Minority Interest and Agency Costs: Implications for Free Cash Flow

Dr. Sankar Sundarrajan Dr. Arthur E. Young*

Abstract

There has been extensive research involving the utilization of free cash flow within an agency theory framework. This study investigates the relationship between minority interests and free cash flow on a sample of 37 firms using time-series analysis. In particular, we improve on previous studies by bringing in a time-series approach. Our data ranges from 1991 to 2008. We additionally study these relationships using the averages on both variables. Using a bivariate vector autoregressive (VAR) model that captures dynamic relationships, we find that a minority interest positively affects free cash flow, whereas the opposite relationship is less evident. This is also backed by Granger causality tests. By means of impulse responses, we find that a once and for all standard deviation increase to a minority interest causes a statistically significant positive reaction on free cash flow, by the second year. Findings from the times-series analysis are consistent with previous literature stating that investors can benefit from the minority interests' monitoring of the resources available for utilization at the managers' discretion.

Keywords: Agency theory; Free Cash Flow; Minority Interest; VAR models
JEL codes: G11, G30

I. Introduction

According to the agency theory of Jensen (1986), agents should act on behalf of the shareholders to maximize shareholder wealth. Owners have to decide the threshold between monitoring costs and management expropriation costs. Management expropriation costs arise from the difference between the decision made by the managers and those that would have maximized shareholder wealth. Jensen and Meckling (1976) label this phenomenon as the residual loss. Jensen (1986) discusses the agency costs of free cash flow (FCF) to be of substantial importance. These costs take place when instead of returning the money to investors, managers overinvest retained earnings in underperforming projects. In essence, managers can overgrow the firm to create corporate wealth instead of shareholder wealth. In addition, Wang and Esqueda (2014) state that the free cash flow theory implies less than optimal management quality for firms with high levels of free cash flow. Minority interests (MI) (often referred to as non-controlling interests) represent the part of the firm that is not actually owned by the shareholders, but instead, is owned by third parties with less than a fifty percent ownership interest in a subsidiary. In this paper, we investigate whether companies with high levels of minority interest tend to generate higher FCFs using time-series data which has been relatively under-utilized in this field relative to cross-sectional.

Minority interests help to reduce agency costs. Marginal shareholders have the risk of management expropriation when the agent tries to maximize his own wealth at the shareholder's expense. However, if the agent owns a partial share of the firm (α), he will bear a share of the costs, equal to α for every dollar wasted (Jensen & Meckling, 1976). Graham and Lefanowics (1999) found that due to information asymmetry and major representation on the board of directors, investors buy shares at discount of companies with minority ownership in a subsidiary, compared with similar firms.

This study contributes to the literature in the following distinct ways: First, we analyze the agency theory using a different perspective, time-series analysis. Second, we investigate how minority

interests impact the free cash flow of a firm, an area that has been little studied in the literature. Specifically, prior research has analyzed free cash flow and minority interests separately with respect to different variables but not jointly as we do in this paper. Third, we employ vector autoregression models in a panel of firms to utilize the information contained in time-series as well as cross-sectional data. This approach also allows us to analyze any contemporaneous dynamic relationships which many studies that use simple regression analysis on cross-sectional data do not. Further we investigate the postulated relationship between minority interests and free cash flow at the aggregate level on a sample of 37 firms from the S&P 1500 for the period of January 1991 to December 2008. We exclude financial and utility companies as these industries tend to be highly regulated relative to the rest of the industries (De Fusco, Dunham, and Geppert, 2007**;** Sarig, 2004; and Lins, Strickland and Zenner, 2005).

The findings reveal that on average a shock to MI leads to higher average amount of FCF. A one standard deviation shock to the average amount of MI leads to a significant increase in FCF by the second year. Granger causality tests are significant for 17 firms at a 90% confidence level or higher.

The paper is organized as follows: in section 2, we review the literature. Section three presents the data and descriptive statistics. Section 4 describes the econometric methodology. Section 5 reports empirical results. Section 6 concludes.

II. Literature Review

As mentioned by Jensen and Meckling (1976) and Myers and Majluf (1984) the parent firm (controlling firm) will try to maximize its own wealth instead of that of the minority shareholders. The MI firm will act as the agent for the rest of the shareholders of companies that have a minority interest present in a subsidiary.

Recent literature suggests that investors will pay a higher value for a company with a majority ownership in a subsidiary (as opposed to a 100% interest). Graham and Lefanowics (1999) assess the price for the majority ownership firm versus a similar diffusely held firm, in several cases to validate this hypothesis. It is also possible that wealth transfers are done in non-monetary forms. The agent might find other forms of tunneling resources. For instance, in transfer prices and decisions that will benefit directly or indirectly the parent company such as location or production strategy, in all such cases there may be a transfer of profits at the expense of the owners with marginal representation. Atomistic shareholders are sometimes protected by contracts; however, in some situations, it is very subtle and the monitoring costs might outweigh the losses from such tunneling to the majority of the shareholders.

Barclay and Holderness (1989) document that shares of majority owned firms (at least 5%) are sold at a premium of 20% on average. They also find that the premium increases for companies with more cash holdings, firms with a higher debt-equity ratio, and with less return volatility. In our model, we observe the relationship of MI and FCF on the firm with control on other entities' assets. We use the amount of MI to determine the degree of control of the firm over someone else's assets.

Moreover, FCF is considered in the literature to be an important determinant of corporate value (Brigham & Ehrhardt, 2005, pp. 91-125, 2005), (Copeland, Weston, & Shastri 2005 pp. 497-555, 2005) and (Koller, Goedhart, & Wessels pp. 159-228, 2005). In financial literature, the net present

value of FCF is considered as the main proxy for shareholder wealth. Additionally, in corporate control transactions, such as management buyouts and hostile takeovers, investment professionals use discounted cash flow techniques to value shares, and usually the future cash flows have to be predicted using historical accounting data (DeAngelo, 1990).

