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Can Idiosyncratic Shocks to Firms Explain Macroeconomic Growth and Fluctuations in Korea?

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Abstract This paper examines whether idiosyncratic firm-level shocks can explain an important part of aggregate movements as in Gabaix (2011). Its findings show that, different from the case in the United States, the idiosyncratic movements of the largest 20 firms in Korea appear to explain up to 18% of the variations in output growth between 1981 and 2011. In addition, they are also useful in explaining the cyclical component of GDP. It is found that the top three firms movements account for 58% of the cyclical component of GDP during the period from 2001q1 to 2012q3. This empirical evidence suggests that the granular hypothesis also holds in Korea.

Keywords Economic growth; Business cycle; Granular hypothesis

JEL Classification O4, E32.

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1. INTRODUCTION

Modern economies are dominated by large firms. Even though such firms make up a small fraction of the total firms in an economy, this small fraction employs a large number of employees and produces a significant amount of GDP. According to SMEs status statistics from the Small and Medium Business Administration, large firms in Korea comprise 0.1% of the total firms in the Korean economy. However, these large firms at the same time account for approximately 45% of value-added (see Figure 1) and 12% of total employment. This fact is well documented in the existing literature: for example, the sales of the top two firms, Samsung and Hyundai, account for 25% of exports and 22% of Korean GDP (di Giovanni and Levenchenko (2009)). These facts suggest that if one of these firms is hit by a sudden shock, it will have a considerable macroeconomic impact. Motivated by these facts, this paper aims to uncover the sources of annual economic growth and fluctuations using firm-level data. Specifically, it tries to answer the question of to what extent idiosyncratic shocks to these large firms can explain macroeconomic movements in Korea. This is, to my knowledge, the first study that analyzes Korean macroeconomic movements using firm-level data.

A natural question to ask then is this: how can the role of large firms in explaining macroeconomic movements be evaluated? Gabaix (2011) finds that the idiosyncratic movements of the largest 100 firms in the United States appear to explain about one-third of the variations in output growth in that economy. He surmises this phenomenon into the "granular" hypothesis, which states that "many economic fluctuations are attributable to the incompressible 'grains' of economic activity, the large firms". Idiosyncratic shocks to such large firms hence have the potential to generate significant shocks that affect GDP. Since, as is well known the Korean corporate sector is less diversified than in the United States[1], the granular effects in Korea can be expected to be larger.

This paper finds that idiosyncratic shocks to the top 20 firms in Korea, which account for less than 0.01% of the total firms in the country, can explain over 18% of economic growth and about 58% of the cyclical fluctuations in the economy. All of those findings provide empirical evidence that the granular hypothesis does indeed holds in Korea. Those also confirm that idiosyncratic shocks to large firms may shed light on understanding economic growth and fluctuations in Korea.

[1]The sales Herfindahl index of $h = 5.3\%$ for the U.S. in 2008 while the sales Herfindahl index of $h = 11.01\%$ for Korea.

Figure 1: Sum of Value-added by Firm Size, as Portions of Total Value-added

Notes: The valued added for each firm size is calculated based on Financial Statement Analysis (FSA). Value-added is defined as the sum of employment costs, operating surplus, taxes and dues, depreciation and interest expenses.
Source: Financial Statement Analysis, Bank of Korea

The remainder of this paper is organized as follows: Section 2 describes the data used for the empirical analysis, and Section 3 presents the empirical results and implications of those results. Section 4 concludes.

2. DATA DESCRIPTION

I start by examining whether the granular hypothesis holds in Korea, as in the U.S. as found by Gabaix (2011), and whether it has significant explanatory power in explaining Korean GDP growth. I then investigate whether the granular residual can be useful in accounting for the business cycle component of GDP.

Since the purpose of the empirical analysis here is to test whether idiosyncratic shocks to firms are able to explain macroeconomic movements, we need to first define how to measure idiosyncratic labor productivity shocks to individual firms. Based upon Gabaix (2011), I define total annual idiosyncratic shock to a K number of firms, which is called a granular residual (Γ_t), as follows:

$$\Gamma_t = \sum_{i=1}^{K} \frac{S_{i,t-1}}{Y_t - 1}(g_{it} - \bar{g}_t) \tag{1}$$

where $\frac{S_{i,t-1}}{Y_t-1}$ denotes i th firms sales as a fraction of GDP at time $(t-1)$, $g_{i,t}$ labor productivity growth of th firm at time t and $\bar{g}_t$ average labor productivity growth of top K number of firms at time t. Note that K, the number of firm is selected based on their sales for the previous year. And a firms labor productivity growth is defined as follows:

Firm-level data on sales and employment come from KIS-Value dataset, which covers the period between 1980 and 2011 and hence enables us to explore a longer time-series than Compustat Global [2].

