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Overproduction, Aggregate Accounting Performance, and Gross Domestic Product*

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ABSTRACT

This paper explores possible links between overproduction and future gross domestic product (GDP) growth. Using a measure of economy-wide overproduction that captures firms' real earnings management (REM) incentives, we find that REM-driven overproduction has a negative moderating effect on the positive association between growth in aggregate accounting performance and one-quarter-ahead GDP growth documented in the literature. We also find that macro forecasters do not fully incorporate

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this effect into their forecasts. Our findings contribute primarily to the literature that links aggregate accounting information to GDP growth.

Keywords: Overproduction, Aggregate earnings, Gross domestic product (GDP)

1. INTRODUCTION

Prior literature provides evidence of the informativeness of accounting data for growth in gross domestic product (GDP). In particular, several studies (e.g., Konchitchki and Patatoukas 2014a) find that growth in aggregate accounting performance (e.g., aggregate earnings growth) predicts future GDP growth. In this paper, we seek to enhance our understanding of the source and nature of macroeconomic information embedded in aggregate accounting performance by focusing on possible links between overproduction and GDP growth. Specifically, we examine the direct effect of overproduction on future GDP growth as well as the moderating effect of overproduction on the relation between changes in aggregate accounting performance and future GDP growth as documented in prior literature.

We focus on overproduction because of its importance and relevance to this study from both macroeconomic and accounting perspectives. From the macroeconomic perspective, overproduction is a key topic in the history of economic theory and has attracted substantial attention in the literature. This increased attention warrants an investigation of overproduction as a source of information related to macroeconomic indicators such as GDP growth. Furthermore, macroeconomic studies highlight the important role of changes in inventories in explaining fluctuations in GDP (e.g., Ramey 1989; McConnell and Perez-Quiros 2000; Stock and Watson 2002). Changes in inventories have implications for current and future earnings based on accounting relations. This partially motivates a re-examination of the link between overproduction and GDP growth using a novel approach, such as the accounting approach used in this study.

From the accounting perspective, prior studies on the relation between aggregate earnings and macroeconomic indicators have paid increasing attention to how this aggregate relation is affected

by aggregate earnings properties. Recent studies examine various properties of aggregate earnings including conservatism (e.g., Crawley 2015; Laurion and Patatoukas 2016), persistence (e.g., Abdalla and Carabias 2017; Hann, Li, and Ogneva 2019), and smoothness/volatility (Ball, Gallo, and Ghysels 2019; Dichev and Zhao 2019). These prior studies beg a question of how manipulation alters the information content of aggregated accounting figures. Relatedly, Ball, Gallo, and Ghysels (2019) identify two conditions for earnings properties to enhance the informativeness of aggregate earnings. Specifically, an earnings property must: (1) reflect firms' overall reporting behavior in the economy, and (2) exhibit substantial cross-sectional variation. As discussed later, overproduction of inventories has conceptual implications for aggregate earnings properties. Thus, our aggregate overproduction measure based on the accounting approach operationally captures the economy-wide tendency of firms to manage earnings in a given period, whereas prior studies already document sufficient variation in overproduction across firms. For example, Roychowdhury (2006) finds substantial cross-sectional variation in real earnings management practices as a means to avoid losses. In this sense, we expect our focus on overproduction to enhance our understanding of the relation between aggregate accounting performance measures and future GDP.

Our investigation of the possible direct and moderating effects of overproduction on future GDP growth requires an understanding of how overproduction affects current and future earnings, motivated primarily by the contemporaneous positive association between aggregate earnings growth and GDP growth reported by Konchitchki and Patatoukas (2014a). While this association can be partially explained by an overlap between aggregate earnings and corporate profits, which are a component of GDP, some portion of accruals (e.g., inventory write-down) contained only in aggregate earnings can be directly reflected in the calculation of GDP. For example, the production approach to measuring GDP deducts intermediate consumption (i.e., the cost of material, supplies and services used to produce final goods or services) from the gross value of domestic output. Under this approach, inventory write-down is reflected as a decrease in the gross value of domestic output, thereby reducing GDP directly. Moreover, aggregate earnings are likely correlated with other drivers of GDP, such as producer prices (Shivakumar

and Urcan 2017) and aggregate investment (Kothari, Lewellen, and Warner 2006). Therefore, aggregate earnings are a plausible channel through which overproduction affects future GDP growth.

We rely on the accounting literature that typically views overproduction as a real earnings management (REM) activity used to inflate current earnings, likely at the expense of future earnings (e.g., Roychowdhury 2006; Gunny 2010). Specifically, under absorption costing required by U.S. Generally Accepted Accounting Principles (GAAP), increased overproduction results in lower cost of goods sold (COGS), thereby leading to higher operating margins in the current period. This relation is based on the assumption that the decrease in COGS per unit is not offset by any increase in marginal cost per unit. Related studies also rely on this assumption (e.g., Roychowdhury 2006; Gunny 2010). The increase in current earnings resulting from overproduction is thus rather mechanical, albeit likely being temporary and reversing in future periods.

In contrast to the clear predicted link between overproduction and current earnings, the directional effect of overproduction on future earnings is *ex ante* unclear. On one hand, overproduction likely results in a decline in future earnings, regardless of whether the overproduced inventories are unsold or sold in the current period (e.g., Gupta, Pevzner, and Seethamraju 2010). The unsold portion increases inventory holding costs on the firm, especially in periods following overproduction. The sold portion is usually accompanied by price discounts and/or lenient credit terms to customers and can lead to a decline in future earnings if firms have difficulty reestablishing old prices and/or credit terms. On the other hand, overproduction may enable managers to signal superior future earnings (e.g., Jiambalvo, Noreen, and Shevlin 1997), especially when managers use their discretion just to meet earnings benchmarks (Gunny 2010). This alternative scenario implies a positive association between overproduction and future earnings.

These competing effects of overproduction on future earnings at the firm level become more ambiguous at the aggregate level, primarily because it is *ex ante* unclear whether cross-sectional variation in firm-specific overproduction survives or cancels out in the aggregation of accounting data. First, several studies (e.g., Hirshleifer, Hou, and Teoh 2009; Ball and Sadka 2015) argue that variation in firm-specific earnings properties could be diversified away in the aggregate. Second, Ball, Gallo, and Ghysels (2019)

suggest that earnings smoothness is an earnings attribute that is positively correlated across firms, shows substantial cross-sectional variation, and therefore may improve the informativeness of aggregate earnings for predicting future GDP. Moreover, Sadka (2006) suggests that fraudulently reported accounting numbers by a firm can affect the whole industry and social welfare as well. Since whether overproduction (and more generally, REM) is related to earnings smoothing is *ex ante* unclear, it would be challenging to document a significant direct effect of overproduction on future earnings at the aggregate level and, by extension, future GDP.

Some of the discussions above also have competing implications for the moderating effect of overproduction on the relation between growth in aggregate accounting performance and future GDP growth. This moderating effect relates to how the aforementioned temporary increase in current earnings resulting from overproduction is associated with future performance. We again consider two competing possibilities. On one hand, the moderating effect is expected to be negative because future earnings will decline in the period that the temporary increase in current earnings resulting from overproduction reverses. On the other hand, the moderating effect could be positive if it reflects on-average overproduction signalling superior future earnings. Therefore, the direction of the moderating effect of overproduction with respect to future GDP growth is an empirical question.

Our analysis requires an aggregate overproduction measure that captures REM incentives. Based on the methodology employed in related studies, we construct this measure in the following two stages. In the first stage, we estimate abnormal production costs for each firm-quarter using firm-specific time-series regressions. In the second stage, we aggregate these firm-level abnormal production costs using value-weighted cross-sectional averages. In particular, we perform this aggregation using only the firms that are suspected of having overproduced inventory because of REM incentives. Specifically, these "suspect" firms satisfy the requirement of quarterly scaled earnings falling in the interval to the immediate right of zero, as in Roychowdhury (2006). This requirement is imposed to better ensure that our overproduction measure is driven by REM incentives.

