Detecting Financial Misreporting with Real Production Activity: Evidence from an Electricity Consumption Analysis

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Background

- An essential element in detecting financial misreporting and assessing financial reporting quality is finding proxies for an enterprise's underlying financial performance that are not a function of the accounting system (Dechow et al. 2010).

- Research has focused on the use of accruals, total and discretionary revenues to identify reporting misbehavior. However, Isolating discretionary and nondiscretionary components of earnings and revenues using financial statement data can be difficult (incentives to manipulate, Lewis 2013).

- Prior studies examining nonfinancial measures (**NFMs**) have focused on order backlogs, the number of employees, the number of retail outlets, and vocal cues during conference calls to assess a firm's true economic activity.

Literature review

- Stubben (2010) finds that **unexpected revenues** are a better proxy for earnings management than unexpected accruals that are common in the literature.

- Zha Giedt (2018) develops a measure of discretion in revenues using **accounts receivable and deferred revenues** and finds that measures of discretionary revenues are associated with Accounting and Auditing Enforcement Releases.

- NFM: Curtis et al. (2014) and Bonacchi et al. (2015) demonstrate that **growth in retail outlets and the number of customers**, respectively, can be modeled to assess a firm's underlying performance.

Motivation

- **Underlying performance metrics**: Electricity consumption is sensitive to a firm's real production and thus is a timely measure of economic activities.

- **Independence**: Relative to accrual-basis measures, a firm's electricity consumption from an independent (a monopolistic electricity provider in Korea) source represents its underlying activities in an unbiased manner.

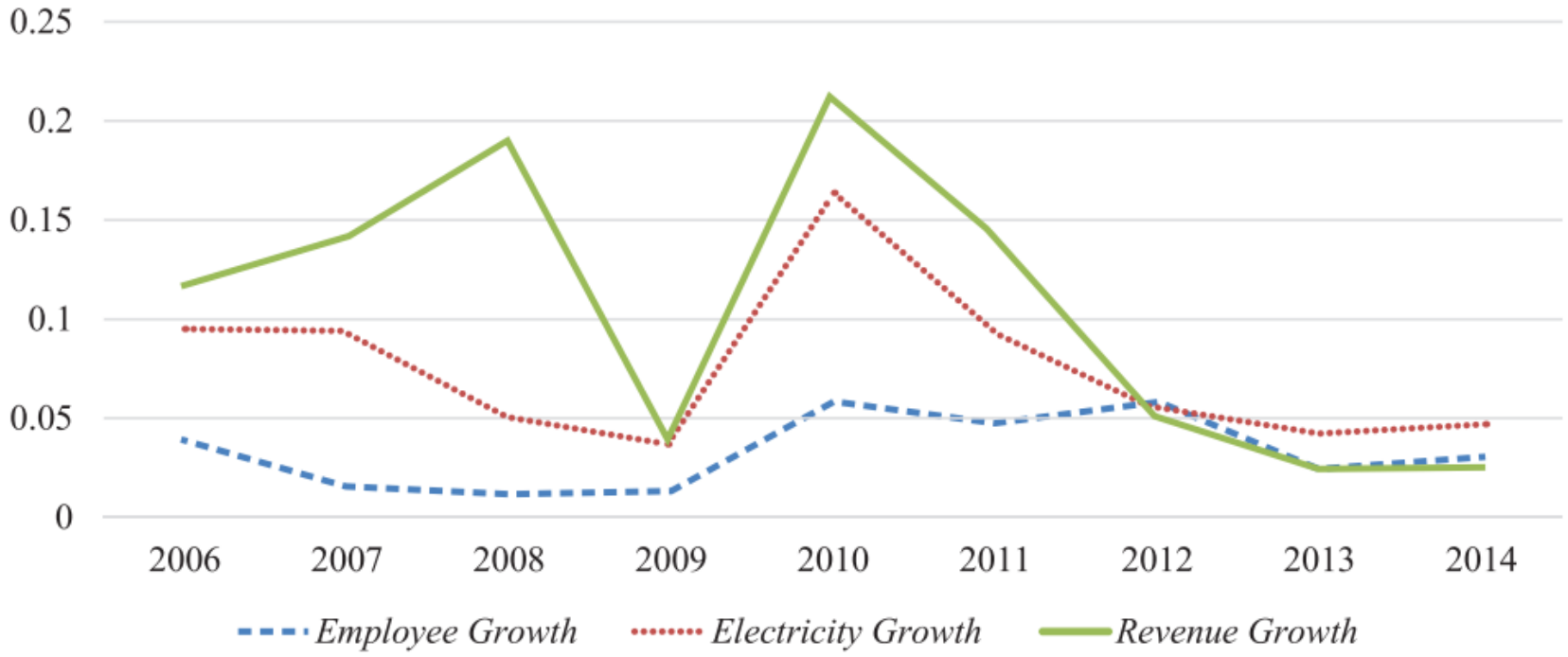
- **A relatively homogenous product**：Modern firms rely on electricity as their main power source, the units of electricity consumed are comparable across different firms within an industry.