For empirical analysis I exclude the electricity, gas, steam and water supply (D), financial and insurance activities (K), real estate activities and renting and leasing (L), public administration and defense (O), and human health and social work activities and security (Q) sectors[3] . I also calculate the net sales[4] based on KIS-Value following Gabaix (2011).

To evaluate the macroeconomic movements generated by idiosyncratic shocks at the firm level as described in Gabaix (2011), we also need to see whether the firm size distribution exhibits a "Zipf" distribution[5]. Typically, idiosyncratic shocks are considered to be insignificant since they are smaller than the aggregate shocks. However, this argument falls when the firm size distribution is different from a thin-tailed distribution. Therefore, if the firm size distribution follows Zipf distribution, idiosyncratic shocks to large firms could account for macroeconomic movements larger than expected. Kang et al. (2011) evaluate the firm size distribution in Korea using the amounts of sales, total assets and capital, and the number of workers. They document that firm sizes in Korea follow a Zipf distribution with a power law with exponent $\zeta = 0.934$ in 1987 and $\zeta = 0.985$ in 2007. Hence the size distribution of Korean firms is well approximated by a power law with exponent $\zeta = 1$. Figure 2 plots the distributions of firm size both in 1987 and 2007, showing that the firm size distribution of log(employment) differs from the normal density. Both figures show that the densities of the largest values are higher than the normal density.

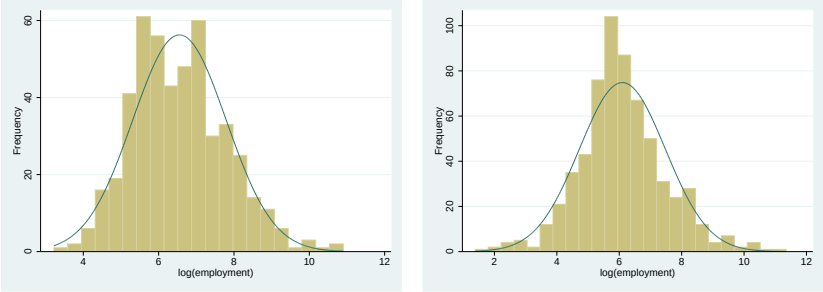
[2]In addition, the sales and employment data in Compustat Global do not provide proper coverage. For example, employment data are rarely available in the Compustat for Korean firms.

[3]Gabaix (2011) dropped those sectors due to the following reasons:) large fluctuations in energy price do not well match with total factor productivity) Similar to this, the sales of financial sectors are not good proxy of total factor productivity. I also exclude those social and government sectors due to the same reason.

[4]Subject to data availability, it is defined as follows: net sales = sales - sales discounts - sales returns and allowances.

[5]For example, lets denote the probability of a firm have more than employees as $P(S > s) = k/x^{\zeta}$ where ζ is some positive numbers. When we say the firm size distribution follows "Zipfs law, the exponent $\zeta \simeq 1$.

Figure 2: Distribution of Firm Size by Employment



(a) 1987 (b) 2007

Gabaix (2011) shows that GDP volatility can be expressed as $\sigma_{GDP} = \mu\sigma_\pi h$, where σ_{GDP} is the volatility of GDP, μ is a constant, σ_π is the volatility of the sales of certain number of firms and h is a Herfindahl index. Based on this equation, we can decide how many firms we will consider when calculating the granular residual.

