor could only have used past periods' information to estimate the model and not the entire sample period's information. Third, unlike the restrictive use of constant variance in Eq. (1), both the mean and the variance of the return are determined together. As argued in Marquering and Verbeek (2004), such simultaneous determination is preferred compared to the return forecasting framework in Eq. (1) with its constant variance. Here, the conditional variance, $V_{t-1}(r_t)$, of market excess returns is determined from prior (high-frequency) daily market excess return data using a mixed data sampling (MIDAS) approach proposed by Ghysels, Santa-Clara, and Valkanov (2005). By using the MIDAS process in estimating conditional variance, this study employs potentially useful information at a higher frequency (daily). This is a major improvement compared to the standard return forecasting framework in Eq. (1). The MIDAS approach and the distance weighting scheme are explained in the next subsection.

2.3. A MIDAS regression with a beta-weighting scheme

The MIDAS approach links variables that are sampled at different frequencies. It provides a framework to include potentially valuable information from higher frequency data that have many appealing properties, such as parsimony, flexibility, etc., compared to other distributed lag models. The superiority of this approach over many competing approaches in determining the conditional variance of market excess returns has been shown in many recent papers, such as Alper, Fendoglu, and Saltoglu's (2008), Ghysels, Santa-Clara, and Valkanov's (2006), among others.

The main task in a MIDAS regression is a polynomial specification, which can be conceived as specifying a parsimonious weighting scheme to the lag values of the (higher frequency) regressors on the right-hand side of the equation. Following Ghysels et al.'s (2006) and Ghysels, Sinko, and Valkanov's (2007), work this study uses a single parameter beta polynomial to specify a distance weighting scheme. Such a

[2] This study reports an analysis that corresponds to vintage data; however, similar results were obtained with revised data.

[3] By construction both the WAgap and the QTgap are ex-ante. For simplicity, instead of denoting "the ex-ante QTgap," I denote it as "the QTgap."

[4] Here 01 denotes January, 02 February,…, 12 December.

[5] Welch and Goyal (2008) aptly indentify the following 17 prominent predictors for market returns from the literature: book-to-market ratio, consumption–wealth ratio, cross-sectional premium, default return spread, default yield spread, dividend payout ratio, dividend price ratio, dividend yield, earnings price ratio, inflation, investment-to-capital ratio, long-term return, long-term yield, net equity expansion, stock variance, term spread, and T-bill rate.