Building on previous work, we formulate the following hypotheses in our study. Due to the benefits of controlling third parties' assets, managers are expected to reap some profits for the firm. These profits, minus the residual loss, are expected to be positive and they can be parameterized by increases in FCF.

H1: A standard deviation shock to the firms' amount of MI positively affects the amount of FCF.

Theoretically, it is not expected to find causality in the opposite direction, from FCF to MI. Additionally, we hypothesize each direction of causality using two measures in each equation. In the first run of tests we use firm level values. Similarly, in the second part of the analysis we use average amounts for the portfolio of firms.

H2: A standard deviation shock to the firms' FCF positively affects the amount of MI for the firms.

Free cash flow and minority interest often move in the same direction, for instance, as corporations reach their maturity stage. Therefore, it is important to emphasize the results of the impulse response functions and granger causality tests.

III. Data and Descriptive Statistics

We use annual financial data from 1991 to 2008. The data is from Thompson Reuters Datastream (TRD). The initial sample of firms includes the non-financial and non-utility constituents of the S&P 1500 (as available in TRD). First, we exclude firms with zero values in MI during any year to avoid high fluctuations when companies include MI liabilities for fewer years than the sample period. In a similar approach, Esqueda et al. (2013) omit firms with no financial information at any time during their sample period in order to maintain a balanced panel. Additionally, we exclude all firms with missing data in any year, and in any of the two variables. Due to the high number of firms that do not have MI in their balance sheets during the complete sample period, our final sample includes 37 companies. As described above we excluded financial and utility companies, SIC codes 6000-6999 and 4000-4949. These industries were omitted due to the higher level of regulation they are subject to compared with the rest of the industries (De Fusco, Dunham, and Geppert, 2007**;** Sarig, 2004; and Lins, Strickland and Zenner, 2005).

All series were deflated using the 2005 GDP deflator from the International Financial Statistics (IFS) from the International Monetary Fund (IMF). Therefore the series are in U.S. currency adjusted to 2005 values.

Refer Table I

IV. Econometric Methodology

We use a bivariate VAR model to analyze the nature of the time-series relationship between MI and FCF. Additionally, we analyze this relationship using the portfolio averages. We calculate the arithmetic mean to obtain the average series. We test for stationarity to avoid spurious findings. Most series appear to be stationary in the form of levels, however, those that were found to be non-stationary were tested using the multivariate cointegration method of Johansen (1995), similar to Luo and Esqueda (2011). We found at least a single cointegrating vector in those non-stationary series. We proceeded to use our data in levels.[1] Additionally we estimated a separate two-variable VAR for each of our 37 firms

We express the VAR model as:

$$MI_{it} = \propto + \beta_{i1} MI_{it-1} + \beta_{i2} FCF_{it-1} + \varepsilon_{it} \quad (1)$$

$$FCF_{it} = \propto + \beta_{i1} FCF_{it-1} + \beta_{i2} MI_{it-1} + \varepsilon_{it} \quad (2)$$

Using models (1) and (2) we carried out the impulse responses to a five period step-ahead horizon (measured in years). Due to the limited number of observations, the lag length was set to 1 for all firms and for the average values.[2]

V. Empirical Results

Figures 1a and 1b plot the average series; we found that a shock to MI leads to a statistically significant increase in the average amount of free cash flow in agreement with the agency theory. A one standard deviation shock to the average amount of MI led to a significant increase in FCF by the second year, but it dissipates after the fourth year.

Refer Figures 1a and 1b

Table II reports that MI granger causes FCF at a 0.01 significance level. Hypothesis 1 is supported in the averages series; if we were to form a portfolio of securities, it would be advisable to include companies with high minority interest percentages in their balance sheets. The response of MI to a shock on FCF has a marginally significant coefficient in the average series.

Refer Table II

At the individual level we obtained a similar positive trend in the VAR results (individual impulse response function results are available upon request). The shock to MI had a positive and significant effect on FCF on eleven firms and in one firm it had a negative and significant effect.

Table II further reports Granger causality tests. The causality of MI towards FCF is significant at least at the 0.10 significance level for seventeen firms. Finally, the opposite direction of causality (free cash flow to minority interest) shows significant results eleven times at a similar significance interval.

[1] Vector error correction results yielded qualitatively similar results.
[2] Degrees of freedom limitations from the time-series data of eighteen years are to a certain extent mitigated from cross-sectional data of thirty seven firms.

VI. Conclusions

We tested whether the amount of a minority interest is significant and positively correlated with free cash flows, as would be expected by theory. We have found that these predictions of the agency theory are supported. Minority interest is an important factor to consider when investors build a portfolio. We found that on average a shock to the amount of minority interest had a positive effect on the amount of FCF. We found that MI granger causes FCF more often than the opposite direction of causality.

We attributed this positive effect of minority interest, to a reduction in agency costs for the shareholders. In a scenario with MI, managers have control over assets not wholly owned by the firm. In other words, the agency costs are reduced as the amount of minority interest increases. Corporate wealth increases without a cost to shareholders. Free cash flow is the most important factor to observe when investors assess the value of a company. Free cash flow is an important criterion when building a portfolio. Therefore the capacity to produce higher amounts of FCF in the future should be carefully evaluated by investors.

This paper contributes to the existing literature in the following distinct ways. We brought the time-series framework to the literature when analyzing agency theory issues. Most studies in the past have utilized cross-sectional analysis. Additionally, we investigated how minority interest impacts the free cash flow of a firm, an area that had been little studied in the literature.