According to Gabaix (2011), the sales Herfindahl(h) index of the rest of the world excluding the U.S. is 0.22. Compared to this, the sales Herfindahl index of Korea is 0.0754. But the value is still twice that of the U.S., suggesting that the granular hypothesis is thus more likely to hold in Korea than in the U.S. Now, we need to measure the size of μ , and to this end two benchmarks are considered. First, I adopt the simplest neoclassical growth model in Gabaix (2011) where only capital can be accumulated, and have $\mu = 1/\alpha$ in the long-run where α is the labor share. This gives $\mu = 1.9$. Second, when $\mu = (1+\varphi)/\alpha$, where φ denotes an effective Frisch elasticity[6] of 1.6 (as recommended for emerging economies by Boz et al. (2012)), $\mu = 3.02$. And by averaging these two benchmark values, I come up with $\mu = 2.47$. Now I can incorporate all of these numbers using $\sigma_\pi = 39\%$[7] for the top 20 firms. Thus, $\sigma_{GDP} = 2.47 \times 0.0754 \times 39\% = 7.26\%$, which is relatively close to the 6.8% as described in Gabaix (2011) for a typical country. However, it overshoots the ac-

[6]Frisch elasticity measures the substitution effect of a change in the wage rate on labor supply.

[7]σ_π is actually very large compared to that in the U.S. It ranges from around 30% to 40% for the top 10 to 100 firms. Even though the sales volatilities are quite similar regardless of how many firms we choose, the granular residual from the top 20 firms seems to explain the aggregate fluctuations in Koreas GDP growth better. And to handle some outliers, which may come from extraordinary events, I winsorize the extreme demeaned growth rates at 20% following Gabaix (2011).

tual GDP volatility during this period, which is 5.6%. After examining the sales volatilities by altering the number of firms, I conclude that the top 20 have the least volatility, and thus most closely fit the actual GDP volatility compared to the rest.

3. EMPIRICAL IMPLEMENTATION

3.1. UNDERSTANDING ECONOMIC GROWTH THROUGH THE LENS OF GRANULAR RESIDUAL

To answer the questions of whether the granular hypothesis holds and how much it explains economic growth rate in Korea using annual and quarterly data. I first present the results based upon the annual KIS-Value data from 1980 to 2011. We regress real GDP growth rate on the granular residuals. Therefore, when calculating the granular residual, $\Gamma_t = \sum_{i=1}^{K} \frac{S_{i,t-1}}{Y_t - 1}(g_{it} - \bar{g}_t)\ s_{i,t-1}$ is the net sales of a firm in the previous year and $Y_t - 1$ denotes real GDP. Since net sales are nominal values, we also deflate them using the CPI, and hence replace $(g_{it} - \bar{g}_t)$ with $(g_{it} - \bar{g}_t - inflation)$.

The period studied includes the Asian currency crisis of 1998, which hit the Korean economy severely, as well as the recent global financial crisis. As the available observations given in the data are 29 at maximum, this presents a challenge to this empirical implementation. I thus include a crisis dummy, which has a value of 1 if the year is 1998 and 0 otherwise, to capture the effect of the 1998 currency crisis. And as a measure of economic growth, real GDP growth rate and per capita GDP growth rate are used for the analysis.

Table 1 presents the results - regressions of GDP growth rate on the granular residuals based on the top 20 firms in Korea. The results show, based on the annual Korean data, that idiosyncratic shocks to the top 20 firms can explain approximately 18% of Koreas GDP growth rate (Column (1)). When the crisis dummy is included, its explanatory power goes up to 57%. Therefore, the results in Table 1 are supportive of the granular hypothesis. Different from the findings in Gabaix (2011), the results show that the lagged granular residuals turn out to be more important in explaining GDP growth rate in Korea. For example, when we regress GDP growth rate on Γ_t and Γ_{t-1}, the adjusted R-square is about 7%. However, when including Γ_{t-2}, it adds about 10% of significance. It is noteworthy that, when the crisis dummy is included, Γ_t also has significantly positive coefficients, with the adjusted R-square going up to 57$\sim$64%.

The results in Table 1 also suggest that the crisis that happened in 1998 had

Table 1: Explanatory Power of Granular Residual

	real GDP growth rate			per capita GDP growth rate		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	7.607***	8.313***	8.804***	6.028***	6.637***	7.146***
	(9.307)	(9.509)	(13.687)	(8.032)	(8.088)	(13.357)
Γ_t^{20}	0.276	0.437	0.598**	0.111	0.255	0.423*
	(0.720)	(1.146)	(2.145)	(0.316)	(0.714)	(1.823)
Γ_{t-1}^{20}	0.699*	0.558	0.374	0.596	0.479	0.288
	(1.820)	(1.495)	(1.366)	(1.689)	(1.365)	(1.262)
Γ_{t-2}^{20}		0.801**	0.866***		0.648*	0.715***
		(2.129)	(3.162)		(1.835)	(3.140)
Crisis Dummy			-12.970***			-13.450***
			(-4.833)			(-6.026)
N	30	29	29	30	29	29
adj. R-sq	0.074	0.181	0.568	0.039	0.117	0.634