Furthermore, we examine whether our aggregate overproduction measure is associated with economy-wide production. Our investiga-

tion is partially motivated by the analytical research of Strobl (2013) predicting that firms differ in their probability of manipulation over the business cycle. Thus, to the extent that overproduction is a type of manipulation, our aggregate overproduction measure is expected to exhibit a positive correlation with a production measure that varies with the business cycle. In this regard, we confirm that our overproduction measure is positively associated with a measure of economy-wide production (i.e., "industry production" defined by the Board of Governors of the Federal Reserve System).

Having validated our accounting-based overproduction measure, we next examine the earnings implications of overproduction. While we do not find a significant association between our aggregate overproduction measure and future aggregate earnings growth, we find that overproduction mitigates the positive association between current and one-quarter-ahead aggregate earnings growth. This latter finding is consistent with the REM explanation that future aggregate earnings decline in the period during which the temporary increase in current earnings resulting from overproduction reverses, while dismissing the alternative REM explanation that firms engage in overproduction to signal superior future earnings.

Our primary tests examine not only the direct effect of overproduction on future GDP growth but also the moderating effect of overproduction on the association between growth in aggregate accounting performance and future GDP growth. In particular, we focus on whether these effects mirror the aforementioned earnings effects of overproduction. Consistent with the earnings effects, we find that the moderating effect of REM-induced overproduction is negative with respect to one-year-ahead GDP growth in both nominal and real terms, while we do not find a significant association between overproduction and future GDP growth. Thus, our findings imply that the overproduction information related to REM can be used to enhance our understanding of the relation between aggregate accounting performance measures and future GDP.

Finally, we examine whether professional macro forecasters incorporate the macroeconomic information contained in overproduction. Following the literature, we compute forecast errors using GDP growth forecasts issued by the Survey of Professional Forecasters (SPF). The results suggest that macro forecasters do not fully impound the negative moderating effect of overproduction with respect to subsequent GDP growth.

We make several contributions to the literature. First, this study contributes to the rapidly growing literature in the accounting field that links accounting information to GDP growth (Konchitchki and Patatoukas 2014a, 2014b; Ball and Sadka 2015; Gaertner, Kausar, and Steele 2020; Gallo, Hann, and Li 2016; Abdalla and Carabias 2017; Nallareddy and Ogneva 2017). Specifically, we identify overproduction as a moderating factor that affects the predictive power of aggregate earnings for future GDP. More generally, this finding enhances our understanding of the source and nature of macroeconomic information embedded in aggregate earnings.

Second, our study contributes to macroeconomic research in several ways. In particular, while prior research in this area generally provides descriptive evidence on the relation between overproduction and macroeconomic outcomes, we develop an empirical measure of economy-wide overproduction that can be used to shed light on this issue. Furthermore, our finding that overproduction affects the predictability of accounting data for future GDP growth has potential implications for macroeconomic policies (e.g., monetary policy) that are known to rely on GDP growth forecasts (Taylor 1993; Konchitchki and Patatoukas 2014a) and aggregate earnings (Gallo, Hann, and Li 2016).

Finally, this study contributes to the accounting literature on consequences of real earnings management (e.g., Cohen and Zarowin 2010; Gunny 2010; Eldenburg et al. 2011; Vorst 2016). In particular, while Gunny (2010) finds that firm-level overproduction has a negative direct effect on one-year-ahead operating performance, we complement her findings by documenting a negative moderating effect of overproduction with respect to one-quarter-ahead earning growth at the aggregate level. Further, this evidence enhances our understanding of the link between accounting data and aggregate economic activities examined in related studies (e.g., Kothari, Lewellen, and Warner 2006; Sadka 2007).

The remainder of the paper is organized as follows. Section 2 presents backgrounds and our research questions. Section 3 describes the methodology and sample and provides descriptive statistics. Section 4 presents and discusses the empirical results. Section 5 concludes.

2. BACKGROUND AND RESEARCH QUESTIONS

2.1. Prior Research on Overproduction in Economics Literature

Overproduction is a key topic in the history of economic theory and has attracted substantial attention in the literature. Debates on the nature of overproduction and its implications for macroeconomic outcomes date back to as early as the nineteenth century (Callaway 2014). Classical economists generally dismissed the existence of overproduction in theory. For example, according to Say's Law formulated by Jean-Baptiste Say (1767–1832), aggregate production is necessarily followed by an equal quantity of aggregate demand, suggesting that overproduction does not exist in theory. Several notable economists, however, proposed alternative views. For example, Karl Marx (1818–1883) proposed the inherent tendency of capitalism towards overproduction. Specifically, he suggested that the self-adjusting demand-supply relationship does not hold when the impoverishment of producing workers prohibits an increase in their consumption. A resulting price decline may create a crisis within the capitalist system.

Relatedly, John Maynard Keynes (1883–1946) suggested that a suffering economy results from overproduction as well as lack of demand, and proposed government intervention in response to the Great Depression in the U.S. that took place mostly during the 1930s. In particular, the Keynesian view on overproduction, among others, suggests that overproduction is a key to understanding the cause of financial crises. As such, overproduction has also generated much attention in the media. This increased attention warrants an investigation of overproduction as a source of information related to macroeconomic indicators such as GDP growth.

Several other studies in macroeconomics document that changes in inventory are an important source of fluctuations in GDP. Ramey (1989) finds that shifts in the demand for inventories are a major source of economic fluctuations. McConnell and Perez-Quiros (2000) and Stock and Watson (2002) suggest that a sharp decrease in the volatility of production in manufacturing in the mid-1980s, due to new inventory management methods, is a source of the reduction in volatility in GDP. The reduction in volatility in macroeconomic variables since the mid-1980s is referred to as the Great Moderation

(e.g., Kim and Nelson 1999; McConnell and Perez-Quiros 2000; Stock and Watson 2002; Kim, Nelson, and Piger 2004).

Somewhat surprisingly, however, the economics literature pays little attention to the issue of how to empirically measure economy-wide overproduction based on changes in inventories. Moreover, from an accounting perspective, changes in inventories have implications for accounting earnings. This motivates our estimation of economy-wide overproduction using a novel approach, such as the accounting-based approach related to real earnings management.

2.2. Research Questions

The primary objective of this study is to examine the direct effect of overproduction on future GDP growth and the moderating effect of overproduction on the positive association between growth in aggregate accounting performance and future GDP growth as documented in the literature. We also examine whether professional macro forecasters incorporate these direct and moderating effects of overproduction, if any. Our investigation of these overproduction effects requires an understanding of how overproduction affects earnings in current and future periods both at the firm and aggregate levels.

Regarding the effect of overproduction on *current* earnings at the firm level, U.S. GAAP mandates absorption costing such that higher production levels allow fixed overhead costs to be spread over a larger number of units, leading to a decline in fixed cost per unit. Total per unit cost will also decrease, assuming that the decrease in fixed cost per unit is not offset by any increase in per unit marginal cost (due to congestion costs from increased volume of output). Consequently, overproduction results in lower COGS and higher operating margins in the same period, while the resulting increase in earnings is likely to be mechanical and temporary (Thomas and Zhang 2002).

Regarding the effect of overproduction on *future* earnings at the firm level, we entertain two competing scenarios. On one hand, overproduction likely results in lower future earnings, regardless of whether the overproduced inventories are sold during the current period. The unsold portion increases inventory holding costs on the firm. Ceteris paribus, earnings decrease in periods where some of these holding costs are realized. Regarding the sold portion

of overproduced inventories, some managers have incentives to sacrifice future earnings to recognize additional sales in the current period by offering price discounts or extending more lenient credit terms to customers. For instance, aggressive price discounts may lead customers to believe that such discounts will continue to be provided in future periods. As a result, firms could have difficulty reestablishing old prices, thereby leading to a decline in future earnings.