The practical implications of this study are that investors should consider the level of the minority interest of companies, when building a portfolio. Indeed, those firms who have a greater stream of free cash flows are more valuable to shareholders. Policy makers should monitor the financial health of firms by paying greater attention to the level of minority interests, to determine their sustainability in the long run.

References

Barclay, M. J. and C. G. Holderness (1989). Private Benefits from Control of Public Corporations. *Journal of Financial Economics,* Vol. 25, No. 2 (December), pp. 371-95

Brigham, E. F. and M. C. Ehrhardt (2005). Chapter 3, Financial Statements, Cash Flow and Taxes, 11th ed., Financial Management, pp. 91-125, U.S., South Western Thompson.

Copeland, T. E., J. F. Weston, and K. Shastri (2005). Chapter 14 Valuation and Tax Policy, 4th ed., Financial Theory and Corporate Policy, pp. 497-555, U.S. Pearson Addison Wesley.

DeAngelo, L. (1990). Equity Valuation and Corporate Control. *The Accounting Review,* Vol. 65, No. 1 (January), pp. 93-112.

De Fusco R., L. Dunham, and J. Geppert, (2007). The Dynamic relation among investment, earnings and dividends, *Working Paper.*

Esqueda O. A., Y. Luo, and D. O. Jackson (2013). The linkage between the U.S. "fear index" and ADR premiums under non-frictionless stock markets. Journal of Economics and Finance, 1-16.

Graham, R. C. and C. E. Lefanowics (1999). Majority and Minority Ownership of Publicly-Traded Firms: A Test of the Value of Control Using Market Multiples. *Journal of Business, Finance, & Accounting,* 26(1) & (2). 1999, 0306-686X.

Jensen, M. C. and W. H. Meckling (1976). Theory of the firm: Managerial behavior, agency costs, and ownership structure, *Journal of Financial Economics*, pp. 305-360.

Jensen. M. C. (1986). Agency Costs of Free Cash Flow Corporate Finance and Takeovers, *American Economic Review,* 76. pp. 323-350.

Johansen, S., (1995). Likelihood-based Inference in Cointegrated Vector Autoregressive Models. *Oxford University Press*, Oxford.

Koller, T., M. Goedhart, and D. Wessels (2005) Chapter 7, Analyzing historical performance, 4th ed., Valuation, pp. 159-228.

Lins, K., D. Strickland, and M. Zenner, (2005) Do Non-U.S. Firms Issue Equity on U.S. Stock Exchanges to Relax Capital Constraints? *Journal of Financial and Quantitative Analysis*, Vol. 40, No. 1, (March), pp. 109-132

Luo, Y., and O. A. Esqueda, (2011). Cointegration and Priority Relationships Between Energy Stocks and Oil Prices. *Journal of Current Research in Global Business*, *14*(21), 22-32.

Myers, S. C. and N. S. Majluf (1984). Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have, *Journal of Financial Economics, Vol.* 13, No. 2 (June), pp. 187-22

Sarig, O. (2004). A Time-Series Analysis of Corporate Payout Policies. *Review of Finance*, 9, 1–22.

Wang, D. and O. A. Esqueda (2014). National cultural effects on leverage decisions: Evidence from emerging-market ADRs. *Research in International Business and Finance*, *31*, 152-177.