Note: 1) GDP growth is regressed on current and lagged granular residuals using annual data for 1981-2011. 2) Top 20 firms granular residual is denoted as Γ_t^{20}. 3) Standard errors in parentheses; + $p < 0.15$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

a significant impact on economic growth rate during the time. Since the sample period also includes the recent global financial crisis that emerged in 2008, I try to examine its impact as well in the following. I change model specifications by including crisis dummies differently from Table 1 as a robust check. Three different crisis dummies are defined to analyze the effects of the Asian currency crisis and the global financial crisis. In Table 2, crisis dummy variables are separately defined based on the two crises. Each of those dummy variables is defined by 1 if the year is 1998 or 2008 to capture the possible effects of both of the financial crises. In addition, I also define the crisis dummy variable which is defined by 1 if the year is 1998 or 2008 and 0 otherwise to capture the effects of both crises simultaneously. Table 2 shows the results which still remain the same. Similar to Table 1, the inclusion of the crisis dummies enhances the explanatory power of the granular residual on GDP growth rate. What is noticeable is that the results show that the Asian currency crisis had a significantly negative effect on GDP growth rate while the recent global financial crisis did not.

The explanatory power slightly varies depending upon the measure of growth, but the results still confirm that idiosyncratic shocks to large firms can account for a large part of economic growth in Korea based on Table 1 and 2. In the beginning, I mentioned that large firms constitute 0.1% of total firms in Korea,

Table 2: Robustness Check for Growth Regressions

	real GDP growth		per capita GDP growth	
	(1)	(2)	(3)	(4)
Intercept	8.572***	8.772***	6.907***	7.111***
	(12.418)	(13.595)	(11.648)	(13.443)
Γ_t^{20}	0.726**	0.660**	0.558**	0.490**
	(2.357)	(2.301)	(2.107)	(2.084)
Γ_{t-1}^{20}	-0.394	0.085	-0.515	-0.028
	(-1.047)	(0.207)	(-1.596)	(-0.082)
Γ_{t-2}^{20}	0.914***	0.889***	0.766***	0.741***
	(3.076)	(3.229)	(3.001)	(3.281)
Crisis Dummy	-10.747***		-11.220***	
	(-4.055)		(-4.928)	
Currency Crisis		-13.500***		-14.028***
		(-4.919)		(-6.234)
Global Financial Crisis		-3.791		-4.127
		(-0.957)		(-1.271)
N	29	29	29	29
adj. R-sq	0.494	0.566	0.543	0.643

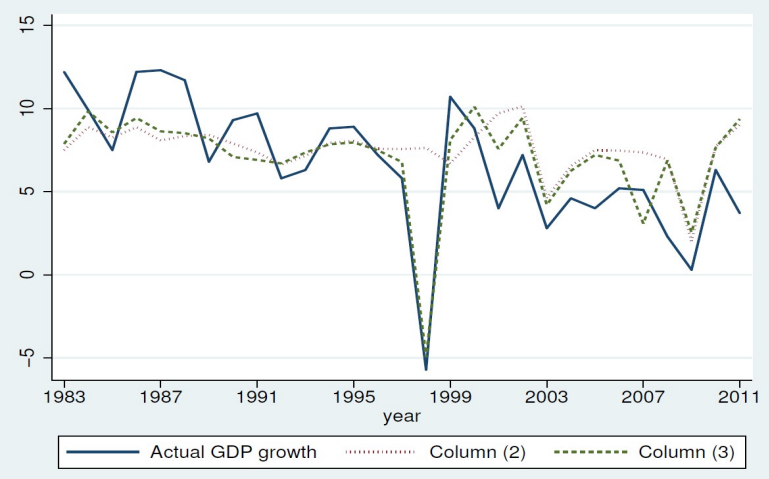
Note: 1) GDP growth is regressed on current and lagged granular residuals using annual data for 1981-2011. 2) Top 20 firms granular residual is denoted as Γ_t^{20}. 3) Standard errors in parentheses; + $p < 0.15$, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ 4) The crisis dummy is denoted as 1 if the year is 1998 or 2008. 5) The currency Crisis is denoted as 1 if the year is 1998; the global financial crisis is 1 if the year is 2008.

and recent statistics say those 0.1% actually comprised 3,053 firms in 2011. The 20 firms considered here therefore make up just 0.000618% of the total firms in Korea, and have yet accounted for about 18% of its economic growth rate over the past 30 years.