- So we measure the gap between a firm's accounting performance (from firms' financial statements) and a timely and independent measure of firms' electricity consumption, **a growth wedge (GW)**, and relate it to financial misreporting.

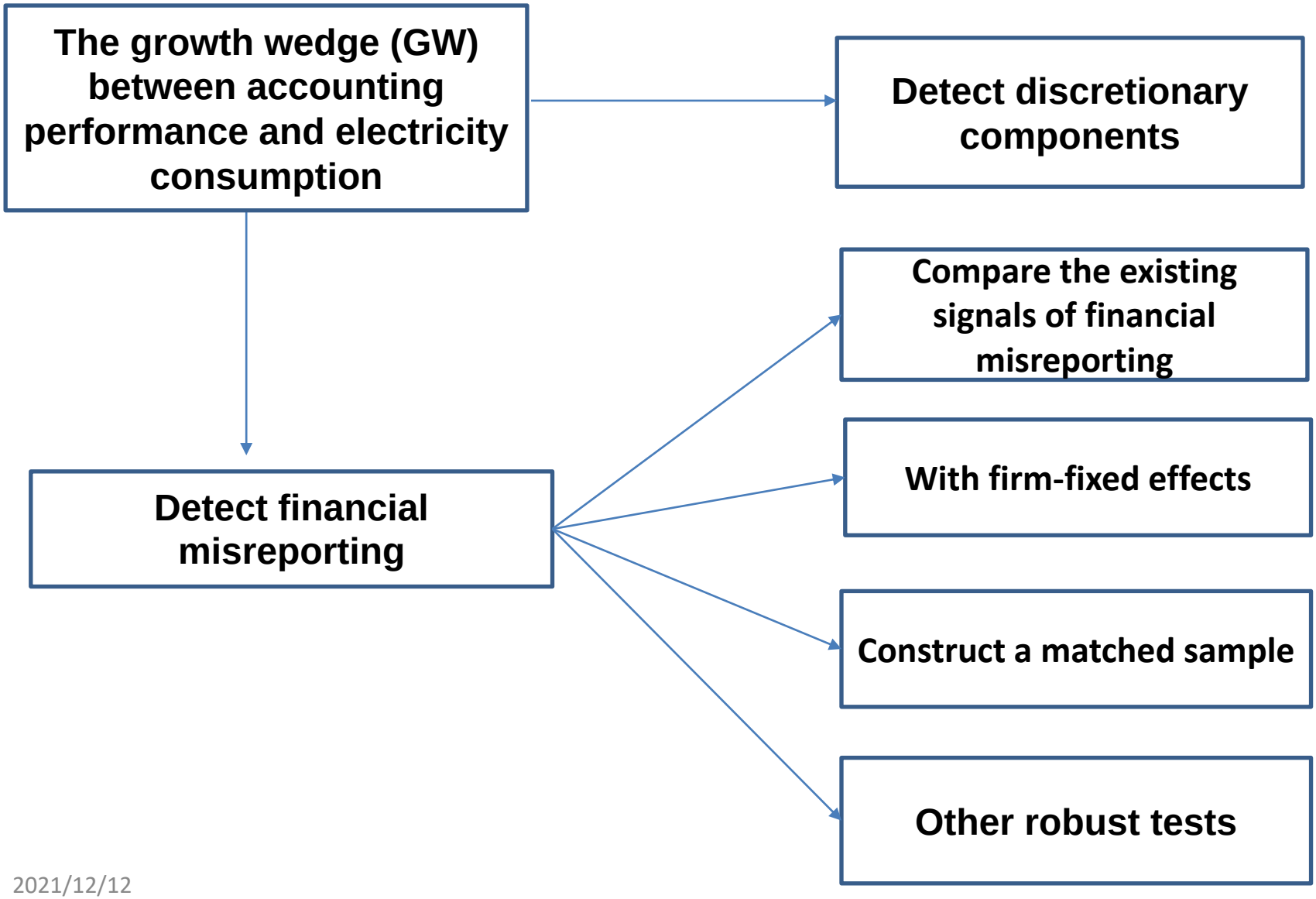
Motivation

Higher (lower) GW indicates that a firm's financial performance increases faster (slower) than its electricity consumption, we expect that higher GW is associated with a higher likelihood of financial misreporting.

Figure 1 Mean of electricity consumption, employee, and revenue growth by year



Research Frame



Research Conclusion

- We document that the revenue-electricity growth difference is positively associated with discretionary revenues and accruals.

- We also find that this GW increases the likelihood of financial misreporting proxied by an adverse restatement, qualified audit opinion, and a fraud investigation initiated by regulatory authorities.

- We find compelling evidence of the incremental explanatory power of electricity consumption in detecting financial misreporting even after controlling for financial ratios and NFMs.

- We further show that comparisons between firm-level GW and economy- and industry-level benchmarks are informative in identifying financial misreporting.

Research Contribution

- First, our findings are broadly related to research in forensic economics. This line of research focuses on detecting hidden behavior by comparing two independent measures that capture the same economic activity but are affected differently by managers' incentives.