Table I Descriptive statistics

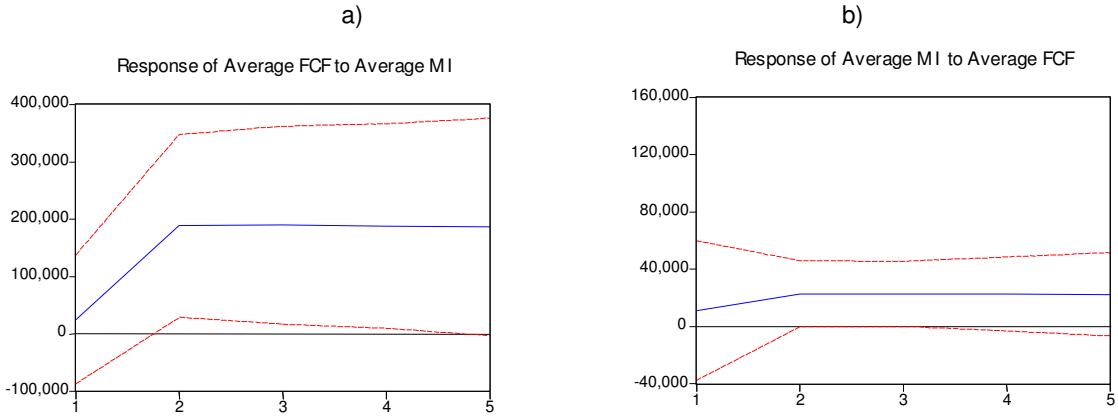
Id	Variable	N	Min	Mean	Median	Max	S.D.	Skewness	Kurtosis
Average	FCF	18	1394419	2394119	2289911	3854759	774418	0.33	1.90
Average	MI	18	409186	633539	641997	961515	134426	0.39	3.21
1	FCF	18	671117	2132877	2163238	3194197	590847	-0.53	3.41
1	MI	18	1365000	1770933	1733290	2393923	292738	0.64	2.74
2	FCF	18	1360139	3311634	3508176	4332878	909056	-0.67	2.21
2	MI	18	63604	1121007	472869	3143585	1075310	0.94	2.21
3	FCF	18	2217815	5477078	5650863	10700000	2459078	0.29	2.09
3	MI	18	221235	727692	456518	2715796	753856	2.06	5.85
4	FCF	18	-230958	324094	262700	1107357	304400	0.58	3.92
4	MI	18	49436	77211	56356	193487	42324	1.83	5.05
5	FCF	18	105344	881657	559281	5738226	1281378	3.27	12.90
5	MI	18	19089	252042	135302	1224155	349317	2.32	6.70
6	FCF	18	58836	96493	92025	176692	30825	0.89	3.55
6	MI	18	2621	12721	15794	21912	6882	-0.17	1.48
7	FCF	18	1151449	1842571	1874197	2722518	468221	0.40	2.38
7	MI	18	206281	1437926	1602913	2417977	724310	-0.85	2.42
8	FCF	18	41149	502081	427594	1556752	427199	1.12	3.37
8	MI	18	97453	433459	207361	1364227	440344	1.07	2.58
9	FCF	18	227266	797611	543005	2119526	590805	1.37	3.55
9	MI	18	166326	256563	254852	357081	64552	0.05	1.47
10	FCF	18	627682	1032592	1031434	1293759	165035	-0.57	3.14
10	MI	18	66488	112279	105141	147998	26352	0.04	1.71
11	FCF	18	3357	17717	17075	33167	9086	0.04	1.76
11	MI	18	2121	6185	4395	13038	3415	0.47	1.83
12	FCF	18	11617	56822	58351	100924	25357	-0.11	2.16
12	MI	18	1691	4181	4937	6812	1753	-0.24	1.52
13	FCF	18	336715	556418	517439	882600	192818	0.49	1.78
13	MI	18	32491	44563	43470	61341	8858	0.40	1.95
14	FCF	18	191514	347551	341460	591310	112394	0.60	2.71
14	MI	18	22207	46694	51377	63647	12974	-0.66	2.15
15	FCF	18	-321867	725307	760131	1397554	387124	-0.95	4.61
15	MI	18	157189	589798	787267	1036531	347288	-0.18	1.21
16	FCF	18	822383	1910664	2238924	2969600	732606	-0.33	1.54
16	MI	18	67711	273354	295435	455778	122594	-0.51	2.07
17	FCF	18	410492	1523966	1681937	2274908	512335	-0.66	2.70
17	MI	18	17514	441900	542754	712964	266962	-0.54	1.66
18	FCF	18	-87123	117464	99206	386641	130464	0.39	2.40
18	MI	18	2933	23923	31474	42323	15240	-0.33	1.39
19	FCF	18	-19563	331160	285148	943949	234325	0.90	3.83
19	MI	18	0	45664	41454	100050	32921	0.30	1.81
20	FCF	18	149629	749364	697980	1639332	458702	0.35	2.03
20	MI	18	36145	133374	150429	227936	67338	-0.13	1.41
21	FCF	18	7981	63611	60022	127829	40675	0.09	1.63
21	MI	18	1515	3452	3419	5233	991	-0.11	2.37
22	FCF	18	2756187	6414103	6446327	10300000	2395014	-0.06	1.88
22	MI	18	797251	2920290	2466565	5741652	1582036	0.48	2.04
23	FCF	18	2005681	3114633	2909954	4282000	664533	0.31	1.96
23	MI	18	248464	405863	403606	593738	108631	0.33	2.19
24	FCF	18	57809	314211	322903	620374	167354	0.22	1.91
24	MI	18	968	15938	9658	61350	15518	1.53	5.12
25	FCF	18	103967	226023	223570	374462	88528	0.17	1.66
25	MI	18	1795	25775	29529	45939	15115	-0.59	1.91
26	FCF	18	9826126	24400000	24000000	42400000	9954002	0.14	1.78
26	MI	18	1634458	5705360	5743611	17200000	3579529	1.74	6.97
27	FCF	18	141507	444602	392915	752857	167259	0.14	2.02
27	MI	18	64091	188463	189608	292509	61457	-0.39	2.83
28	FCF	18	1541148	3001508	2861228	5110425	1104973	0.51	2.29
28	MI	18	449174	643558	594911	955003	165273	0.59	2.04

Table I Continued.

Id	Variable	N	Min	Mean	Median	Max	S.D.	Skewness	Kurtosis
29	FCF	18	-2646	50147	41725	129557	38319	0.70	2.58
29	MI	18	628	6030	7037	15528	4086	0.37	2.70
30	FCF	18	-181434	479535	348580	2197675	558263	1.69	5.99
30	MI	18	3640	18686	6472	72107	22416	1.44	3.64
31	FCF	18	12100000	24000000	17200000	47900000	12800000	0.92	2.32
31	MI	18	2124423	3390456	3590253	4289415	671420	-0.38	1.94
32	FCF	18	-350011	882628	784108	1914586	627336	0.17	2.35
32	MI	18	30434	197766	156697	415683	148137	0.16	1.34
33	FCF	18	50809	144250	134698	232648	58774	0.03	1.75
33	MI	18	4398	15170	15832	26795	6225	-0.19	2.33
34	FCF	18	-1147953	863181	1290973	2026605	992176	-0.67	2.22
34	MI	18	80554	439854	146746	1280766	480007	0.76	1.68
35	FCF	18	-614325	-2425	38464	310981	194495	-1.63	6.68
35	MI	18	11306	20586	16486	103918	21005	3.75	15.44
36	FCF	18	102020	521887	508264	965931	312385	0.00	1.33
36	MI	18	152997	470635	522889	613419	141276	-1.21	3.22
37	FCF	18	40855	879735	376003	2269946	853546	0.52	1.52
37	MI	18	14325	1161604	886135	3150724	1068797	0.67	2.32

Note: S.D. is equal to the standard deviation values. In the id column, average indicates the equal weighted average of all firms in the sample.