Based on the findings, Figure 3 illustrates how closely the predicted growth rate from Column (2) in Table 1 fits actual real GDP growth. It is found to fit the actual growth rate reasonably well during the Asian currency crisis and afterwards, although there are times when it underestimates or overestimates real GDP growth.

Until now I have used annual data for the empirical analysis, which gives a short time period for the analysis. One way of extending this time-series data is to instead use quarterly data. Korean firms began to report their balance sheets

Figure 3: Real GDP Growth and Predicted GDP Growth using Granular Residual



Notes: The fitted lines are drawn from Column (2) and (3) of Table 1.

on a quarterly basis from 2000, and allowing us relatively longer time series for more reliable statistical inference. And as this period, in addition, does not include 1998, when Korea was hard hit by the Asian currency crisis, it may lead to more robust results. For these reasons, I next use the quarterly data from 2000Q1 to 2012Q3.

The question now becomes: how many firms are we going to consider to calculate the granular residual? In other words, should we still use 20 firms, as we did in the above for the annual data? And to answer this question, I calculate the granular residuals for the top 20 firms, the top 19 firms and so on, down to the one largest firm, and find that the granular residual for the top three firms is most closely related to GDP growth. And I thus use the granular residual from the top three firms, and examine whether it can explain economic growth since 2000. The following explores the other possibility of whether the granular residual is useful in explaining the cyclical component of GDP.

The results in Table 3 again support the granular hypothesis. When including the granular residual from time t to $t-2$, it can explain about 10% of GDP growth since 2000.

Table 3: Explanatory Power of the Granular Residual for GDP growth from Top 3 Firms

	(1)	(2)	(3)	(4)
Intercept	0.892***	0.878***	0.883***	0.911***
	(5.361)	(5.076)	(4.976)	(4.999)
Γ^3_t	2.664**	2.769**	2.888**	3.038**
	(2.443)	(2.317)	(2.395)	(2.473)
Γ^3_{t-1}		-0.139	0.37	0.501
		(-0.116)	-0.292	-0.389
Γ^3_{t-2}			-1.392	-1.197
			(-1.159)	(-0.970)
Global Financial Crisis				-0.488
				(-0.754)
N	47	46	45	45
adj. R-sq	0.097	0.081	0.093	0.083

Note: 1) GDP growth is regressed on current and lagged granular residuals using annual data for 2001Q1-2012Q3. 2) The granular residual for the top 3 firms is denoted as Γ^3_t. 3) The global financial crisis is a dummy variable denoted as 1 if the time is between 2008Q1 to 2008Q4, and 0 otherwise.

The results point out that current GDP growth is closely related to the current granular residual. If we look at the firm-level data, we can find a link between micro-level variations and macroeconomic movements. For example, real GDP growth in 2008Q4 fell to -4.6%, and one of the reasons for this can be found in the micro data as the weighted sum of the annual granular residual was -20.8% in 2008Q4, with a probably negative effect on growth at that time.

One may question whether using the granular residual from top 20 firms could give the same results. Unfortunately, with quarterly data, the granular residual calculated from top 20 firms does not seem to suit for explaining growth, while that calculated from top 3 firms has some explanatory power.

To compare the results between the granular residual from top 3 and that from top 20 firms, the granular residual from the top 20 firms and top 3 firms are calculated then regressed on the GDP growth. Table 4 repeats the same exercise as in Table 3. The results indicate that none of the coefficients turns out to be significant[8].

The findings lead to the conclusion that the granular residual has explanatory power to GDP growth to some extent. And I examine now whether this granular residual has explanatory power for the cyclical component of GDP, the issue that has not been ad-

[8]I calculate the granular residual from 100 to 1 firms. It turns out that the granular residual from top 3 firms seems to fit the cyclical movement of GDP well compared to the rest.

