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Reexamining Gibrat's Law for Equity Funds of Taiwan Using SPSM Tests

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A B S T R A C T

This study applies the Sequential Panel Selection Method (SPSM) with panel KSS unit root tests (Kapetanios et al., 2003) to investigate whether the growth rate of fund net assets is independent of their size, as postulated by Gibrat's (1931) Law of proportionate effects. Time-series data for the net assets of 121 equity funds in Taiwan for quarterly data from March 2005 to December 2015 are used. The empirical results from several panel-based unit root tests indicate that the net assets of all equity funds in Taiwan studied here are the most stationary, implying that Gibrat's Law does not hold in the 121 equity funds of Taiwan; however, the SPSM with panel KSS unit root tests unequivocally indicate that Gibrat's Law is valid for 13 of these 121 equity funds in Taiwan here.

Keywords: Gibrat's law, sequential panel selection method, panel-based unit root tests, fund net assets, equity fund of Taiwan

JEL classification: C33, F21, G11, O47

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1. Introduction

In comparison with the other Asian markets, Taiwan's mutual fund industry is well developed, currently larger in scale than that of Hong Kong and of Singapore, and continuously provides an "open door" policy for the entry of offshore funds. Furthermore, Taiwan has a prime position in participation in the Mainland China fund management business, not only due to the geographic proximity, but also because of the common language and familiarity with many of the cultural and attitudinal issues that are common.

The size of fund assets belongs to fund attributes. It can be measured by average net assets under management and reflects market acceptance and popularity in the form of asset growth. In this study, we employ fund net assets to analyze the relationship between growth rate and fund size for121 equity funds in Taiwan. Gibrat (1931) pioneers the theory that a firm is independent of its size at the beginning of the period examined and that the distribution of that firm sizes towards the lognormal. In other words, the probability of a proportionate change in size during a specified period is the same for all firms in a given industry irrespective of their size at the beginning of the period (Mansfield, 1962). This indicates that the size-growth relationship is based on the random growth process.

Previous investigations of Gibrat's Law have been empirically tested cross-sectional regressions of logarithmic growth over certain periods, but these empirical results have not been conclusive. Several studies provide evidence of either no relationship or a positive relationship between the size and growth of a firm (Mansfield, 1962; Utton, 1971; Singh and Whittington, 1975; Tschoegl, 1983). Otherwise some researchers argue that Gibrat's Law never holds true (Kumar, 1985; Evans, 1987; Hall, 1987; Hart and Oulton, 1996).

The size of a fund is one of the often discussed issues in the mutual fund, but empirical studies have not got a conclusive result. Many researchers provide evidence showing a positive correlation between fund size and performance. For instance, Simth (1978) finds that fund performance and net new money flow risk-adjusted positively correlated. Ciccotello and Grant (1996) discover history remuneration large funds than smaller funds, good performance of past fund performance, it will be the size of today's largest fund. Indro et al. (1999) document fund size (net assets under management) affects mutual fund performance. Mutual funds must attain a minimum fund size in order to achieve sufficient returns to justify their costs of acquiring and trading on information. Payne and Prather (1999) show that risk-adjusted and fee-adjusted returns are generally enhanced by managerial tenure and fund size. Fund longevity is positively and significantly associated with the adjusted returns of growth funds. Cummings (2016) finds fund size positively affects performance for two major superannuation industry sectors (retail and not-for-profit) in Australia. Rao et al. (2017) discover positive relationship of fund size, age and expense ratio with the fund's performance in Chinese equity funds market. Filip (2017) shows a slightly positive relationship between asset size and returns of mutual funds in the Czech Republic, Hungary and Poland.

But some scholars find some negative relationship between the fund size and growth rate. Beckers and Vaughan (2001) notice a growth of fund size will significantly retard fund performance. Chen et al. (2004) show that fund performance and fund size are negatively correlated. Yan (2008) examines the effect of liquidity and investment style of the relation between fund size and fund performance, and finds a significant inverse relation between fund size and fund performance.