Figure 1
Impulse Responses based on the sample averages



Figures 1a and 1b correspond to the generalized impulse response function five periods step-ahead using the series average values. The upper and lower series (dotted lines) indicate values two standard errors from the mean.

Table II Results from VAR model and Granger causality tests

Firm ID	Response Variable	Impulse Variable	Regressor Variables		Coefficient	S.E.	p-value	95% interval coefficient		Granger causality test			
										Excluded	chi2	df	P value
Average	FCF	MI	L1.	FCF	0.80	0.10	0.00	0.60	1.00				
Average	FCF		L1.	MI	1.66	0.53	0.00	0.62	2.70	MI	9.80	1	0.00
Average	FCF		α		-456716	249774	0.07	-946264	32831				
Average	MI	FCF	L1.	FCF	0.09	0.04	0.05	0.00	0.17	FCF	3.96	1	0.05
Average	MI		L1.	MI	0.20	0.23	0.38	-0.25	0.66				
Average	MI		α		314845	108429	0.00	102329	527361				
1	FCF	MI	L1.	FCF	0.64	0.24	0.01	0.17	1.11				
1	FCF		L1.	MI	0.64	0.54	0.24	-0.42	1.71	MI	1.41	1	0.24
1	FCF		α		-325521	1255028	0.80	-2785331	2134289				
1	MI	FCF	L1.	FCF	-0.14	0.09	0.15	-0.32	0.05	FCF	2.09	1	0.15
1	MI		L1.	MI	0.69	0.21	0.00	0.28	1.11				
1	MI		α		848891	494239	0.09	-119801	1817582				
2	FCF	MI	L1.	FCF	0.39	0.22	0.08	-0.04	0.83				
2	FCF		L1.	MI	-0.03	0.19	0.89	-0.40	0.34	MI	0.02	1	0.89
2	FCF		α		2010278	798844	0.01	444573	3575983				
2	MI	FCF	L1.	FCF	0.00	0.16	0.99	-0.31	0.32	FCF	0.00	1	0.99
2	MI		L1.	MI	0.87	0.14	0.00	0.60	1.13				
2	MI		α		74157	571383	0.90	-1045734	1194048				
3	FCF	MI	L1.	FCF	0.41	0.20	0.04	0.01	0.80				
3	FCF		L1.	MI	-1.13	0.65	0.08	-2.41	0.15	MI	2.99	1	0.08
3	FCF		α		3978838	1419933	0.01	1195821	6761855				
3	MI	FCF	L1.	FCF	0.15	0.06	0.01	0.03	0.27	FCF	6.02	1	0.01
3	MI		L1.	MI	0.55	0.19	0.01	0.16	0.93				
3	MI		α		-471171	423313	0.27	-1300850	358508				
4	FCF	MI	L1.	FCF	0.22	0.22	0.32	-0.22	0.66				
4	FCF		L1.	MI	-1.66	1.62	0.30	-4.83	1.50	MI	1.06	1	0.30
4	FCF		α		365454	161541	0.02	48839	682068				
4	MI	FCF	L1.	FCF	0.01	0.03	0.64	-0.04	0.06	FCF	0.21	1	0.64
4	MI		L1.	MI	0.64	0.19	0.00	0.28	1.01				
4	MI		α		22611	18645	0.23	-13931	59154				
5	FCF	MI	L1.	FCF	0.55	0.27	0.04	0.02	1.08				
5	FCF		L1.	MI	4.18	0.45	0.00	3.30	5.05	MI	87.05	1	0.00
5	FCF		α		-221264	131370	0.09	-478744	36217				
5	MI	FCF	L1.	FCF	0.72	0.11	0.00	0.51	0.93	FCF	45.03	1	0.00
5	MI		L1.	MI	0.12	0.18	0.51	-0.23	0.47				
5	MI		α		-187551	52300	0.00	-290057	-85045				
6	FCF	MI	L1.	FCF	0.34	0.24	0.15	-0.12	0.80				
6	FCF		L1.	MI	0.81	1.09	0.46	-1.34	2.95	MI	0.54	1	0.46
6	FCF		α		54548	28700	0.06	-1702	110799				
6	MI	FCF	L1.	FCF	-0.02	0.04	0.59	-0.10	0.06	FCF	0.29	1	0.59
6	MI		L1.	MI	0.69	0.19	0.00	0.32	1.06				
6	MI		α		5922	5023	0.24	-3922	15766				
7	FCF	MI	L1.	FCF	0.16	0.21	0.45	-0.26	0.58				
7	FCF		L1.	MI	0.31	0.15	0.04	0.01	0.61	MI	4.08	1	0.04
7	FCF		α		1073573	437724	0.01	215650	1931496				
7	MI	FCF	L1.	FCF	-0.20	0.21	0.33	-0.61	0.20	FCF	0.94	1	0.33
7	MI		L1.	MI	0.94	0.15	0.00	0.65	1.23				
7	MI		α		391094	420806	0.35	-433670	1215857				
8	FCF	MI	L1.	FCF	0.42	0.32	0.19	-0.20	1.04				
8	FCF		L1.	MI	0.39	0.35	0.27	-0.29	1.07	MI	1.24	1	0.27
8	FCF		α		168067	98578	0.09	-25142	361277				
8	MI	FCF	L1.	FCF	0.34	0.13	0.01	0.09	0.59	FCF	7.21	1	0.01
8	MI		L1.	MI	0.73	0.14	0.00	0.46	1.01				
8	MI		α		1719	39460	0.97	-75622	79060				
9	FCF	MI	L1.	FCF	0.94	0.13	0.00	0.68	1.20				
9	FCF		L1.	MI	-1.40	1.12	0.21	-3.60	0.80	MI	1.56	1	0.21
9	FCF		α		485338	293175	0.10	-89274	1059950				
9	MI	FCF	L1.	FCF	0.01	0.01	0.36	-0.02	0.04	FCF	0.85	1	0.36
9	MI		L1.	MI	0.78	0.12	0.00	0.54	1.02				
9	MI		α		53370	32285	0.0980	-9906	116647				