On the other hand, overproduction may enable managers to attain benefits that allow better future performance or to signal superior future earnings, especially when managers use their discretion to just meet earnings benchmarks (Gunny 2010). While this argument applies to situations where managers have incentives to meet earnings benchmarks, to the extent that such incentives are prevalent in the economy, overproduction could be followed by an improvement in future performance. These possibilities alternatively suggest an increase in future earnings as a result of overproduction.

Given these competing effects of overproduction, we have no clear ex ante prediction as to whether or not those effects of overproduction on future earnings at the firm level would hold at the aggregate level. Several studies suggest that firm-level properties or changes in earnings could be canceled out or diversified away when they are aggregated (Hirshleifer, Hou, and Teoh 2009; Ball and Sadka 2015). In contrast, other studies argue that firm level earnings properties could be extended to the aggregate level. For example, Ball, Gallo, and Ghysels (2019) find that relatively low volatile earnings compared to cash flows at the firm level improve the usefulness of aggregate earnings in predicting future economic outcomes. Thus, it is an empirical question whether the *direct* effect of overproduction on future earnings, and future GDP by extension, is negative, positive, or insignificant.

In addition, we note that implications for future GDP of the moderating effect of overproduction with respect to future earnings are not clearly predictable based on the REM interpretation of overproduction. If current earnings, which are temporailiy boosted by overproduction, reverse to the normal level in the following period, the moderating effect is expected to be negative. However, if firms engage in overproduction due to expected better future performance and signal managegerial competence by producing more inventories (Gunny 2010), the moderating effect could be positive. Thus, it is an

empirical question whether the *moderating* effect of overproduction on the relation between aggregate accounting performance and future GDP is negative, positive, or insignificant.

Even if direct and moderating effects of overproduction with respect to future GDP are significant, it is unclear whether macro forecasters incorporate these effects into their forecasting. Moreover, Konchitchki and Patatoukas (2014a, p. 79) conjecture that "macro forecasters may perceive accounting data as too coarse to draw inferences regarding the prospects of the U.S. economy." This leads to the next research question of whether macro forecasters fully impound the macroeconomic information embedded in overproduction. In the next section, we discuss our methodology for handling these issues.

3. METHODOLOGY, SAMPLE, AND DESCRIPTIVE STATISTICS

3.1. Construction of an Aggregate Overproduction Measure

Our analysis requires a proxy for an REM-driven aggregate overproduction measure. We construct this measure in the following two stages. In the first stage, we estimate abnormal production costs for each firm-quarter over the prior 16 quarters (a minimum of 12 non-missing firm-quarter observations required) using a model based on prior studies (e.g., Dechow, Kothari, and Watts 1998; Roychowdhury 2006; Gunny 2010). Specifically, the normal level of production cost is measured with the following model:

$$\begin{aligned} PROD_q/TA_{q-4} = {} & \beta_1(1/TA_{q-4}) + \beta_2 MV_q + \beta_3 TQ_q + \beta_4(SALE_q/TA_{q-4}) \\ & + \beta_5(\Delta SALE_q/TA_{q-4}) + \beta_6(\Delta SALE_{q-4}/TA_{q-4}) + \varepsilon_q, \end{aligned} \quad (1)$$

where PROD is the sum of the cost of goods sold and the change in inventory; TA is total assets; MV is the natural log of market value; TQ is Tobin's Q, which is defined as the market value of assets (measured as the book value of debt and equity), divided by the replacement cost of assets (measured as the book value of assets); SALE is net sales; and ΔSALE is the change in net sales. Similar to Kothari, Lewellen, and Warner (2006), we use as scalars total assets at the end of four quarters earlier. Throughout the paper, we suppress the time subscripts when no ambiguity arises. We

interpret the residual of the equation as abnormal production costs for firm i and quarter q. To ensure the abnormal production measure is not driven by a small number of firms in each industry, we require each quarter-industry (two-digit SIC) combination to have at least 20 firm-quarter observations.

In the second stage, we aggregate these firm-level abnormal production costs using value-weighted cross-sectional averages based on market capitalization at the beginning of each calendar quarter. We perform this aggregation using only the firms that are suspected of having overproduced inventory because of REM incentives. These "suspect" firms satisfy the requirement of quarterly earnings scaled by beginning assets falling in the interval to the immediate right of zero (i.e., between 0 and 0.0025). This requirement is imposed to better ensure that our overproduction measure is driven by REM incentives. We then normalize the overproduction measure and add a constant (one) to turn it into a positive measure (Kalay, Nallareddy, and Sadka 2018). This standardization process ensures that our overproduction measure always takes positive values, thereby making its interaction with other variables easier to interpret.

Regarding the aforementioned methodology to construct an aggregate overproduction measure, we make several observations. First, we perform the aggregation using value-weighted averages, not equal-weighted averages. While we follow Konchitchki and Patatoukas (2014a, 2014b), their method is conceptually appealing because it takes into account the relative importance of each firm (Gonedes 1973) and effectively captures economy-wide overproduction activities that are likely driven by large firms.

Second, instead of changes, we use levels of abnormal production costs to construct our aggregate overproduction measure. The underlying assumption here is that the expected overproduction level (not change) is zero.

Third, our overproduction measure before the standardization process can take negative values when suspect firms with overproducing incentives somehow end up under-producing inventory collectively, thereby reducing their ability to meet their earnings targets. The presence of such suspect firms would go against finding the expected results.

Fourth, by focusing on the REM-driven component of overproduction, we intend to minimize the possibility that our overproduction

measure reflects underlying economic conditions, such as possible spillovers across industries. For example, facilitated production of downstream industries will lead to performance improvements in upstream industries via sales increases. While we do not rule out the possibility that our overproduction measure contains measurement errors, some of which may be related to spillovers across industries, we seek to mitigate this concern by performing the aggregation of firm-level abnormal production costs using only suspect firms.

Fifth, we note that the link between measuring REM for a relatively small percentage of firms and extrapolating it to the GDP growth for the entire economy may not be clear. Nonetheless, we focus on the relatively small number of firms that are likely to engage in REM in order to provide a cleaner measure of non-demand-driven shocks that result in overproduction. However, a downside to this approach would be a decrease in the power of tests. We acknowledge this as a limitation of our approach.

3.2. Sample

We obtain quarterly accounting data from the Compustat database. To match accounting and GDP growth information for the same calendar quarters, we restrict fiscal quarters to those ending in March, June, September, or December. We eliminate firms in regulated industries (SIC code between 4400 and 5000) and the financial industry (SIC code between 6000 and 6999) to make our sample consistent with those used in prior studies on real earnings management (e.g., Roychowdhury 2006; Gunny 2010).

We measure aggregate earnings growth as the cross-sectional sum of earnings changes for all firms, scaled by the sum of lagged market value of equity for all firms, where firm-level earnings changes are seasonally differenced quarterly earnings, defined as income before extraordinary items in the current quarter less income before extraordinary items four quarters earlier. We scale earnings changes by lagged market equity in order to avoid a possible effect of REM choices on other scalars, such as sales. In the aggregation process, we exclude firms with stock prices less than $1. Similar to the overproduction measure, we standardize the aggregate earnings growth measure.

The timeline of our research follows Konchitchki and Patatoukas (2014a, 2014b). In particular, survey questionnaires are sent to

the Survey of Professional Forecasters (SPF) panelists (i.e., macro forecasters) by the end of the first month after each quarter ends, and the deadline for the panelists to submit their GDP growth forecasts is the middle of the second month after the quarter ends. Accordingly, to allow SPF panelists a reasonable amount of time to collect and analyze accounting data, we restrict our sample to firms with income statement and balance sheet data available by the end of the first month after quarter q ends. As a result, macro forecasts have access to the inputs to our model for estimating OVERPROD in a timely manner.