- We also contribute to the literature on misreporting detection and revenue management by demonstrating that firm-level real production activity is useful in identifying firms' financial misreporting when prior financial proxies do not.

- Our study is also related to a growing body of research concerning the use of NFMs in various contexts.

- Our findings should be of interest to auditors who are responsible for attesting to the veracity of financial statements.

Sample Selection

- We finally collect 8597 observations based on industrial electricity consumption provided by KEPCO for the period from 2005 to 2014.

Selection filters	*N*
Firm-months with available electricity consumption for the period of 2005–2014	140,358
Merge into firm-years	12,005
Initial sample:	
Less: Firm-years without a complete series of electricity information for all 12 months	(623)
Less: Firm-years without prior year's information to calculate electricity growth	(1,397)
Less: Financial firms	(849)
Less: Firm-years without information to calculate dependent variables and controls	(539)
Final sample: firm-years	8,597

Industry	*N*	%
Light manufacturing	1,162	14
Heavy manufacturing	5,800	67
Utilities and construction	290	3
Wholesale and retail	307	4
Transportation and accommodation	330	4
Information, professional, and others	708	8
Total	8,597	100

Measurement of key variables

- **Growth wedge (GW) :** To limit the possibility that extreme values of GW drive our primary results, we use annual quintile ranks of GW in each 2-digit SIC industry code for our analyses.

$$GW_{i,t} = \frac{\text{Revenue }_{t} - \text{Revenue }_{t-1}}{\text{Revenue }_{t-1}} - \frac{\text{Electricityconsumption }_{t} - \text{Electricity consumption }_{t-1}}{\text{Electricity consumption }_{t-1}}$$