Firm ID	Response Variable	Impulse Variable	Regressor Variables	Coefficient	S.E.	p-value	95% interval coeff		Granger causality test Excluded	chi2	df	P value
10	FCF	MI	L1. FCF	0.02	0.24	0.94	-0.45	0.49				
10	FCF		L1. MI	0.79	1.55	0.61	-2.26	3.83	MI	0.26	1	0.61
10	FCF		α	916585	270150	0.00	387100	1446070				
10	MI	FCF	L1. FCF	0.03	0.03	0.33	-0.03	0.08	FCF	0.97	1	0.33
10	MI		L1. MI	0.69	0.18	0.00	0.33	1.04				
10	MI		α	8333	31352	0.79	-53116	69782				
11	FCF	MI	L1. FCF	0.08	0.24	0.74	-0.38	0.54				
11	FCF		L1. MI	-0.48	0.63	0.44	-1.70	0.75	MI	0.59	1	0.44
11	FCF		α	18862	6225	0.00	6661	31064				
11	MI	FCF	L1. FCF	0.16	0.04	0.00	0.07	0.25	FCF	12.44	1	0.00
11	MI		L1. MI	0.75	0.12	0.00	0.52	0.99				
11	MI		α	-1088	1185	0.36	-3410	1235				
12	FCF	MI	L1. FCF	-0.27	0.23	0.24	-0.72	0.18				
12	FCF		L1. MI	-1.79	3.34	0.59	-8.34	4.75	MI	0.29	1	0.59
12	FCF		α	78241	21207	0.00	36676	119805				
12	MI	FCF	L1. FCF	0.01	0.01	0.44	-0.01	0.02	FCF	0.61	1	0.44
12	MI		L1. MI	0.83	0.11	0.00	0.62	1.05				
12	MI		α	540	709	0.45	-850	1931				
13	FCF	MI	L1. FCF	0.49	0.19	0.01	0.11	0.86				
13	FCF		L1. MI	-7.16	4.33	0.10	-15.65	1.32	MI	2.74	1	0.10
13	FCF		α	604213	253741	0.02	106890	1101537				
13	MI	FCF	L1. FCF	0.00	0.01	0.80	-0.01	0.01	FCF	0.07	1	0.80
13	MI		L1. MI	0.78	0.15	0.00	0.48	1.07				
13	MI		α	9760	8808	0.27	-7503	27022				
14	FCF	MI	L1. FCF	-0.06	0.26	0.83	-0.57	0.45				
14	FCF		L1. MI	7.07	2.00	0.00	3.15	11.00	MI	12.48	1	0.00
14	FCF		α	51007	66411	0.44	-79157	181170				
14	MI	FCF	L1. FCF	0.00	0.01	0.97	-0.02	0.02	FCF	0.00	1	0.97
14	MI		L1. MI	0.91	0.07	0.00	0.79	1.04				
14	MI		α	6273	2157	0.00	2045	10501				
15	FCF	MI	L1. FCF	-0.10	0.27	0.70	-0.62	0.42				
15	FCF		L1. MI	-0.46	0.27	0.10	-0.99	0.08	MI	2.78	1	0.10
15	FCF		α	1065330	314088	0.00	449729	1680932				
15	MI	FCF	L1. FCF	0.26	0.11	0.03	0.03	0.48	FCF	4.96	1	0.03
15	MI		L1. MI	0.92	0.12	0.00	0.68	1.15				
15	MI		α	-109444	135341	0.42	-374707	155820				
16	FCF	MI	L1. FCF	0.61	0.15	0.00	0.31	0.91				
16	FCF		L1. MI	1.82	0.93	0.05	0.00	3.64	MI	3.85	1	0.05
16	FCF		α	318214	201183	0.11	-76097	712524				
16	MI	FCF	L1. FCF	0.04	0.03	0.15	-0.01	0.10	FCF	2.09	1	0.15
16	MI		L1. MI	0.60	0.17	0.00	0.26	0.94				
16	MI		α	47244	37398	0.21	-26055	120543				
17	FCF	MI	L1. FCF	0.63	0.15	0.00	0.34	0.92				
17	FCF		L1. MI	0.98	0.28	0.00	0.44	1.53	MI	12.71	1	0.00
17	FCF		α	87110	239552	0.72	-382403	556624				
17	MI	FCF	L1. FCF	-0.07	0.07	0.32	-0.20	0.06	FCF	1.00	1	0.32
17	MI		L1. MI	1.00	0.12	0.00	0.76	1.25				
17	MI		α	77781	107929	0.47	-133755	289318				
18	FCF	MI	L1. FCF	0.53	0.25	0.03	0.04	1.02				
18	FCF		L1. MI	-1.44	2.08	0.49	-5.52	2.64	MI	0.48	1	0.49
18	FCF		α	104074	55953	0.06	-5591	213739				
18	MI	FCF	L1. FCF	0.03	0.02	0.08	0.00	0.06	FCF	3.03	1	0.08
18	MI		L1. MI	0.78	0.13	0.00	0.53	1.03				
18	MI		α	2562	3471	0.46	-4241	9364				
19	FCF	MI	L1. FCF	0.03	0.27	0.91	-0.50	0.56				
19	FCF		L1. MI	3.06	2.06	0.14	-0.99	7.10	MI	2.19	1	0.14
19	FCF		α	177666	100534	0.08	-19376	374709				
19	MI	FCF	L1. FCF	0.02	0.02	0.39	-0.02	0.06	FCF	0.75	1	0.39
19	MI		L1. MI	0.83	0.15	0.00	0.53	1.13				
19	MI		α	1034	7546	0.89	-13756	15824				

