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Shaping the manufacturing industry performance: MIDAS approach☆

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ABSTRACT

We aim to find out whether the exchange rate (against US dollar) or the interest rate (in local currency) is a better variable in predicting the capacity utilization rate of manufacturing industry (CUR) of Turkey after the 2008 global financial crisis. In that manner, we implement dynamic mixed data sampling (MIDAS) regression model to forecast monthly changes in CUR by using daily changes in the exchange rate and the interest rate separately. The results show that exchange rate has a better forecast performance suggesting that it is a stronger determinant in shaping the manufacturing industry.

1. Introduction

Manufacturing is one of the most important sectors of every economy as well as an essential tradable sector, which makes it often the most competitive one. Its significance also stems from the fact that it is the carrier of innovation and development activities that spill over to other sectors and brings out an increased productivity.

Besides industry specific factors, macroeconomic conditions such as business cycle fluctuations, foreign demand, interest and exchange rates, taxes and government expenditure are the most influential drivers of manufacturing performance.

The empirical literature regarding the relationship between manufacturing performance and macroeconomic policies is very limited. This is somewhat surprising considering the fact that monetary policy is often considered to be the main reason for the weak/strong performance of manufacturing. Accordingly, the aim of this paper is to determine which one of the two main macroeconomic factors; exchange rate and interest rate; drive output and expectations in manufacturing. In that manner, we compare the forecasting performance of these two factors on the capacity utilization rate (CUR) of manufacturing industry in a leading emerging market, Turkey.

CUR in Turkey, is calculated based on the responses to the business tendency survey (BTS) and aims to compile these responses (received in the surveyed month) of the local units operating in the manufacturing industry on their actually realized capacity utilization rates as physical capacities.[1] As easily understood, CUR carries important information regarding the current status and the future expectations about the manufacturing industry.

Although our task may seem easy at first glance, we face with the problem of mixed data frequencies as CUR is sampled low frequency (LF)-monthly, on the other hand

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[1] Responses regarding the CUR within the BTS are included as percentages; then by calculating their weighted averages; these figures are aggregated for the overall manufacturing industry. In addition, seasonally adjusted series is also calculated and disseminated.

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the other two variables can be sampled at much higher frequency (HF). Since forecasting generally requires data with the same frequency, such a situation brings out practical problems.

In this paper, we deal with this problem with a novel methodology called mixed data sampling (MIDAS) regression which enables us to perform mixed frequency regressions. The results show that compared to interest rate, exchange rate is a better forecaster of CUR in Turkey indicating that it is a stronger determinant of manufacturing industry performance.

2. Data and methodology

MIDAS regression models are a recently developed framework (see, [1–5]) to deal with regressions where the dependent variable is of lower frequency to the explanatory variable(s). It can be applied to a context such as ours, where daily variables; interest rate and exchange rate; are used to forecast capacity utilization rate, a monthly quantity. Indeed, MIDAS models have already been employed and showed promising results in both nowcasting and forecasting (see, [6–10]).

Simply, MIDAS is a way of dealing with the mixed frequency problem that is both parsimonious and data-driven. For example, suppose that we are interested in studying the relationship between Y_t, the monthly changes in CUR; and the X_t, daily changes in exchange rate or interest rate. An initial and simplest approach is to construct monthly averages using the daily observations of X_t during the month i.e. $X_{m,t} = (X_1 + \cdots + X_{N_d})/N_d$ then regress Y_t on $X_{m,t}$ where N_d is the number of business days in a month. However, such equal weighting scheme can be quite restrictive, and Andreou et al. [3] discuss the resulting econometric problems. An alternative approach is to regress Y_t on each of the month's daily returns separately: $Y_t = \mu + \beta_1 X_1 + \cdots + \beta_{N_d} X_{N_d} + \varepsilon_t$. However, this approach can be quite problematic (because of parameter proliferation) if the high and low frequencies differ significantly as in our case. It can also suffer from dynamic misspecification without further refinement of the equation. Considering these facts, MIDAS models are of particular interest as they are parsimonious and also allow for data-driven weights. In our study, MIDAS provides an adjustable environment within which we can analyze the separate contributions of the daily exchange rate (or interest rate) values to the forecast every next month's CUR.

