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The output gap and stock returns: Do cyclical fluctuations predict portfolio returns?

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ABSTRACT

This study examines whether the output gap leads portfolio stock returns. The paper conducts in-sample and out-of-sample forecasting of US stock portfolios formed on the basis of size and value. First, the paper finds cross-sectional portfolios are predictable in-sample by the output gap. Out-of-sample evidence is weaker but still generally supports the finding that the historical average benchmark can be beaten. Secondly and most importantly, we find mixed evidence that the Fama–French factor mimicking portfolios can be forecasted by the output gap. In particular, there is some out-of-sample predictability of the size effect (SMB) suggesting this lags the output gap. However, the output gap, a key business cycle indicator, cannot predict the value effect (HML) either in-sample or out-of-sample. Our results add to the prior literature which finds that the factor mimicking returns are related contemporaneously (Petkova and Zhang, 2005) or lead (Liew and Vassalou, 2000) economic indicators.

1. Introduction

“Many recent studies conclude that stock returns can be predicted by means of publicly available information, such as time series data on financial and macroeconomic variables with an important business cycle component” (Pesaran & Timmermann, 1995 p1201).

One rational explanation for the existence of stock return predictability is that expected returns time-vary over the business cycle (see, for example, Fama & French, 1989). Recent analysis by Cooper and Priestley (2009 p2801) provides support for this hypothesis by demonstrating that, “the output gap, a prime business cycle indicator, predicts stock and bond market returns both in-sample and out-of-sample”. The output gap is an attractive predictor variable. First, in contrast to financial variables, such as the dividend yield (Campbell & Shiller, 1988; Fama & French, 1988) and gilt-equity yield (Clare, Thomas, & Wickens, 1994), the output gap does not contain the level of asset prices. Using non-financial-based variables, such as the output gap, to predict returns removes the suspicion that return predictability may be due to “fads” in prices (see Cochrane, 2005). Secondly, it is a production-based measure of activity which might lead other economic variables. Thus, the output gap may constitute independent evidence with respect to variations in returns over the business cycle.

This paper extends the analysis of Cooper and Priestley (2009) to portfolio returns. If the output gap captures business cycle risk then it should predict returns in the cross-section. We therefore conduct in-sample and out-of-sample forecasting of US stock portfolios formed on the basis of size and value. We investigate size-value portfolios because prior literature argues that size and value are related to economic risk factors (see for example Fama & French, 1996). An unresolved debate is whether the Fama and French (1993, 1996) return factors linked to size and book to market ratio are in fact economic risk factors. Cyclical fluctuations, as measured via the output gap, could potentially provide insight into why firms with differing size-value characteristics earn such different returns. If the output gap is a pervasive economic risk then it should not just explain and forecast returns on size or value portfolios but it should be able to explain the returns on the Fama–French size factor (SMB) and value factor (HML).

The approach in this paper is consistent with asset pricing models under the assertion that the output gap proxies for economic activity which impacts investor risk aversion. This means slope coefficients from predictive regressions can be interpreted as sensitivity to cyclical risk. However, unconditional asset pricing models with economic factors have typically had limited ability to capture cross-sectional variation in returns such as the Consumption CAPM (see for example Hansen & Singleton, 1982, 1983) and Output-based asset pricing model (see for

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example Rodriguez, Restoy, & Pena, 2002). In this paper we use a smoother variable, the output gap, which is a proxy for current state of the economy which in turn affects investor risk aversion.

The forecasting of portfolio returns conducted in this paper is an important extension of the prior literature. Do movements in economic activity precede movements in portfolio returns? Given that the output gap is a measure of production rather than consumption it is plausible that this will lead rather than lag other economic variables. Further, the output gap can be used to measure time-variation in returns over the business cycle. This extends prior literature because, for instance the value premium is found to be linked to future economic activity (Liew & Vassalou, 2000) and to contemporaneous economic activity (Petkova & Zhang, 2005), but to our knowledge there is little evidence on whether economic activity leads the value premium or other cross-sectional return premium. If return premia can be reliably forecast this could enable asset managers to enhance their performance.

Petkova and Zhang (2005) make the important contribution of providing evidence that the value effect is related to cyclical risk fluctuations. However, their evidence is based upon discrete allocation of periods into four (economic) stages from recession to boom. In this paper we use the output gap following Cooper and Priestley (2009), which is a continuous measure of cyclical risk. Cooper and Priestley (2009) measure the output gap as the deviation of log industrial production from its (linear and quadratic) trend. We extend the aggregate analysis of Cooper and Priestley (2009) to a wide range of stock portfolios. Can a continuous measure of economic risk predict and forecast cross-sectional portfolio returns? Our paper adds to this literature by examining if the Fama–French factors can be predicted or forecasted by the output gap. Petkova and Zhang (2005) include dividend yield as an indicator of expected returns; hence their evidence is not entirely free from the possibility that predictability stems from "fads" in prices. In contrast, the Cooper–Priestley measure, adopted in this paper, is free from this criticism.