Firm ID	Response Variable	Impulse Variable	Regressor Variables		Coefficient	S.E.	p-value	95% interval coeff		Granger causality test Excluded	chi2	df	p value
20	FCF	MI	L1.	FCF	-0.06	0.24	0.81	-0.53	0.41				
20	FCF		L1.	MI	6.56	1.57	0.00	3.48	9.64	MI	17.46	1	0.00
20	FCF		α		-17746	92654	0.85	-199345	163853				
20	MI	FCF	L1.	FCF	0.00	0.03	0.87	-0.05	0.05	FCF	0.03	1	0.87
20	MI		L1.	MI	0.93	0.16	0.00	0.61	1.25				
20	MI		α		15488	9705	0.11	-3534	34509				
21	FCF	MI	L1.	FCF	0.79	0.05	0.00	0.69	0.90				
21	FCF		L1.	MI	8.95	2.16	0.00	4.71	13.18	MI	17.16	1	0.00
21	FCF		α		-12603	5759	0.03	-23890	-1315				
21	MI	FCF	L1.	FCF	0.00	0.01	0.65	-0.01	0.01	FCF	0.20	1	0.65
21	MI		L1.	MI	0.50	0.24	0.03	0.04	0.97				
21	MI		α		1653	630	0.01	417	2889				
22	FCF	MI	L1.	FCF	0.60	0.13	0.00	0.34	0.86				
22	FCF		L1.	MI	0.45	0.20	0.03	0.05	0.86	MI	4.93	1	0.03
22	FCF		α		1448004	679571	0.03	116068	2779939				
22	MI	FCF	L1.	FCF	-0.03	0.14	0.84	-0.29	0.24	FCF	0.04	1	0.84
22	MI		L1.	MI	0.74	0.21	0.00	0.33	1.14				
22	MI		α		1034933	684623	0.13	-306903	2376769				
23	FCF	MI	L1.	FCF	0.52	0.28	0.06	-0.02	1.06				
23	FCF		L1.	MI	-1.53	1.61	0.34	-4.68	1.62	MI	0.90	1	0.34
23	FCF		α		2148499	1415062	0.13	-624972	4921969				
23	MI	FCF	L1.	FCF	-0.02	0.05	0.73	-0.12	0.08	FCF	0.12	1	0.73
23	MI		L1.	MI	0.50	0.30	0.10	-0.09	1.09				
23	MI		α		258286	265259	0.33	-261613	778184				
24	FCF	MI	L1.	FCF	0.55	0.27	0.04	0.03	1.07				
24	FCF		L1.	MI	-1.24	2.62	0.64	-6.38	3.90	MI	0.22	1	0.64
24	FCF		α		181444	115315	0.12	-44569	407457				
24	MI	FCF	L1.	FCF	-0.07	0.02	0.00	-0.11	-0.03	FCF	13.17	1	0.00
24	MI		L1.	MI	-0.04	0.20	0.83	-0.43	0.35				
24	MI		α		36848	8703	0.00	19791	53904				
25	FCF	MI	L1.	FCF	0.85	0.15	0.00	0.55	1.14				
25	FCF		L1.	MI	-0.31	0.81	0.70	-1.89	1.27	MI	0.15	1	0.70
25	FCF		α		57024	46950	0.23	-34996	149044				
25	MI	FCF	L1.	FCF	-0.04	0.04	0.28	-0.11	0.03	FCF	1.16	1	0.28
25	MI		L1.	MI	0.55	0.20	0.01	0.15	0.95				
25	MI		α		20489	11805	0.08	-2649	43626				
26	FCF	MI	L1.	FCF	0.67	0.18	0.00	0.32	1.02				
26	FCF		L1.	MI	0.82	0.45	0.07	-0.06	1.70	MI	3.34	1	0.07
26	FCF		α		4946532	3213566	0.12	-1351941	11200000				
26	MI	FCF	L1.	FCF	0.25	0.10	0.01	0.07	0.44	FCF	7.02	1	0.01
26	MI		L1.	MI	0.04	0.24	0.87	-0.43	0.51				
26	MI		α		-187542	1721427	0.91	-3561477	3186394				
27	FCF	MI	L1.	FCF	0.22	0.21	0.29	-0.19	0.64				
27	FCF		L1.	MI	1.18	0.57	0.04	0.05	2.30	MI	4.22	1	0.04
27	FCF		α		133973	136340	0.33	-133249	401195				
27	MI	FCF	L1.	FCF	-0.07	0.04	0.05	-0.14	0.00	FCF	3.97	1	0.05
27	MI		L1.	MI	0.79	0.10	0.00	0.60	0.97				
27	MI		α		80570	22827	0.00	35830	125309				
28	FCF	MI	L1.	FCF	0.31	0.20	0.13	-0.09	0.71				
28	FCF		L1.	MI	3.85	1.37	0.01	1.17	6.52	MI	7.95	1	0.01
28	FCF		α		-220366	709789	0.76	-1611527	1170795				
28	MI	FCF	L1.	FCF	0.03	0.02	0.17	-0.01	0.07	FCF	1.89	1	0.17
28	MI		L1.	MI	0.80	0.15	0.00	0.51	1.09				
28	MI		α		65075	78009	0.40	-87821	217970				
29	FCF	MI	L1.	FCF	-0.43	0.25	0.08	-0.91	0.06				
29	FCF		L1.	MI	6.94	2.68	0.01	1.68	12.20	MI	6.69	1	0.01
29	FCF		α		34422	15208	0.02	4614	64230				
29	MI	FCF	L1.	FCF	0.00	0.02	0.84	-0.03	0.03	FCF	0.04	1	0.84
29	MI		L1.	MI	1.00	0.17	0.00	0.67	1.33				
29	MI		α		694	961	0.47	-1189	2577				