Our sample period spans from 1988:Q1 to 2018:Q4. Our sample starts in 1988:Q1 because real-time accounting data are available beginning with this quarter. Also, because GDP growth is unavailable for 1995:Q4 from the Real-Time Data Set for Macroeconomists, we exclude this quarter from our analyses when GDP growth is required. We also exclude 1995:Q3 because one-quarter ahead GDP growth is not available for this quarter due the omission of GDP growth in 1995:Q4. Our final sample thus consists of 121 quarterly observations for 1988 through 2018.

3.3. Descriptive Statistics

Table 1 presents descriptive statistics before the standardization process. We first note that our aggregate overproduction measure before the standardization process exhibits substantial variation around zero as reported in figure 1. We discuss the time-series pattern of this measure in Section 4.1. Aggregate earnings growth (ΔEARN) exhibits a mean of 0.001 with a standard deviation of 0.002. The mean of aggregate changes in return on net operating assets (ΔRNOA) is -0.003 with a standard deviation of 0.017. These statistics are generally comparable to those reported in related studies, and most variables show considerable time-series variation. In the regression analyses, we standardize these variables such that their mean and standard deviation are normalized to one. The one-quarter-ahead nominal GDP growth ($\Delta NGDP_{q+1}$) has a mean of 0.047 with a standard deviation of 0.024 and the mean of one-quarter-ahead real GDP growth ($\Delta RGDP_{q+1}$) is 0.025 with a standard deviation of 0.022. For the one-quarter-ahead forecast horizon, nominal and real GDP growth forecast errors exhibit a mean of -0.001 and 0.000, respectively.

Table 1. Descriptive Statistics

Variable	N	Mean	SD	Q1	Median	Q3
$OVERPROD_q$	121	0.003	0.123	-0.034	0.004	0.038
$\Delta EARN_q$	121	0.001	0.002	0.000	0.001	0.001
$\Delta RNOA_q$	121	-0.003	0.017	-0.011	-0.004	0.006
$\Delta NGDP_{q+1}$	121	0.047	0.024	0.037	0.046	0.062
$\Delta RGDP_{q+1}$	121	0.025	0.022	0.014	0.026	0.038
$\Delta NGDP_{q+1} - E_q(\Delta NGDP_{q+1})$	121	-0.001	0.021	-0.011	-0.001	0.010
$\Delta RGDP_{q+1} - E_q(\Delta RGDP_{q+1})$	121	0.000	0.019	-0.011	-0.001	0.010
$INDPROD_q$	121	0.020	0.039	0.008	0.027	0.040
$\Delta NGDP_q$	121	0.045	0.022	0.035	0.046	0.058
$SIZE_q$	121	14.478	0.804	14.108	14.763	15.035
MTB_{q-1}	121	4.753	1.601	3.876	4.377	5.145
$EARN_q$	121	0.008	0.003	0.006	0.008	0.009
$YIELD_q$	121	0.033	0.026	0.006	0.033	0.054
$SPREAD_q$	121	0.015	0.011	0.006	0.015	0.025
RET_q	121	0.026	0.078	-0.005	0.028	0.074

SD represents the standard deviation, and Q1 and Q3 represent the first and third quartiles, respectively. We report descriptive statistics prior to standardization. All variables are defined in Appendix.

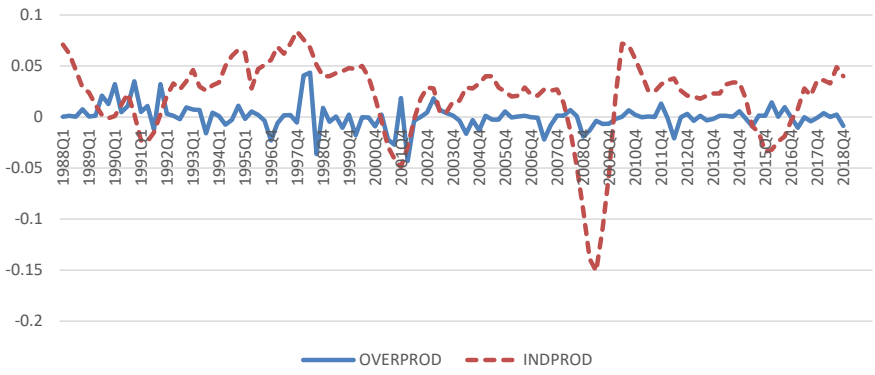
4. EMPIRICAL RESULTS

This section provides the methodology and results for the following four sets of analyses. First, we validate our aggregate overproduction measure by examining its association with an economy-wide production measure. Second, we investigate how overproduction affects future aggregate earnings growth and the relation between current and future aggregate earnings growth. Third, we examine the direct and moderating effects of overproduction with respect to future GDP growth. Fourth, we test whether professional macro forecasters incorporate these overproduction effects in their forecasting.

4.1. Validation of Our Aggregate Overproduction Measure

In an analytical accounting study, Strobl (2013) documents that firms may differ systematically in their probability of manipulation over the business cycle. Further, both theoretical and empirical evidence in finance (e.g., Povel, Singh, and Winton 2007; Wang, Winton, and Yu 2010) suggests that fraud is more likely under relatively good business conditions. Thus, to the extent that overproduction is a type of manipulation, our aggregate overproduction measure, OVERPROD, is expected to exhibit a positive correlation with a production measure that varies with the business cycle. In this regard, we examine whether OVERPROD is associated with an economy-wide production measure, INDPROD, which captures "movements in production output and highlights structural developments in the economy" according to the Board of Governors of the Federal Reserve System.

In figure 1, we plot the quarterly time-series patterns of OVERPROD (before the standardization process) and INDPROD. We note a general co-movement between the two measures. In particular, both measures exhibit a peak in late 1997 to early 1998 and then a drop in 2000 and 2001. Thus, the graphical evidence indicates that changes in macroeconomic conditions, which are associated with the probability of manipulation according to



This figure presents the time-series patterns of our aggregate overproduction measure (OVERPROD) before standardization and the industry production measure (INDPROD). See Appendix for variable definitions.

Figure 1. Overproduction and Industry Production

Table 2. Relation between Overproduction and Industry Production

Variable	Dep. Var. = $OVERPROD_q$	
	Estimate (t-stat.)	Estimate (t-stat.)
$INDPROD_q$	0.680 (1.63)	0.712* (1.93)
$\Delta NGDP_q$	-1.542* (-1.78)	-1.477* (-1.70)
$YIELD_q$	1.552** (2.24)	0.689 (0.49)
$SPREAD_q$	1.452 (1.24)	-0.400 (-0.21)
RET_q	0.065 (0.29)	0.001 (0.00)
$SIZE_q$		-0.018 (-0.48)
MTB_{q-1}		-0.017 (-1.44)
$EARN_q$		-2.086 (-0.30)
Intercept	-0.016 (-0.35)	0.402 (0.67)
N	121	121
Adjusted R^2	0.06	0.09

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively, based on two-tailed tests.

This table presents the results for the regression of overproduction (OVERPROD) before standardization on industry production (INDPROD). See Appendix for variable definitions. T-statistics are reported in parentheses, where standard errors are adjusted for both heteroskedasticity and autocorrelation based on Newey and West (1987) with the lag length set to 4.

Strobl (2013), are effectively captured by our accounting-based overproduction measure.

To test the statistical significance of the patterns in figure 1, we estimate a regression of OVERPROD on INDPROD and control variables as follows:

$$OVERPROD_q = \beta_0 + \beta_1 INDPROD_q + \beta_2 \Delta NGDP_q + \beta_3 YIELD_q$$

$$+ \beta_4 SPREAD_q + \beta_5 RET_q + \beta_6 SIZE_q + \beta_7 MTB_{q-1} + \beta_8 EARN_q + \varepsilon_q, \quad (2)$$

where the control variables are chosen based on Konchitchki and Patatoukas (2014a) and Roychowdhury (2006). All variables are defined in appendix. A positive coefficient on INDPROD would be consistent with Strobl (2013).