We examine if i) whether Fama–French factor portfolios can be forecasted by fluctuations in the output gap and ii) whether small and value stock returns can be forecast by fluctuations in the output gap. The paper is structured as follows: Section 2 presents the data and methodology, Section 3 contains in-sample predictability results and Section 4 addresses out-of-sample forecasting. Section 5 concludes.

2. Data and methodology

2.1. Data description

The data is monthly over the January 1948 to December 2010 sample period. This extends the original Cooper and Priestley (2009) sample to include 2005–2010, which enables us to assess the robustness of their results to the inclusion of the recent economic downturn. Return data is from Ken French's data library.[2] There are two main segments of the return data. First, we use the Fama-French three factors and the risk-free rate. The three factors are the value-weighted excess market return, and two factor mimicking portfolios which capture the size premium (SMB) and the value premium (HML) respectively. Second, we use portfolios which are two-way independently sorted on size and value. A two-way, two by three sort on size and value is used to obtain the six portfolios that are used to estimate SMB and HML (Fama & French, 1993, 1996). A two-way, five by five sort on size and value is used to generate the 25 Fama and French (1996) portfolios used widely to test asset pricing models.

Following Cooper and Priestley (2009) output is measured using vintage data[3] on the Federal Reserve's total Industrial Production index (y_t). The output gap is then calculated as the deviation of output from a linear trend and a quadratic trend (Eq. (1)):

$$y_t = \alpha + \phi t + \gamma t^2 + v_t \tag{1}$$

y_t is the total output reported at time t but since this is reported with a lag the data actually refers to time t − 1. ϕt is a linear time trend, and γt^2 is a quadratic time trend. v_t , the residual from Eq. (1), is the output gap. For the in-sample tests, Eq. (1) is estimated using data over the full sample period (1948:1–2010:12), and is used in the in-sample predictability tests. For the out-of-sample tests we calculate the output gap in a similar way to Cooper and Priestley (2009). Firstly, we estimate Eq. (1) over the in-sample period (1948:1–1952:12) and save the output gap values. Secondly we re-estimate Eq. (1) over each out-of-sample period and save the most recent output gap value. This approach means that the output gap for the out-of-sample tests is only based on information available in real-time.

We solely report results using the quadratic trend measure of the output gap because it is Cooper and Priestley's (2009) primary measure; Cooper and Priestley (2009) demonstrate three other measures of the output gap that provide very similar results to this primary measure.

For robustness tests we include the S&P 500 dividend yield, term spread and default spread. We obtain the S&P 500 dividend yield and a long-term bond yield from Robert Shiller's website and obtain Moody's BAA corporate bond yield from FRED. The term spread is calculated as the log of one plus the long-term bond yield minus the risk-free rate. The default spread is calculated as the log of one plus the Moody's BAA corporate bond yield minus the long-term bond yield.

2.2. Predictive regressions and individual forecasts

Eq. (1) is used to measure in-sample predictive power. $R_{t,t+k}$ is the continuously compounded log stock return from t to $t+k$. v_t is the output gap using information available at period t, since the output is reported with a lag the output gap for period t is based on data for period t − 1.[4]

$$R_{t,t+k} = \alpha + \beta v_t + \varepsilon_{i,t} \tag{2}$$

We estimate Eq. (1) for horizons (k) from one-year through five-years. Bootstrapped t-statistics are calculated following Mark (1995) and fully described in Section 2.3. This simulation approach helps mitigate concerns over the impact of autocorrelation caused by overlapping observations as well as concerns over data mining (Rapach & Wohar, 2006).

Out-of-sample forecasts (for period $t+k$) are generated using only information available at period t. Time-varying coefficients are estimated in real-time from Eq. (3) using a recursive regression technique. A minimum window length of 5 years of monthly data (60 observations) is used to derive parameter estimates. Thus the 1948:1–1952:12 period provides the first coefficient estimates, 1948:1–1953:1 the second and so on. Eq. (4) is then used to produce forecasts of returns for each horizon. Thus, the first forecast for horizon k = 1 is for the return from 1952:12 to 1953:1, for horizon k = 3, the first is from 1952:12 to 1953:3 and for horizon k = 12 is 1952:12 to 1953:12. This regression process is followed for each return portfolio.

$$R^k_{t-k,t} = \alpha_t + \beta_t v_{t-k} + \varepsilon_t \tag{3}$$

$$R^k_{t,t+k} = \alpha_t + \beta_t v_t \tag{4}$$

The benchmark, unless otherwise stated, is the historical average return model as in Cooper and Priestley (2009), however results are

[2] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

[3] Vintage data is that which is actually reported to the market; such data is not subject to subsequent revision which is common in macroeconomic time series. See Croushore and Stark (2003) for an analysis of the effect and issues of not using vintage data.

[4] Including the one-period lagged return in regression equations gives very similar empirical results.