However, some researchers find that the size and scale of growth are not related. Grinblatt and Titman (1989) show that mutual fund performance and fund turnover rate have a positive relationship, but no relationship with the fund size. Afza and Rauf (2009) find that asset size is not a distinctive factor for the recognition of superior or inferior funds. Yong and Jusoh (2012) discover that higher risk fund provides higher return. However, fund size and turnover ratios are found to have no significant relationship with fund performance. Abbasi et al. (2012) examine the effect of fund size on the

performance of Iranian mutual funds. The findings highlight no significant relationship between fund size and performance. At last, previous studies provide evidence of a positive relationship, negative or no relationship between the fund size and growth rate, but have not a consistent conclusion.

The purpose of this research is to investigate whether Gibrat's Law holds true in 121 equity funds in Taiwan. We test the non-stationarity of the net assets of 121 equity funds using the Sequential Panel Selection Method (SPSM) with panel KSS unit root tests of Kapetanios et al. (2003). We believe this is the first study in which the SPSM with the panel KSS unit root tests are used to test Gibrat's Law with such a large panel equity funds in Taiwan.

This study is organized as follows. Section 2 briefly describes the Gibrat's Law. Section 3 describes the research methodology we employ. Section 4 first presents the data used in our study and then discusses empirical findings. Finally, Section 5 reviews the conclusions we draw.

2. The Gibrat's Law

Based on Gibrat (1931), a firm's growth rate is independent of its size at the beginning of the period examined; that is to say, the probability of a proportionate change in size during a specified period is the same for all firms in a given industry regardless of their size at the beginning of the period (Mansfield, 1962). Thus, the analysis of the size-growth relationship is depending on the random growth process as Gibrat's Law of Proportionate Effects indicated.

According to Vining (1976) and Clark and Stabler (1991), we exploit a simple version of Gibrat's Law. We indicate the size of firm *i* at time *t* by FS_{it} and consider the following expression to relate fund size in different periods:

$$FS_{it} = \delta_{it} FS_{i,t-1} \tag{1}$$

If we consider the decomposition of the growth rate in terms of a random factor ε_{it} and a deterministic component involving a constant rate and a previous growth rate, then the expression is as follow:

$$\delta_{it} = \varepsilon_{it} C_i \prod_{j=1}^{n} \delta_{i,t-j}^{\gamma_{ij}} \tag{2}$$

where C_i and γ_{ij}, j = 1,…, n, represent constants. The combination of expressions (1) and (2) yields an empirical model of the form:

$$\Delta \ln FS_{it} = c_i + \beta_i \ln FS_{i,t-1} + \sum_{j=1}^{n} \gamma_{ij} \Delta \ln FS_{i,t-1} + v_{it} \tag{3}$$

where $c_i = \ln C_i$ and $v_{it} = \ln \varepsilon_{it}$. Here we employ a standard augmented Dickey-Fuller (ADF) testing framework. The null hypothesis of a unit root should correspond to $\beta_i = 0$ (against the alternative hypothesis $\beta_i < 0$) and should display Gibrat's Law which signals independence between growth rate and firm size (in log form). Gibrat's Law concerning independence between firm growth and size can be estimated in terms of a unit root test for the log of firm size that involves testing a zero coefficient in expression (3). Rather than undertake a comprehensive model to explain fund growth, we examine the time-series implications of Gibrat's Law with respect to fund size (in log form).

3. Research Methodology

A number of studies provide that many macroeconomic and financial time series not only contain unit roots but also exhibit nonlinearities. Conventional unit root tests, such as the ADF unit root test, show low power in detecting the mean-reverting tendency of the series. For this reason, we use the nonlinear stationary advanced by Kapetanios et al. (2003) to test for equity funds sizes of Taiwan in our study.

According to Kapetanios et al. (2003), the KSS unit root test is based on detecting the presence of non-stationarity against a nonlinear but globally stationary exponential smooth transition autoregressive (ESTAR) process. The main concept is that time series data may revert to their mean only when they are sufficiently far away from it. When they are close to their mean, they may behave as non-stationary processes. The model is expressed as follows:

$$\Delta FS_t = \gamma FS_{t-1}\{1 - exp(-\theta FS_{t-1}^2)\} + v_t \quad (4)$$

Where FS_t is the data series of fund size, v_t is an i.i.d. error with zero mean and constant variance, and $\theta \geq 0$ is the transition parameter of the ESTAR model and governs the speed of transition. Under the null hypothesis FS_t should follow a linear unit root process, against the alternative hypothesis, FS_t should follow a nonlinear stationary ESTAR process. One weakness of this framework is that the parameter γ is not identified under the null hypothesis. Kapetanios et al. (2003) used a first-order Taylor series approximation for $\{1 - \exp(-\theta FS_{t-1}^2)\}$ under the null hypothesis $\theta = 0$ and then estimated equation (4) by using the following auxiliary regression:

$$\Delta FS_t = \xi + \beta FS_{t-1}^3 + \sum_{i=1}^{k} b_i \Delta FS_{t-1} + v_t, t = 1,2, \ldots, T \quad (5)$$

In this framework the null hypothesis and alternative hypotheses are shown as $\beta = 0$ (non-stationarity) against $\beta < 0$ (non-linear ESTAR stationarity). Ucar and Omay (2009) expand a nonlinear panel data unit root test in regard to regression (5). The regression is expressed as follows:

$$\Delta FS_{i,t} = \gamma_i FS_{i,t-1}\{1 - exp(-\theta_i FS_{i,t-1}^2)\} + v_{i,t} \quad (6)$$

Ucar and Omay (2009) use first-order Taylor series approximation for the Panel ESTAR (6) model around $\theta_t = 0$ for all i, and gather the auxiliary regression:

$$\Delta FS_{i,t} = \xi_i + \beta_i FS_{i,t-1}^3 + \sum_{j=1}^{k} \theta_{i,j} \Delta FS_{i,i-j} + v_{i,t} \quad (7)$$

Where $\beta_i = \theta_i \gamma_i$ and the hypotheses launch for unit root testing based on regression (7) are as follows:

$H_0: \beta_i = 0$, for all *i*, (linear nonstationarity)

$H_1: \beta_i < 0$, for some *i*, (nonlinear stationarity)

Then the SPSM recommend by Chortareas and Kapetanios (2009) follow the following steps:

(1) The Panel KSS test is first dealt with all log of the net assets FS_t in the panel. If the unit-root null hypothesis cannot be rejected, the procedure is stopped, and all the series in the panel are non-stationary. If the null hypothesis is rejected, go to Step 2.

(2) Eliminate the series with the minimum KSS statistic since it is classified as being stationary.

(3) Return to Step 1 for the remaining series, or stop the procedure if all the series are eliminated from the panel.

The whole panel in the final result is separated into a set of mean-reverting series and a set of non-stationary series.

4. Data and Empirical Findings

4.1 Data

In this study, we use quarterly data for fund net assets collected from 121 equity funds in Taiwan over the March 2005 to December 2015 period. The data period covers the global financial crisis of 2008-09, which have a profound impact on the world economic and the financial markets. We use fund net assets collected as a measure of fund size among all size variables, because the fund net assets is the most important source of growth for mutual funds. The source of the data is the Taiwan Economic Journal (TEJ).

4.2 Empirical Findings of Taiwan Equity Fund

The datasets for net assets of fund indicate that Capital Marathon Fund and Union Technology Fund, respectively, have the highest and lowest net assets collected in 121 equity funds of Taiwan, as shown in Table 1. The Jarque-Bera test results indicate that the datasets for net assets collected for 76 of the 121 equity funds are approximately non-normal.

Table 1 Summary Statistics of Taiwan Fund Net Assets (in Thousands of NT$)