Table 4: Explanatory Power of the Granular Residual: From the Top 20 Firms

	(1)	(2)	(3)	(4)
Intercept	0.989***	0.978***	0.960***	0.984***
	(5.681)	(5.419)	(5.131)	(4.888)
Γ_t^{20}	0.361	0.41	0.402	0.432
	(0.533)	(0.559)	(0.532)	(0.563)
Γ_{t-1}^{20}		-0.055	0.072	0.104
		(-0.075)	(0.090)	(0.129)
Γ_{t-2}^{20}			-0.313	-0.278
			(-0.417)	(-0.364)
Global Financial Crisis				-0.239
				(-0.354)
N	47	46	45	45

Note: 1) GDP growth is regressed on current and lagged granular residuals using annual data for 2001Q1-2012Q3. 2) The granular residual for the top 3 firms is denoted as Γ_t^{20}. 3) The global financial crisis is a dummy variable denoted as 1 if the time is between 2008Q1 to 2008Q4, and 0 otherwise.

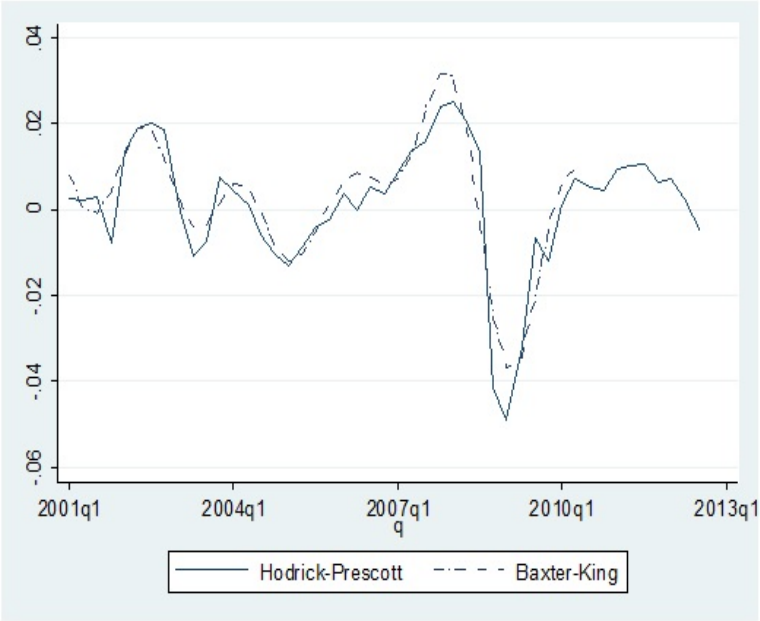
dressed in Gabaix (2011).

3.2. CAN THE GRANULAR RESIDUAL EXPLAIN CYCLICAL FLUCTUATIONS?

The previous section found the granular residual to have significant explanatory power regarding GDP growth. This section attempts to uncover the sources of economic fluctuations based on the granular residual of the top three firms, in order to build a micro-foundation for understanding the business cycles. The origins of economic fluctuations are still controversial: for example, the traditional business cycle literature considers aggregate demand and technological shocks (Shapiro and Watson (1988)) or investment shocks (Justiniano et al. (2008)) to be the sources of economic fluctuations.

For the empirical analysis we need to extract the long-term trend of GDP. To remove the long-term trend from the data and derive the cyclical component, HP-filtering and Baxter-King filter are used (Figure 4). In defining the granular residual, I define the labor productivity growth rate of each firm as $z_{it} = g_{it} - g_{i,t-4}$ to control seasonality, and then subtract the CPI inflation rate. The results show that the top three firms account for 25% of the cyclical movement.

Figure 4: Cyclical Component of GDP



Notes: To extract the cyclical component of GDP, GDP from 1970Q1 to 2013Q2 is used. Since the empirical analysis uses the cyclical component of GDP from 2001Q1 to 2012Q3, I try to minimize the end point problem that may arise from using HP-filter.

Table 5 gives us some intuition as to the relationship between the cyclical component of GDP and the granular residual. $\Gamma_t^3 \sim \Gamma_{t-2}^3$ have positive coefficients and are also statistically significant throughout (1)∼(3). This means that the cyclical component of GDP co-moves with the granular residual. Thus, the changes in the granular residual can cause or magnify business cycle fluctuations. However, different from $\Gamma_t^3 \sim \Gamma_{t-2}^3$, the coefficients on $\Gamma_{t-4}^3 \sim \Gamma_{t-5}^3$ andΓ_{t-8}^3 are both negative and statistically significant, indicating that they have counter-cyclical effects on the business cycle component.