- **Discretionary revenues (DR), Caylor (2010) and Zha Giedt (2018):**

$$\Delta Accounts\ Receivable_{it} = \alpha + \beta_1 1/Assets_{it} + \beta_2 \Delta Revenue_{it} + \beta_3 \Delta CFO_{it+1} + \varepsilon_{it},$$

$$\Delta Deferred\ Revenue_{it} = \alpha + \beta_1 1/Assets_{it} + \beta_2 \Delta CFO_{it} + \beta_3 \Delta Revenue_{it+1} + \varepsilon_{it},$$

$$\Delta Long\text{-}term\ Deferred\ Revenue_{it} = \alpha + \beta_1 1/Assets_{it} + \beta_2 \Delta CFO_{it} + \beta_3 \Delta Revenue_{it+2} + \varepsilon_{it},$$

- **Discretionary accruals (DC), Kothari et al. (2005):**

$$\Delta Accruals_{it} = \alpha + \beta_1 1/Assets_{it} + \beta_2 (\Delta Revenue_{it} - \Delta Accounts\ Receivable_{it}) + \beta_3 PPE_{it} + \beta_4 ROA_{it} + \varepsilon_{it},$$

Measurement of key variables

- Sample firms on average experience 2.6% greater revenue growth than growth in electricity consumption during the sample period.
- The standard deviation of GW is 0.281, implying a substantial variation in the GW between revenue and electricity consumption.

Variables	*N*	Mean	SD	Q1	Median	Q3
Main variables						
GW	8,597	0.026	0.281	−0.074	0.020	0.117
Discretionary Revenue	8,597	−0.004	0.040	−0.023	−0.004	0.014
Discretionary Accruals	8,597	0.006	0.096	−0.043	0.008	0.053
Misreporting	8,597	0.029	0.168	0.000	0.000	0.000
Electricity Growth	8,597	0.074	0.195	−0.028	0.027	0.112
Control variables						
Public	8,597	0.411	0.492	0.000	0.000	1.000
Intangibles	8,597	0.005	0.012	0.000	0.000	0.003
Capital	8,597	0.443	0.217	0.284	0.418	0.585
Size	8,597	7.590	1.585	6.511	7.434	8.420
Age	8,597	3.056	0.739	2.565	3.219	3.638
Leverage	8,597	2.631	3.665	1.483	2.042	2.933

Measures of financial misreporting

We rely on three proxies for financial misreporting:

- The first proxy is restatements: We identify 86 restatements that decrease net income in our sample based on whether they report a prior period error correction in the year t + 1 financial statements.

- The second proxy is qualified audit opinions: We identify 99 qualified audit opinions based on firms' audit reports for year t's financial statements in our sample.