Table 2 reports the estimation results. The results are reported in two columns without and with the two groups of control variables, respectively. In both columns, we find that the coefficient on INDPROD is positive. It is marginally insignificant (p-value = 0.105) in the first column and significant at the 10 percent level in the second column, indicating that OVERPROD exhibits a somewhat weak positive association with INDPROD. Thus, while our overproduction measure contains some information associated with economy-wide production, it appears to have incremental information as a result of incorporating REM incentives into the measure. To gain some insight into this conjecture, we perform several additional tests and discuss them in Section 4.5.1.

4.2. Overproduction and Current and Future Aggregate Earnings Growth

To examine how overproduction affects future aggregate earnings growth and the relation between current and future aggregate earnings growth, we estimate the following regression:

$$\Delta EARN_{q+1} = \beta_0 + \beta_1 \Delta EARN_q + \beta_2 OVERPROD_q + \beta_3 \Delta EARN_q * OVERPROD_q + \beta_4 \Delta EARN_{q-1} + \beta_5 \Delta EARN_{q-2} + \varepsilon_{q+1}, \quad (3)$$

where $\Delta EARN_q$ is aggregate earnings growth for quarter q. We include $\Delta EARN_{q-1}$ and $\Delta EARN_{q-2}$ to further control for possible serial correlations in aggregate earnings growth.

Table 3 reports the results for the estimation of equation (3). We provide the results in three columns as we increase the number of explanatory variables. We first note that the coefficient on $\Delta EARN_q$ is significantly positive in all three columns, consistent with prior research (e.g., Kothari, Lewellen, and Warner 2006).

Turning to the variables related to overproduction, we find that the coefficient on OVERPROD is negative but insignificant in the

Table 3. Regressions of Future Aggregate Earnings Growth on Current Aggregate Earnings Growth and Overproduction

Variable	Dep. Var. = $\Delta EARN_{q+1}$		
	Estimate (t-stat.)	Estimate (t-stat.)	Estimate (t-stat.)
$\Delta EARN_q$	0.507*** (5.85)	0.588*** (6.26)	0.566*** (6.18)
$OVERPROD_q$		0.070 (1.29)	0.058 (1.02)
$\Delta EARN_q$*$OVERPROD_q$		-0.132** (-2.57)	-0.110** (-2.07)
$\Delta EARN_{q-1}$			0.082 (0.82)
$\Delta EARN_{q-2}$			-0.131 (-1.42)
Intercept	0.493*** (3.51)	0.476*** (3.08)	0.537*** (2.66)
N	121	121	121
Adjusted R^2	0.25	0.25	0.25

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively, based on two-tailed tests.

This table presents the results for the regressions of one-quarter-ahead aggregate earnings growth on current aggregate earnings growth and overproduction. See Appendix for variable definitions. T-statistics are reported in parentheses, where standard errors are adjusted for both heteroskedasticity and autocorrelation based on Newey and West (1987) with the lag length set to 4.

last two columns, regardless of whether $\Delta EARN_{q-1}$ and $\Delta EARN_{q-2}$ are controlled for. Thus, while overproduction could be followed by an increase or decrease in future earnings, our results suggest that neither of these two competing scenarios dominate. However, regarding the interaction term, we find that the coefficient on $\Delta EARN$*$OVERPROD$ is negative and significant (coeff. = -0.110, t-stat. = -2.07) when we control for lagged earnings growth. This implies that a substantial portion of a temporary increase in current earnings due to overproduction reverses in the subsequent quarter.

Overall, table 3 reveals a negative moderating effect of overproduction with respect to one-quarter-ahead aggregate earnings growth. However, untabulated results indicate that the coefficients on both

OVERPROD and ΔEARN*OVERPROD are insignificant for the forecast horizons of two, three and four quarters ahead. In the analysis that follows, therefore, we focus on whether future GDP growth reflects this negative moderating effect of overproduction with respect to earnings growth for the horizon of one quarter ahead.

4.3. Overproduction, Aggregate Accounting Performance, and Future GDP Growth

To examine overproduction's direct effect on future GDP growth and moderating effect on the relation between aggregate accounting performance and future GDP, we estimate an extended version of Konchitchki and Patatoukas (2014a, 2014b) models with our overproduction measure, as follows:

$$\begin{aligned}\Delta NGDP_{q+1} = {} & \beta_0 + \beta_1 \Delta EARN_q + \beta_2 OVERPROD_q \\ & + \beta_3 \Delta EARN_q * OVERPROD_q + \beta_4 \Delta NGDP_q + \beta_5 YIELD_q \\ & + \beta_6 SPREAD_q + \beta_7 RET_q + \varepsilon_{q+1}\end{aligned} \tag{4a}$$

$$\begin{aligned}\Delta RGDP_{q+1} = {} & \beta_0 + \beta_1 \Delta EARN_q + \beta_2 OVERPROD_q \\ & + \beta_3 \Delta EARN_q * OVERPROD_q + \beta_4 \Delta NGDP_q + \beta_5 YIELD_q \\ & + \beta_6 SPREAD_q + \beta_7 RET_q + \varepsilon_{q+1}\end{aligned} \tag{4b}$$

$$\begin{aligned}\Delta NGDP_{q+1} = {} & \beta_0 + \beta_1 \Delta RNOA_q + \beta_2 OVERPROD_q \\ & + \beta_3 \Delta RNOA_q * OVERPROD_q + \beta_4 RET_q + \varepsilon_{q+1}\end{aligned} \tag{5a}$$

$$\begin{aligned}\Delta RGDP_{q+1} = {} & \beta_0 + \beta_1 \Delta RNOA_q + \beta_2 OVERPROD_q \\ & + \beta_3 \Delta RNOA_q * OVERPROD_q + \beta_4 RET_q + \varepsilon_{q+1}\end{aligned} \tag{5b}$$

These equations extend Konchitchki and Patatoukas's (2014a, 2014b) models for the prediction of one-quarter-ahead nominal and real GDP growth. Accordingly, the control variables are chosen based on those papers. In these equations, a significantly negative (positive) coefficient on OVERPROD would indicate a negative (positive) direct effect of overproduction on future GDP growth. If none of these contrasting effects dominate, the coefficient on OVERPROD will be insignificant. The moderating effect is captured by the coefficient on ΔEARN*OVERPROD in equations (4a) and (4b) and ΔRNOA*OVERPROD in equations (5a) and (5b). A significantly negative coefficient on these interaction terms would indicate that

Table 4. Regressions of One-Quarter-Ahead Nominal and Real GDP Growth on Aggregate Earnings Growth and Overproduction

Variable	Dep. Var. = $\Delta NGDP_{q+1}$		Dep. Var. = $\Delta RGDP_{q+1}$	
	Estimate (t-stat.)	Estimate (t-stat.)	Estimate (t-stat.)	Estimate (t-stat.)
$\Delta EARN_q$	0.012*** (3.98)	0.009*** (2.95)	0.011*** (4.15)	0.009*** (3.26)
$OVERPROD_q$	0.004** (2.08)	0.003 (1.04)	0.002 (0.77)	0.001 (0.54)
$\Delta EARN_q$*$OVERPROD_q$	-0.008*** (-4.21)	-0.007*** (-3.46)	-0.009*** (-4.29)	-0.008*** (-4.05)
$\Delta NGDP_q$		0.148 (1.16)		0.139 (1.01)
$YIELD_q$		0.254** (2.23)		-0.008 (-0.06)
$SPREAD_q$		0.041 (0.18)		-0.086 (-0.37)
RET_q		0.074** (2.35)		0.081** (2.51)
Intercept	0.038*** (9.99)	0.025*** (4.35)	0.022*** (6.12)	0.017*** (2.79)
N	121	121	121	121
Adjusted R^2	0.14	0.29	0.16	0.25

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively, based on two-tailed tests.