As a robustness check, I also use the cyclical component of GDP from Baxter-King band pass filter. The results in Table 6 seem to provide similar evidence compared to those in Table 5. The coefficients on $\Gamma_t^3 \sim \Gamma_{t-2}^3$ are positive and statistically significant. In addition, the coefficients on $\Gamma_{t-4}^3 \sim \Gamma_{t-8}^3$ are both negative and statistically significant.

Table 5 and 6 also show that the explanatory power of granular residual on business cycle component is about 58% and 75%, respectively. This means that the top 3 firms activities are useful in predicting business cycle and their performance may explain over the half of the business cycle component in Korea.

Table 5: Granular Residuals Explanatory Power regarding Cyclical Fluctuations I

	(1)	(2)	(3)	(4)	(5)
Intercept	0.000	-0.001	0.000	0.000	0.000
	(-0.169)	(-0.464)	-0.057	(-0.037)	(-0.176)
Γ^3_t	0.019	0.019	0.011	0.023*	0.019
	(1.351)	(1.350)	(0.834)	(1.860)	(1.655)
Γ^3_{t-1}	0.037**	0.029*	0.028**	0.021	0.024*
	(2.657)	(1.962)	(2.090)	(1.600)	(1.927)
Γ^3_{t-2}		0.026*	0.033**	0.026*	0.031**
		(1.913)	(2.460)	(2.030)	(2.544)
Γ^3_{t-3}			0.006	0.009	0.011
			(0.445)	(0.712)	(0.925)
Γ^3_{t-4}			-0.044***	-0.024*	-0.035**
			(-3.357)	(-1.834)	(-2.730)
Γ^3_{t-5}				-0.032**	-0.029**
				(-2.308)	(-2.291)
Γ^3_{t-6}				-0.017	-0.007
				(-1.255)	(-0.518)
Γ^3_{t-7}					-0.007
					(-0.558)
Γ^3_{t-8}					-0.030**
					(-2.382)
N	46	45	43	41	39
adj. R-sq	0.199	0.249	0.4	0.517	0.584

Note: 1) HP-filtered cyclical component of GDP is regressed on current and lagged granular residuals using annual data for 2001Q1-2012Q3. 2) The granular residual for the top 3 firms is denoted as Γ^3_t.

Table 6: Granular Residuals Explanatory Power regarding Cyclical Fluctuations II

	(1)	(2)	(3)	(4)	(5)
Intercept	0.002	0.002	0.001	0	0
	(0.750)	(0.678)	(0.539)	(0.123)	(0.040)
Γ^3_t	0.021	0.022	0.01	0.018	0.015
	(1.378)	(1.407)	(0.614)	(1.411)	(1.430)
Γ^3_{t-1}	0.037**	0.031*	0.030*	0.023*	0.022*
	(2.395)	(1.912)	(1.792)	(1.757)	(2.036)
Γ^3_{t-2}		0.019	0.023	0.001	0.01
		(1.237)	(1.409)	(0.102)	(0.950)
Γ^3_{t-3}			-0.001	-0.004	-0.011
			(-0.074)	(-0.302)	(-0.991)
Γ^3_{t-4}			-0.032*	-0.017	-0.027**
			(-1.848)	(-1.307)	(-2.364)
Γ^3_{t-5}				-0.033**	-0.033***
				(-2.394)	(-2.927)
Γ^3_{t-6}				-0.050***	-0.036***
				(-3.783)	(-3.131)
Γ^3_{t-7}					-0.032**
					(-2.687)
Γ^3_{t-8}					-0.020*
					(-1.736)
N	37	36	34	32	30
adj. R-sq	0.194	0.207	0.249	0.619	0.75

Note: 1) HP-filtered cyclical component of GDP is regressed on current and lagged granular residuals using annual data for 2001Q1-2012Q3. 2) The granular residual for the top 3 firms is denoted as Γ^3_t.

4. CONCLUSION

This paper shows that firm-level movements can generate a large portion of growth volatility at the macro level. Taking GDP growth and its cyclical component as examples, it finds that idiosyncratic shocks to the top 20 firms in Korea explain a large fraction of aggregate growth (up to 18%) and that the top three firms also account for about one-quarter of the business cycle components. In cases of countries like Korea, which are small open economies, exchange rates and interest rates may be important drivers of macroeconomic activity, but are not the only contributors to GDP growth and its fluctuations.

In the context of the literature on economic growth and the business cycle, this paper provides new evidence of how micro-level shocks are related to macroeconomic movements. Identifying the sources of idiosyncratic shocks will be an important area for future research.

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