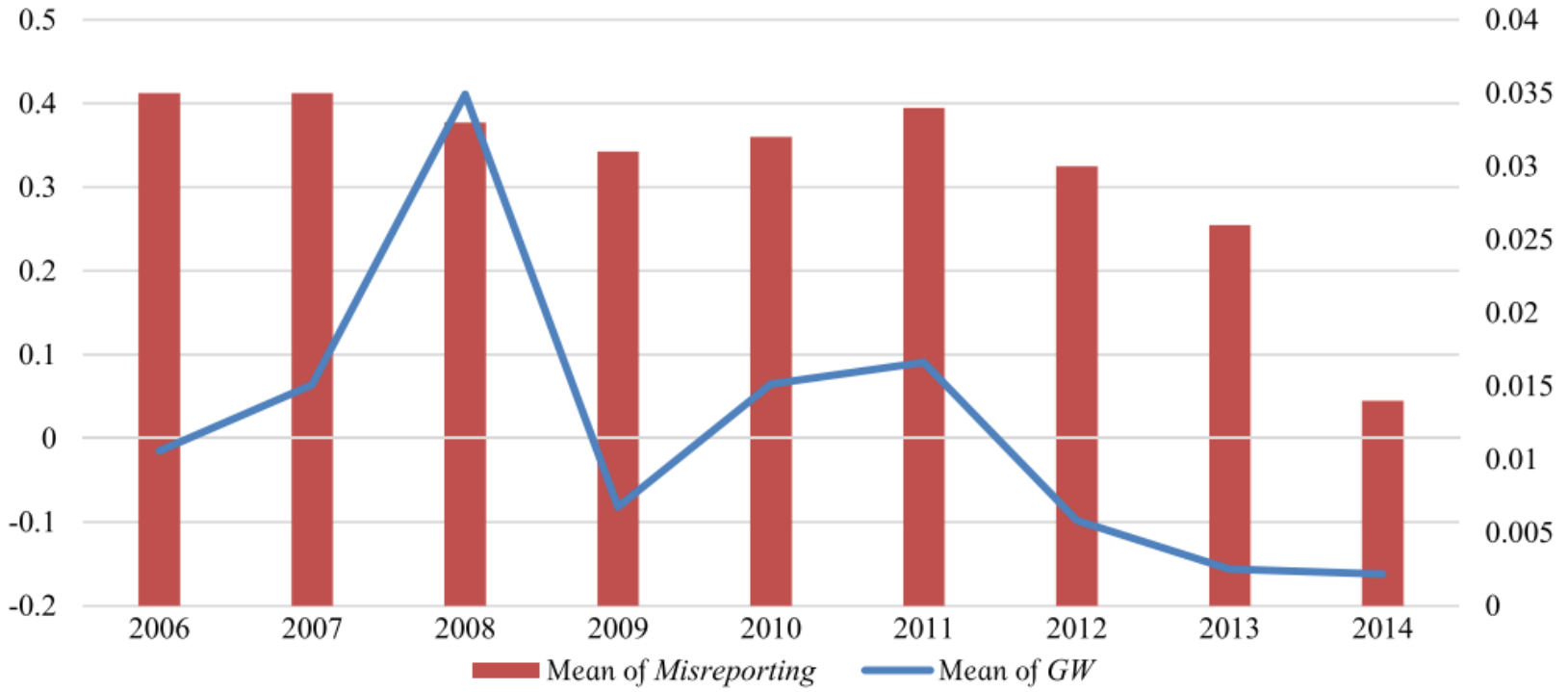
- The third proxy is enforcement actions by regulators: We identify 40 enforcement actions that decrease year t's net income in our sample.

- To increase the power of our misreporting detection tests and to effectively handle measurement errors, we combine the three proxies in our empirical tests.

Measures of financial misreporting

We find that the misreporting rate of our sample firms is relatively stable ranging from 1% to 4%, while it has its lowest in 2014. Overall, our results do not appear to be driven by any particular year.

Figure 2 Mean of *GW* and *Misreporting* by year



Empirical Analysis: GW and discretionary components

- Consistent with our hypothesis, we find that discretionary revenues and discretionary accruals are largely increasing with GW.

- We note that the differences for Discretionary Revenue are highly significant, while the differences for Discretionary Accruals are marginally significant.

Panel A: Univariate analysis

	Discretionary Revenue		*Discretionary Accruals*	
Quintile by *GW*	Mean	Median	Mean	Median
Q1	−0.032	−0.044	−0.027	−0.033
Q2	−0.011	−0.057	−0.036	−0.000
Q3	0.003	−0.002	0.035	0.006
Q4	0.064	0.014	−0.002	0.023
Q5	0.078	0.001	0.030	0.076
Q5 – Q1	0.110***	0.045**	0.058*	0.109*

Empirical Analysis: GW and discretionary components

- Together, our evidence suggests that GW is an effective metric for isolating the discretionary component of accounting performance.

$$Discretionary\ Component_{it} = \alpha + \beta_1 GW_{it} + \sum \beta_j Controls_j + Year_t + Industry_k \text{ or } Firm_i + \varepsilon_{it}.$$