This table presents the results for the regressions of one-quarter-ahead nominal and real GDP growth on aggregate earnings growth and overproduction. See Appendix for variable definitions. T-statistics are reported in parentheses, where standard errors are adjusted for both heteroskedasticity and autocorrelation based on Newey and West (1987) with the lag length set to 4.

the positive association between changes in aggregate accounting performance and future GDP growth is attenuated because of economy-wide overproduction. Throughout the study, we estimate our models using OLS regression and adjust standard errors for both heteroskedasticity and autocorrelation based on Newey and West (1987) with the lag length set to 4.

Table 4 presents the results for the estimation of equations (4a)

and (4b) with respect to both nominal and real GDP growth, respectively. We first note that aggregate earnings growth (ΔEARN) is positively and significantly associated with one-quarter-ahead nominal and real GDP growth with and without control variables, consistent with Konchitchki and Patatoukas (2014a). Regarding the results for overproduction-related variables, the coefficient on OVERPROD is significantly positive when control variables are excluded (in column 1), while it loses significance with inclusion of control (in column 2). Moreover, when the dependent variable is one-quarter-ahead real GDP growth (in columns 3 and 4), the coefficient on OVERPROD is both insignificant. Thus, we do not find a consistent direct effect of OVERPROD on future GDP growth.

More importantly, we find that the coefficient on ΔEARN* OVERPROD is negative and significant at the 1 percent level (coeff. = -0.007, t-stat. = -3.46 with controls for nominal GDP growth, for example) with respect to one-quarter-ahead GDP growth both in nominal and real terms. This result suggests that the aforementioned moderating effect of overproduction on one-quarter-ahead aggregate earnings growth appears to extend to the effect on future GDP growth for the same horizon. In addition, while we scale earnings changes by lagged market equity in order to avoid a possible effect of REM choices, we nonetheless estimate equation (4) using sales as an alternative scalar as in Konchitchki and Patatoukas (2014a). We obtain qualitatively similar results (untabulated) with this specification. The results for control variables are largely consistent with Konchitchki and Patatoukas (2014a).

As we standardize both ΔEARN and OVERPROD, the economic significance of our findings are evident from the reported coefficients on ΔEARN (0.009) and ΔEARN*OVERPROD (-0.007) in column 2. A one-standard-deviation increase in ΔEARN is associated with 0.9 percent increase of one-quarter-ahead nominal GDP growth. Moreover, when there is a one-standard-deviation increase in OVERPROD, OVERPROD moderates the effect of ΔEARN on one-quarter-ahead nominal GDP growth by 0.7 percent.

Table 5 presents the results for the estimation of equations (5a) and (5b) with respect to nominal and real GDP growth, respectively. Overall, the tenor of the results remains largely unaffected in the following aspects. First, aggregate changes in return on net operating assets (ΔRNOA) are positively and significantly associated with nominal and real one-quarter-ahead GDP growth without and with

Table 5. Regressions of One-Quarter-Ahead Nominal and Real GDP Growth on Aggregate Changes in Return on Net Operating Assets and Overproduction

Variable	Dep. Var. = $\Delta NGDP_{q+1}$		Dep. Var. = $\Delta RGDP_{q+1}$	
	Estimate (t-stat.)	Estimate (t-stat.)	Estimate (t-stat.)	Estimate (t-stat.)
$\Delta RNOA_q$	0.005* (1.76)	0.007*** (2.91)	0.005* (1.72)	0.007*** (3.61)
$OVERPROD_q$	0.002 (0.89)	0.002 (1.03)	-0.000 (-0.01)	-0.000 (-0.05)
$\Delta RNOA_q$*$OVERPROD_q$	-0.005* (-1.82)	-0.005** (-2.48)	-0.006** (-2.40)	-0.007*** (-3.23)
RET_q		0.092** (2.18)		0.097** (2.55)
Intercept	0.044*** (11.20)	0.041*** (8.77)	0.027*** (8.47)	0.023*** (5.65)
N	121	121	121	121
Adjusted R^2	0.01	0.09	0.04	0.15

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively, based on two-tailed tests.

This table presents the results for the regressions of one-quarter-ahead nominal and real GDP growth on aggregate changes in return on net operating assets and overproduction. See Appendix for variable definitions. T-statistics are reported in parentheses, where standard errors are adjusted for both heteroskedasticity and autocorrelation based on Newey and West (1987) with the lag length set to 4.

the control variable, RET, consistent with Konchitchki and Patatoukas (2014b). Second, the coefficient on OVERPROD is not significant, suggesting that overproduction does not directly affect future GDP growth. Third, as to the interaction term, the coefficient on ΔRNOA*OVERPROD is significantly negative in all specifications (coeff. = -0.007, t-stat. = -3.23 in column 4, for example). These results suggest a negative moderating effect of overproduction on the positive relation between aggregate changes in return on net operating assets and one-quarter-ahead GDP growth.

Overall, the results reported in tables 4 and 5 indicate that the moderating effects of REM-induced overproduction are strongly

negative with respect to one-year-ahead GDP growth in both nominal and real terms. These results generally mirror the moderating effects of overproduction with respect to one-year-ahead aggregate earnings growth, as reported in table 3. Taken together, our findings suggest that the overproduction information related to REM can be used to enhance aggregate accounting performance measures' predictive power for future GDP.

We note that overproduction can lead to increased production in downstream industries, which will also increase INDPROD and may affect our results. To address this issue, we additionally control for INDPROD in our regression analysis. Untabulated results indicate that our findings are largely unaffected.

We also note that the results for future GDP growth reported in tables 4 and 5 might look a bit obvious, given the results for future aggregate earnings growth reported in table 3. However, we believe that it is still meaningful to provide the results for both of these tests for the following reason. To begin, Konchitchki and Patatoukas (2014a) argue that aggregate earnings growth can predict future corporate profits (which is a component of GDP), and thus can predict future GDP growth as well. However, they empirically test only for the latter prediction, but not for the former one, while just alluding to the relation between corporate profits and GDP. In contrast, we suggest future aggregate earnings growth as an alternative channel through which future GDP growth can be predicted, while providing empirical tests for both future aggregate earnings growth and GDP growth. We believe that providing empirical results for aggregate earnings enhances our understanding of the possible channels through which GDP growth can be predicted, primarily because this study is the first to suggest the aggregate earnings channel and it is worthwhile to provide supporting empirical evidence.

4.4. Overproduction, Aggregate Accounting Performance, and Future GDP Growth Forecast Errors

The analysis so far reveals that our aggregate overproduction measure that captures economy-wide REM activities is incrementally useful over growth in aggregate accounting performance for forecasting one-quarter-ahead GDP growth. We next examine whether macro forecasters fully incorporate this information content of overproduction. To do so, we estimate the following regressions:

$$\Delta NGDP_{q+1} - E_q(\Delta NGDP_{q+1}) = \beta_0 + \beta_1 \Delta EARN_q + \beta_2 OVERPROD_q + \beta_3 \Delta EARN_q * OVERPROD_q + \beta_4 \Delta GDP_q + \beta_5 YIELD_q + \beta_6 SPREAD_q + \beta_7 RET_q + \varepsilon_{q+1} \quad (6a)$$

$$\Delta RGDP_{q+1} - E_q(\Delta RGDP_{q+1}) = \beta_0 + \beta_1 \Delta EARN_q + \beta_2 OVERPROD_q + \beta_3 \Delta EARN_q * OVERPROD_q + \beta_4 \Delta GDP_q + \beta_5 YIELD_q + \beta_6 SPREAD_q + \beta_7 RET_q + \varepsilon_{q+1} \quad (6b)$$

$$\Delta NGDP_{q+1} - E_q(\Delta NGDP_{q+1}) = \beta_0 + \beta_1 \Delta RNOA_q + \beta_2 OVERPROD_q + \beta_3 \Delta RNOA_q * OVERPROD_q + \beta_4 RET + \varepsilon_{q+1} \quad (7a)$$

$$\Delta RGDP_{q+1} - E_q(\Delta RGDP_{q+1}) = \beta_0 + \beta_1 \Delta RNOA_q + \beta_2 OVERPROD_q + \beta_3 \Delta RNOA_q * OVERPROD_q + \beta_4 RET + \varepsilon_{q+1} \quad (7b)$$

$\Delta NGDP_{q+1} - E_q(\Delta NGDP_{q+1})$ and $\Delta RGDP_{q+1} - E_q(\Delta RGDP_{q+1})$ respectively represent nominal and real GDP growth forecast errors for quarter q+1 as of quarter q. All other variables are defined previously. In equation (6a), a positive coefficient on $\Delta EARN_q$ would confirm Konchitchki and Patatoukas (2014a) finding that macro forecasters underreact to the predictive content of aggregate earnings growth for subsequent nominal GDP growth. In addition, Konchitchki and Patatoukas (2014b) estimate equation (7b) using components of ΔRNOA, rather than ΔRNOA itself, and report a positive coefficient on growth in operating margin. We seek to confirm that this result extends to ΔRNOA.