Firm ID	Response Variable	Impulse Variable	Regressor Variables		Coefficient	S.E.	p-value	95% interval coefficient		Granger causality test Excluded	chi2	df	P value
30	FCF	MI	L1.	FCF	0.39	0.23	0.08	-0.05	0.84				
30	FCF		L1.	MI	-3.16	5.59	0.57	-14.11	7.79	MI	0.32	1	0.57
30	FCF		α		359007	211611	0.09	-55743	773757				
30	MI	FCF	L1.	FCF	0.00	0.00	0.32	-0.01	0.00	FCF	0.99	1	0.32
30	MI		L1.	MI	0.73	0.08	0.00	0.57	0.88				
30	MI		α		3060	3008	0.31	-2836	8956				
31	FCF	MI	L1.	FCF	0.98	0.08	0.00	0.82	1.14				
31	FCF		L1.	MI	3.39	1.43	0.02	0.59	6.20	MI	5.64	1	0.02
31	FCF		α		-8979566	4567814	0.05	-17900000	-26816				
31	MI	FCF	L1.	FCF	0.03	0.01	0.03	0.00	0.05	FCF	4.83	1	0.03
31	MI		L1.	MI	0.28	0.21	0.19	-0.14	0.69				
31	MI		α		1840047	674498	0.01	518055	3162040				
32	FCF	MI	L1.	FCF	0.41	0.23	0.08	-0.05	0.87				
32	FCF		L1.	MI	-0.99	0.93	0.29	-2.82	0.85	MI	1.11	1	0.29
32	FCF		α		782649	332210	0.02	131529	1433768				
32	MI	FCF	L1.	FCF	-0.03	0.03	0.33	-0.08	0.03	FCF	0.96	1	0.33
32	MI		L1.	MI	0.90	0.11	0.00	0.69	1.12				
32	MI		α		35603	38813	0.36	-40470	111675				
33	FCF	MI	L1.	FCF	0.51	0.19	0.01	0.13	0.89				
33	FCF		L1.	MI	0.03	1.83	0.99	-3.56	3.62	MI	0.00	1	0.99
33	FCF		α		74613	40488	0.07	-4742	153967				
33	MI	FCF	L1.	FCF	0.01	0.02	0.48	-0.02	0.05	FCF	0.50	1	0.48
33	MI		L1.	MI	0.58	0.19	0.00	0.21	0.95				
33	MI		α		4700	4151	0.26	-3437	12837				
34	FCF	MI	L1.	FCF	-0.10	0.23	0.64	-0.55	0.34				
34	FCF		L1.	MI	-1.15	0.46	0.01	-2.06	-0.24	MI	6.16	1	0.01
34	FCF		α		1455632	385434	0.00	700195	2211068				
34	MI	FCF	L1.	FCF	-0.03	0.06	0.59	-0.14	0.08	FCF	0.30	1	0.59
34	MI		L1.	MI	0.81	0.12	0.00	0.58	1.04				
34	MI		α		52704	97968	0.59	-139309	244717				
35	FCF	MI	L1.	FCF	-0.03	0.24	0.89	-0.50	0.44				
35	FCF		L1.	MI	1.30	2.23	0.56	-3.06	5.66	MI	0.34	1	0.56
35	FCF		α		-33988	65609	0.60	-162580	94604				
35	MI	FCF	L1.	FCF	0.00	0.00	0.30	0.00	0.01	FCF	1.10	1	0.30
35	MI		L1.	MI	-0.03	0.03	0.42	-0.09	0.04				
35	MI		α		16237	966	0.00	14344	18130				
36	FCF	MI	L1.	FCF	0.65	0.14	0.00	0.38	0.92				
36	FCF		L1.	MI	0.69	0.30	0.02	0.11	1.28	MI	5.34	1	0.02
36	FCF		α		-101211	104534	0.33	-306094	103672				
36	MI	FCF	L1.	FCF	0.01	0.05	0.77	-0.08	0.11	FCF	0.09	1	0.77
36	MI		L1.	MI	0.77	0.11	0.00	0.56	0.98				
36	MI		α		125605	37585	0.00	51940	199271				
37	FCF	MI	L1.	FCF	0.68	0.16	0.00	0.37	0.99				
37	FCF		L1.	MI	0.28	0.13	0.04	0.02	0.54	MI	4.46	1	0.04
37	FCF		α		91953	121147	0.45	-145490	329396				
37	MI	FCF	L1.	FCF	0.29	0.20	0.14	-0.09	0.68	FCF	2.21	1	0.14
37	MI		L1.	MI	0.80	0.16	0.00	0.47	1.12				
37	MI		α		160228	150177	0.29	-134112	454569				

Note: The impulse variable is the variable where we applied a one standard deviation shock and the response variable is equal to the dependent variable. The constant equals the initial response to the shock (intercept). Granger causality tests indicate whether the excluded variable granger causes the response variable. In the firm id column, "average" indicates the equal weighted average of all firms in the sample.

Authors
Dr. Sankar Sundarrajan, PhD,
Professor, Tarleton State University (Texas)
Dr. Arthur E Young*, PhD,
Professor, Tarleton State University (Texas), ayoung@tarleton.edu

*Corresponding author