Dependent variables	(1) *Discretionary Revenue*	(2) *Discretionary Revenue*	(3) *Discretionary Accruals*	(4) *Discretionary Accruals*
		Firm-fixed		Firm-fixed
GW	0.004***	0.004**	0.012***	0.010***
	(2.99)	(2.37)	(3.45)	(2.66)
Public	0.001		0.003*	
	(0.91)		(1.66)	
Intangibles	0.000	0.003**	0.000	0.002
	(0.29)	(2.13)	(0.17)	(0.77)
Capital	−0.002***	−0.006***	0.008***	0.000
	(−4.10)	(−4.48)	(6.42)	(0.04)
Size	0.001**	0.022***	−0.002	−0.040***
Year FEs	Yes	Yes	Yes	Yes
Industry FEs	Yes	No	Yes	No
Firm FEs	No	Yes	No	Yes
Cluster by firms	Yes	Yes	Yes	Yes
N	8,597	8,526	8,597	8,526
Adj. R^2	0.0128	0.0406	0.0866	0.0655

Empirical Analysis: GW and financial misreporting

$$Misreporting_{it} = \alpha + \beta_1 GW\_Highest_{it} + \sum \beta_j Controls_j + \sum \beta_k Other\ Measures_k + Year_t + Industry_k\ or\ Firm_i + \varepsilon_{it}.$$

- Overall, our results support the notion that the growth differential between reported revenue and electricity consumption is useful in detecting financial misreporting.

Dependent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Misreporting						Firm-fixed
GW_Highest	0.014**	0.014**	0.015**	0.015***	0.014**	0.015***	0.013***
	(2.53)	(2.47)	(2.55)	(2.65)	(2.51)	(2.59)	(2.67)
F-score		0.008*				0.008*	0.003
		(1.91)				(1.84)	(0.75)
M-score			0.003			0.003	−0.000
			(1.00)			(0.93)	(−0.14)
Dupont Indicator				0.011**		0.010**	0.002
				(2.33)		(2.21)	(0.60)
Employee Growth					−0.001	−0.001	−0.001
					(−0.28)	(−0.64)	(−0.49)
Discretionary Revenue	−0.010	−0.044	−0.027	−0.013	−0.010	−0.059	−0.025
	(−0.19)	(−0.81)	(−0.45)	(−0.23)	(−0.17)	(−1.01)	(−0.50)
Discretionary Accrual	−0.037	−0.052**	−0.050*	−0.042*	−0.037	−0.070**	−0.026
	(−1.59)	(−2.12)	(−1.90)	(−1.81)	(−1.61)	(−2.51)	(−1.13)
Year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes	Yes	Yes	No
Firm FEs	No	No	No	No	No	No	Yes
Cluster by firms	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	8,597	8,597	8,597	8,597	8,597	8,597	8527
Adj. R^2	0.0299	0.0305	0.0300	0.0304	0.0298	0.0309	0.4071

Relevance of electricity consumption for production

- We find that the GW effect is significant for industries with above-median electricity consumption and insignificant for industries with below-median electricity consumption.
- This result supports the notion that electricity consumption, a credible proxy for manufacturers' real production activity, is informative about financial misreporting mainly when the firm's activities are more electricity intensive.

Dependent variable	(1)	(2)
Partitioning variables	Intensity of electricity consumption	
	High	Low
GW_Highest	0.018**	0.010
	(2.11)	(1.31)
F-score	0.003	0.012**
	(0.51)	(2.12)
M-score	−0.002	0.007
	(−0.80)	(1.42)
Dupont Indicator	0.010	0.012*
	(1.60)	(1.68)
Employee Growth	0.000	−0.002
	(0.05)	(−0.83)
Firm characteristics	Yes	Yes
Year FEs	Yes	Yes
Industry FEs	Yes	Yes
Cluster by firms	Yes	Yes
N	4,319	4,277
Adj. R^2	0.0329	0.0333

Timeliness of electricity consumption

- Our monthly real-time electricity consumption data explain a firm's economic activities in a timely manner relative to other financial and nonfinancial measures that are often reported on an annual basis.

$$Abnormal\ Returns_{im} = \alpha + \beta_1 Monthly\ Electricity\ Growth_{im} + \beta_2 Employee\ Growth_{it} + \beta_3 Revenue\ Growth_{it} + Year_t + Industry_j + \varepsilon_{im}.$$

	(1)	(2)
Dependent variable	*Abnormal Returns*	
Monthly Electricity Growth	0.015***	0.011***
	(4.45)	(3.28)
Employee Growth		0.006
		(1.25)
Revenue Growth		0.020***
		(6.38)
Year FEs	Yes	Yes
Industry FEs	Yes	Yes
Cluster by firms	Yes	Yes
N	37,346	37,346
Adj. R^2	0.0094	0.0119

Timeliness of electricity consumption

- We partition our sample into two groups based on the industry-level timeliness measure.
- We find that the association of GW with firm misreporting is driven by industries where electricity consumption is a timelier measure of real activities.