Related to the moderating effect of overproduction on one-quarter-ahead GDP growth, we rely on the sign and significance of the coefficient on the interaction terms–i.e., ΔEARN*OVERPROD in equations (6a) and (6b) and ΔRNOA*OVERPROD in equations (7a) and (7b)–in order to determine whether macro forecasters fully understand the effect. An insignificant coefficient would be consistent with macro forecasters fully incorporating the negative moderating effect of overproduction. In contrast, a significantly negative (positive) coefficient would indicate that macro forecasters underestimate (overestimate) the effect.

Table 6 provides the results for the estimation of equations (6a)

Table 6. Regressions of One-Quarter-Ahead Nominal and Real GDP Growth Forecast Errors on Aggregate Earnings Growth and Overproduction

Variable	Dep. Var. = $\Delta NGDP_{q+1} - E_q(\Delta NGDP_{q+1})$		Dep. Var. = $\Delta RGDP_{q+1} - E_q(\Delta RGDP_{q+1})$	
	Estimate (t-stat.)	Estimate (t-stat.)	Estimate (t-stat.)	Estimate (t-stat.)
$\Delta EARN_q$	0.006*** (2.93)	0.007** (2.46)	0.005*** (3.06)	0.006*** (2.87)
$OVERPROD_q$	0.003 (0.95)	0.002 (0.55)	0.003 (1.13)	0.002 (0.60)
$\Delta EARN_q$*$OVERPROD_q$	-0.006*** (-2.68)	-0.006** (-2.17)	-0.007*** (-3.53)	-0.008*** (-3.02)
$\Delta NGDP_q$		-0.059 (-0.57)		-0.090 (-0.91)
$YIELD_q$		0.110 (0.94)		0.131 (1.32)
$SPREAD_q$		0.002 (0.01)		0.020 (0.09)
RET_q		0.086*** (3.21)		0.091*** (3.90)
Intercept	-0.004 (-1.13)	-0.007 (-1.18)	-0.000 (-0.06)	-0.003 (-0.55)
N				
Adjusted R^2	121	121	121	121

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively, based on two-tailed tests.

This table presents the results for the regressions of one-quarter-ahead nominal and real GDP growth forecast errors on aggregate earnings growth and overproduction. See Appendix for variable definitions. T-statistics are reported in parentheses, where standard errors are adjusted for both heteroskedasticity and autocorrelation based on Newey and West (1987) with the lag length set to 4.

and (6b). We first note that the coefficient on ΔEARN is positive and significant in all specifications, consistent with the corresponding coefficient reported by Konchitchki and Patatoukas (2014a). More importantly, we find that the coefficient on ΔEARN*OVERPROD is negative and significant in all specifications (coeff. = -0.006, t-stat. = -2.17 with controls for nominal GDP growth forecast errors, for

Table 7. Regressions of One-Quarter-Ahead Nominal and Real GDP Growth Forecast Errors on Aggregate Changes in Return on Net Operating Assets and Overproduction

Variable	Dep. Var. = $\Delta NGDP_{q+1} - E_q(\Delta NGDP_{q+1})$		Dep. Var. = $\Delta RGDP_{q+1} - E_q(\Delta RGDP_{q+1})$	
	Estimate (t-stat.)	Estimate (t-stat.)	Estimate (t-stat.)	Estimate (t-stat.)
$\Delta RNOA_q$	0.004* (1.68)	0.006*** (4.36)	0.003 (1.20)	0.005*** (3.25)
$OVERPROD_q$	0.002 (0.86)	0.002 (1.00)	0.001 (0.80)	0.001 (0.82)
$\Delta RNOA_q$*$OVERPROD_q$	-0.006** (-2.24)	-0.006*** (-3.14)	-0.006** (-2.44)	-0.006*** (-3.48)
RET_q		0.097*** (3.12)		0.099*** (3.69)
Intercept	-0.001 (-0.50)	-0.005* (-1.81)	0.002 (0.66)	-0.002 (-0.61)
N	121	121	121	121
Adjusted R^2	0.02	0.15	0.03	0.19

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively, based on two-tailed tests.

This table presents the results for the regressions of one-quarter-ahead nominal and real GDP growth forecast errors on aggregate changes in return on net operating assets and overproduction. See Appendix for variable definitions. T-statistics are reported in parentheses, where standard errors are adjusted for both heteroskedasticity and autocorrelation based on Newey and West (1987) with the lag length set to 4.

example). Given that a higher value of ΔEARN*OVERPROD implies a decline in realized one-quarter-ahead GDP growth (as reported in tables 4 and 5), the significantly negative coefficient on this interaction term reported in table 6 implies that macro forecasts do not appear to revise downward one-quarter-ahead GDP growth forecasts as much as the decrease in realized GDP growth for the same horizon. This suggests that macro forecasters underestimate the negative moderating effects of overproduction with respect to subsequent GDP growth.

Table 7 presents the results for the estimation of equations (7a) and (7b). Overall, the tenor of the results for the relation between

aggregate earnings growth and GDP growth forecast errors (as reported in table 6) remains largely unchanged. In particular, the coefficient on OVERPROD is statistically insignificant and the coefficient on ΔRNOA*OVERPROD is significantly negative (coeff. = -0.006, t-stat. = -3.48 in column 4, for example). Overall, the results reported in tables 6 and 7 suggest that macro forecasters do not fully incorporate the negative moderating effects of overproduction with respect to both nominal and real future GDP growth.

4.5. Additional Analyses

4.5.1. Analysis using industrial production index (INDPROD)

As shown in table 2, OVERPROD is positively associated with INDPROD, and it is possible that our results thus far could be alternatively driven by the information contained in INDPROD, rather than OVERPROD. To examine this possibility, we repeat the analyses of future GDP growth and forecast errors using INDPROD, but we find that the results (untabulated) are mostly insignificant.

To gain some insight into these somewhat puzzling results, we compare the persistence of OVERPROD and that of INDPROD. The results (untabulated) indicate that OVERPROD does not exhibit a significant autocorrelation, while INDPROD exhibits a significantly positive autocorrelation of 0.904 (p-value < 0.01). This finding may arise because it is difficult for firms to continue overproducing inventory over multiple periods, thereby leading to the insignificant autocorrelation for OVERPROD. In contrast, INDPROD captures structural economic developments that tend to exhibit some persistence. Thus, while these two measures are positively correlated with each other, such a correlation may merely reflect an average pattern that holds cross-sectionally, rather than differential inter-temporal patterns. We conjecture that this discrepancy in autocorrelations between the two measures can partially explain the differences in the results. These results confirm that OVERPROD does have incremental information over INDPROD as a result of incorporating REM incentives into the measure.