The benchmark MIDAS regression model that is appropriate for our specific task is the following:

$$Y_{t+1} = \mu_0 + \mu_1 Y_t + \beta \sum_{j=0}^{p_x-1} \sum_{i=0}^{N_d-1} \omega_{N_d-i+j*N_d}(\theta) X_{N_d-i,t-j} + \varepsilon_{t+1} \quad (1)$$

where Y_t is the change in seasonally adjusted CUR from month $t-1$ to month t, $X_{N_d-i,t-j}$ is the daily changes in exchange rate (against US dollar) or interest rate (in local currency) on $(N_d - i)$th day in month $t-j$ and ε_t are the error terms.[2,3] In Eq. (1), $p_x - 1$ shows how many monthly lags of the daily returns we include in the regression. The ωs are the weights which are a function of the parameter(s) θ, and the unknown parameters $(\mu_0, \mu_1, \beta, \theta)$ are to be estimated by non-linear least squares.[4] In order to identify the slope coefficient β, the term $\sum_{j=0}^{p_x-1} \sum_{i=0}^{N_d-1} \omega_{N_d-i+j*N_d}(\theta)$ is set equal to 1.

The existing MIDAS literature (see, for instance, [5]) discusses various choices for parameterizing the MIDAS polynomial weights such as beta, exponential almon and step function weights. After performing several experiments with different lag lengths for the explanatory variables and different specifications for the weights, we observed that in most of the cases, the beta specification is a better model considering polynomial fit and forecast accuracy together. Thus, the structure we implement in this paper uses the beta weights defined as follows[5]

$$\omega_i^{beta}(\theta_1, \theta_2, \theta_3) = \frac{(\frac{i-1}{N-1})^{\theta_1-1}(1-\frac{i-1}{N-1})^{\theta_2-1}}{\sum_{i=1}^{N}(\frac{i-1}{N-1})^{\theta_1-1}(1-\frac{i-1}{N-1})^{\theta_2-1}} + \theta_3 \quad (2)$$

where N is the number of MIDAS lags.

3. Results

We follow two types of dynamic ADL-MIDAS scheme in our analysis. The first one is of recursive type where we take the time interval from June 1, 2009 (which is the end date of the US recession according to NBER) to December 1, 2012 (where our original data set ends with August 1, 2013). For this time interval, we fit the model defined in Eq. (1) and forecast (in sample) the 1 month ahead change in CUR using X_t as daily changes in exchange rate and interest rate separately. Then we record the forecast value $\hat{Y}_t$ and the actual value Y_t. In the next step, we enlarge the sample size by one month and repeat the same procedure. Since our data ends with the CUR value of the July 2013, we can repeat this procedure eight times. In the end, we calculate the root mean square (RMSE) of the forecast results i.e.

$$\text{RMSE} = \sqrt{\frac{\sum_{t=1}^{n}(Y_t - \hat{Y}_t)^2}{n}} \quad (3)$$

[2] All data are obtained from the Central Bank of the Republic of Turkey. The daily interest rate is the annualized compound yield of the highest liquid government bond on a given day. Alternatively, we also repeated the analysis by using annualized yields of the government bonds with 19 months to maturity (the benchmark paper). The conclusive results are the same, hence they are not reported. On the other hand, the corporate bond market was recently introduced in 2010, and there is a big difference in terms of liquidity between government and corporate bond market in favor of the former, hence the information in the latter may be misleading, therefore it is not used in our analysis.

[3] The percentage changes in CUR and exchange rate are taken as (log-returns) × 100 and the percentage changes in interest rate are taken as (first differences) × 100.

[4] Lagged LF variable is inserted into the equation to get rid of the serial correlation effect. In our analysis, for each different daily lags of the HF variables, the optimal lag for the LF variable is found to be 1 by Bayesian Information Criterion.

[5] Where we use the unrestricted model with the zero last lag i.e. $\omega_i(\theta_1, \theta_2, 0)$.