Panel B: Partitioning analysis based on timeliness

	(1)	(2)
Dependent variable	*Misreporting*	
Partitioning variable	Timeliness of electricity consumption for industry	
	High	Low
GW_Highest	0.020**	0.007
	(2.54)	(0.89)
F-score	0.010*	0.005
	(1.87)	(0.81)
M-score	0.005	−0.001
	(1.24)	(−0.23)
Dupont Indicator	0.008	0.011*
	(1.28)	(1.82)
Employee Growth	0.000	−0.001
	(0.05)	(−0.52)

Cross-sectional tests by firm types

We examine whether GW identifies more financial misreporting cases for firms with relatively weak governance or lax legal institutions that would otherwise constrain financial misreporting:

- public vs. private firms;
- non-Chaebol firms vs. Chaebol firms
- the volatility of revenues relative to the volatility of cash flows

Dependent variable				*Misreporting*		
Firm types	Private firms	Public firms	Family firms	Nonfamily firms	High noise in FMs	Low noise in FMs
GW_Highest	0.024**	0.013*	0.008	0.016**	0.027***	0.009
	(2.51)	(1.79)	(0.63)	(2.18)	(2.93)	(0.99)
F-score	0.018**	0.000	−0.005	0.008*	0.002	0.009
	(2.13)	(0.07)	(−1.40)	(1.65)	(0.35)	(1.59)
M-score	0.003	−0.000	−0.001	0.003	0.002	0.003
	(0.89)	(−0.06)	(−0.27)	(0.77)	(0.49)	(0.71)
Dupont Indicator	0.011	0.006	−0.003	0.012**	0.012*	0.008
	(1.49)	(1.44)	(−0.53)	(2.11)	(1.82)	(1.22)
Employee Growth	−0.002	−0.000	−0.002	−0.001	−0.003	0.001
	(−0.88)	(−0.00)	(−0.83)	(−0.38)	(−1.24)	(0.19)

Economy- and industry-based aggregations

- Our results suggest that economy-wide and industry-level electricity consumption contain unique information about “true” performance for misreporting detection that aggregate, or industry-level, revenue growth does not contain.
- In addition, these results, combined with our results from firm-fixed effect models, suggest that our inferences are generalizable to situations in which cross-sectional firm-level electricity information is not available.

Dependent variable	(1)	(2)	(3)	(4)
	Misreporting			
Revenue growth. . .				
relative to industry electricity growth	0.011**			
	(2.13)			
relative to aggregate electricity growth		0.010*		
		(1.93)		
relative to industry revenue growth			−0.006	
			(−1.33)	
relative to aggregate revenue growth				−0.000
				(−0.02)
Public	−0.021***	−0.021***	−0.021***	−0.021***
	(−2.87)	(−2.86)	(−2.86)	(−2.86)
Intangibles	−0.002	−0.002	−0.002	−0.002
	(−1.34)	(−1.32)	(−1.24)	(−1.30)

Conclusion

- We find compelling evidence of the incremental explanatory power of electricity consumption in detecting financial misreporting even after controlling for financial ratios and NFMs.

- We document that the revenue-electricity growth difference is positively associated with discretionary revenues and accruals.

- We also find that this GW increases the likelihood of financial misreporting proxied by an adverse restatement, qualified audit opinion, and a fraud investigation initiated by regulatory authorities.

- We further show that comparisons between firm-level GW and economy- and industry-level benchmarks are informative in identifying financial misreporting.