4.5.2. Analysis using an alternative measure of aggregate earnings growth

Konchitchki and Patatoukas (2014a) measure aggregate earnings growth as a value-weighted mean of changes in quarterly earnings

scaled by sales. As a robustness check, we repeat our main analysis of GDP growth (table 4) using this alternative measure of aggregate earnings growth (ΔEARN_SALE).

Untabulated results indicate that ΔEARN_SALE exhibits a positive association with next quarter's nominal GDP growth which is consistent with Konchitchki and Patatoukas (2014a). We also find that the coefficient on OVERPROD is insignificant, but the coefficient on ΔEARN_SALE*OVERPROD is significantly negative, suggesting that the negative moderating effect of OVERPROD is robust to this alternative definition of aggregate earnings.

Furthermore, the definition of aggregate earnings growth in Konchitchki and Patatoukas (2014a) can be interpreted as a measure of changes in aggregate profit margin since changes in earnings are divided by sales. Thus, the negative moderating effect of OVERPROD can be applicable to the positive relation between changes in profit margin and future GDP growth.

4.5.3. Analysis using an alternative measure of OVERPROD

While we have thus far defined OVERPROD as a continuous variable, for a robustness check, we transform this variable into a discrete one. Specifically, we use an indicator variable, D_OVERPROD, that equals one if the value of OVERPROD is in the top decile of all firm-quarter observations, and zero otherwise. Using D_OVERPROD, we repeat the analyses of future GDP growth and forecast errors. From these analyses, we find qualitatively similar results for the moderating effect of overproduction.

4.5.4. Analysis using alternative measures of REM

While we have focused on the REM-driven component of overproduction, our core argument can be extended to other REM activities. That is, the expected results for overproduction could be also found for other components of REM. To explore this possibility, we have re-estimated all regression models using abnormal discretionary expenditures, such as abnormal research and development expenses and abnormal selling, general, and administrative expenses, as in Gunny (2010). However, untabulated results indicate that these REM components seem to have neither a direct effect nor a moderating effect with respect to future aggregate earnings growth and GDP growth. Future research may refine our methodology to gain a more complete understanding of the relation between

economy-wide REM activities and macro forecasting.

5. CONCLUSION

This paper examines the direct effect of overproduction on future GDP growth as well as the moderating effect of overproduction on the relation between growth in aggregate accounting performance and future GDP growth. We also examine whether professional macro forecasters incorporate the macroeconomic information contained in overproduction into their forecasting. In this regard, we construct an aggregate overproduction measure that reflects the economy-wide prevalence of REM activities.

We report three main findings based on this aggregate overproduction measure that reflects REM incentives. First, the results for aggregate earnings growth indicate that overproduction mitigates the positive association between current and one-quarter-ahead aggregate earnings growth, while we do not find a direct effect on future aggregate earnings growth for the same horizon. Second, the results for GDP growth indicate that overproduction has a significantly negative moderating effect with respect to one-quarter-ahead GDP growth in both nominal and real terms. Third, we find evidence that macro forecasters do not fully impound this moderating effect of overproduction with respect to subsequent GDP growth.

Overall, the findings reported in this study suggest that REM-driven overproduction attenuates the positive association between growth in aggregate accounting performance and one-quarter-ahead GDP growth documented in the literature. Our findings complement and extend the findings of prior studies demonstrating the usefulness of accounting information in predicting GDP growth and other macroeconomic indicators and thus have implications for macro forecasters and macroeconomic policymakers in their use of accounting data.

Several caveats are in order. First, we note that REM-driven overproduction we focus on is narrower than overproduction itself. However, given that a number of prior studies have established the usefulness of various accounting aggregates in macro forecasting, we believe that it is important to examine how manipulation alters the information content of aggregated accounting figures. In this sense,

by focusing on the interplay between REM and overproduction, this study provides some new insight into the moderating effect of accounting manipulation on the relation between aggregate earnings and GDP growth. Second, Shivakumar and Urcan (2017) find that firms increase their investments when aggregate earnings growth is high, thereby leading to increases in the prices of investment goods and services (assuming that the supply of goods and services is relatively inelastic in the short run). To the extent that an economy-wide overproduction indicates excessive serial investments in inventories and these excessive investments are made in response to higher aggregate earnings growth, Shivakumar and Urcan's finding implies that overproduction can be viewed as a "mediator" (rather than a moderator, as reported in our paper) with respect to the association between aggregate earnings growth and subsequent GDP growth. We leave this issue as an avenue for future research.

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APPENDIX
VARIABLE DEFINITIONS

Variable	Definition
$OVERPROD_q$	The cross-sectional value-weighted mean of abnormal production costs which is estimated in the following two stages. In the first stage, we estimate abnormal production costs for each firm-quarter over the prior 16 quarters (a minimum of 12 non-missing firm-quarter observations required) using equation (1) provided in Section 3.1. In the second stage, we aggregate these firm-level abnormal production costs using value-weighted cross-sectional averages based on market capitalization at the beginning of each calendar quarter. We perform this aggregation using only the "suspect" firms that satisfy the requirement of quarterly earnings scaled by beginning assets falling in the interval to the immediate right of zero (i.e., between 0 and 0.0025). Then, we standardize this measure and add a constant (one) to transfer it to a positive number. The variable is multiplied by 1,000 for expositional purpose.
$\Delta EARN_q$	The cross-sectional sum of earnings changes for all firms, scaled by the sum of lagged market value of equity for all firms, where firm-level earnings changes are seasonally differenced quarterly earnings, defined as income before extraordinary items in the current quarter less income before extraordinary items four quarters earlier. Then, we standardize this measure and add a constant (one) to transfer it to a positive number.
$\Delta RNOA_q$	Aggregate year-over-year changes in quarterly return on net operating assets (RNOA), where the aggregation is performed using value-weighted cross-sectional averages. We measure RNOA as operating income after depreciation divided by average net operating assets, where net operating assets are the difference between operating assets (total assets minus cash and short-term investments) and operating liabilities (total liabilities minus long-term debt minus short-term debt). Then, we standardize this measure and add a constant (one) to transfer it to a positive number.
$\Delta NGDP_{q+1}$	The final estimate of nominal GDP growth for quarter q+1.
$\Delta RGDP_{q+1}$	The final estimate of real GDP growth for quarter q+1.
$\Delta NGDP_{q+1} - E_q(\Delta NGDP_{q+1})$	The nominal GDP growth forecast error for quarter q+1.

Variable	Definition
$E_q(\Delta NGDP_{q+1})$	The mean consensus SPF forecast of nominal GDP growth for quarter q+1 as of quarter q.
$\Delta RGDP_{q+1} - E_q(\Delta RGDP_{q+1})$	The real GDP growth forecast error for quarter q+1.
$E_q(\Delta RGDP_{q+1})$	The mean consensus SPF forecast of real GDP growth for quarter q+1 as of quarter q.
$INDPROD_q$	Quarterly year-to-year change in the industrial production index, which is "an economic indicator that measures real output for all facilities located in the U.S. manufacturing, mining, and electric, and gas utilities (excluding those in U.S. territories)" as defined by the Board of Governors of the Federal Reserve System.
$\Delta NGDP_q$	The advance estimate of nominal GDP growth for quarter q.
$SIZE_q$	Log of aggregate market value for quarter q.
MTB_{q-1}	The cross-sectional value-weighted mean of market-to-book ratio for quarter q-1.
$EARN_q$	The cross-sectional sum of earnings for all firms, scaled by the sum of lagged market value of equity for all firms, where firm-level earnings changes are seasonally differenced quarterly earnings, defined as income before extraordinary items in the current quarter less income before extraordinary items four quarters earlier. The variable is expressed in percent.
$YIELD_q$	The yield on the one-year treasury bill measured one month after quarter q ends.
$SPREAD_q$	The yield on the ten-year minus the yield on the one-year treasury note measured one month after quarter q ends.
RET_q	The buy-and-hold market return for three months between one month prior to the fiscal quarter ending month and two months after the fiscal quarter ending month.