Equity Fund	Mean	Max.	Min.	Std. Dev.	Skew	Kurt	J-B
NMR Growth Selection Fund	544249.3	1079200	335032	153374.4	1.408	5.806	28.975***
Mega Citizen Fund	577534.6	1369051	347708	196249.3	2.431	10.087	163.239***
HSBC Taiwan Success Fund	1077456	2177087	471606	503106.5	0.686	2.4	4.105
Hua Nan Yung Chong Fund	724588.1	1696558	201364	328674.7	0.503	3.683	2.713
UPAMC Tung Hsin Fund	1004322	2346037	609610	432255.5	1.072	3.366	8.677**
JPMorgan (Taiwan) Taiwan Fund	1021938	1647687	548887	247310.8	-0.357	2.966	0.937
Shinkong Fu-Kuei Fund	1012050	5390749	496906	801991.1	4.078	21.763	767.332***
Capital Small and Medium Cap. Fund	3648226	9544202	2055518	1303436	2.084	8.521	87.732***
Dah-Fa Fund	967087.1	1887331	437801	353135.1	1.27	3.784	12.956***
PineBridge Taiwan Giant Fund	2298590	3222085	1355236	406536.9	0.109	2.876	0.132
Manulife Taiwan High Dividend Fund	861728	3691579	189183	1042977	1.448	3.521	15.866***
Manulife Dynamic Fund	762990.3	2257151	191983	658028.4	0.913	2.169	7.394**
BlackRock Baoli Fund	416468	573860	215367	97961.07	-0.497	2.253	2.831
Capital Large Cap. Growth Fund	969165.4	1538401	442721	261051.3	0.081	2.822	0.106
Capital High Tech Fund	6810530	20228965	1738937	3750981	1.151	5.35	19.84***
Mirae Asset Apollo Fund	554000.1	1321046	298510	295526.1	1.328	3.485	13.366***
Paradigm Taiwan Fund	465079.3	796238	209324	166066.8	0.027	1.964	1.975
Paradigm Small Capital Fund	1095120	4777613	205154	917509.9	2.157	7.927	78.623***
HSBC Taiwan Phoenix Fund	3351355	5070354	1310802	1042700	-0.54	2.057	3.773
HSBC Taiwan Electronics Fund	2645102	5491857	1306883	1010418	1.253	3.816	12.728***
HSBC Taiwan Mid and Small Cap Fund	908553	1361878	524547	244881.4	0.508	2.377	2.607
HSBC Taiwan Blue-Chips Fund	992248.1	2013672	668679	284271.5	1.934	6.841	54.486***
Eastspring Investments High-Tech Fund	2185478	3948433	1037889	683594.3	1.019	3.57	8.210**
Eastspring Investments Export Fund	4646138	6943189	2904933	1056732	0.81	2.729	4.945*
Eastspring Investments Essence Fund	1351096	4130256	761320	702565.2	1.84	6.578	48.308***

Equity Fund	Mean	Max.	Min.	Std. Dev.	Skew	Kurt	J-B
Eastspring Investments Small Medium Capital Fund	1601255	3595715	1044695	496756.5	1.636	7.131	50.912***
Eastspring Investments E-Tech Fund	1069317	2413168	447364	526472.9	0.786	2.592	4.841*
Invesco Capital Appreciation Fund	2672739	4004246	880610	901639.2	-0.473	2.336	2.448
Invesco Taiwan Technology Fund	1087340	1963612	713513	313374.5	0.687	2.839	3.512
Invesco Mainstream Fund	835423.5	1313394	403743	243186.4	0.394	2.726	1.276
Fubon Taiwan Heart Fund	703081.6	1683035	340492	354676.6	1.373	3.792	13.97***
Cathay Fund	3694231	4905200	2727453	640847.7	0.046	1.758	2.842
Cathay Small Cap Growth Fund	5328767	8647564	1554224	1516576	-0.164	2.882	0.223
Cathay Greater China Fund	8107697	13037695	1798099	3300445	-0.066	2.246	1.075
Cathay Technology Fund	2515504	4726442	579864	1063862	0.103	2.663	0.302
Cathay High-Tech Fund	270264.6	734850	108691	128256.1	1.904	7.625	65.791***
Allianz Global Investors Taiwan Fund	1869048	3441343	955596	620592	1.313	3.735	13.628***
Allianz Global Investors Taiwan Technology Fund	918166.3	2129263	241216	390665.6	0.849	3.813	6.501**
THE RSIT Digital Fund	654202.2	1541039	279212	310168.3	1.284	3.637	12.83***
Fidelity Taiwan Growth Fund	1644938	2789134	472434	686693.5	-0.289	1.972	2.551
Deutsche Far Eastern DWS Taiwan Flagship Fund	446228.1	687588	310625	100047.1	0.683	2.396	4.091
Deutsche Far Eastern DWS Technology Fund	310960	790127	166904	139012.8	1.584	5.136	26.834***
Fuh-Hwa Fund	1078458	2670008	402266	685441.3	0.827	2.367	5.748*
Fuh-Hwa High Growth Fund	1942935	2971674	695179	632800.5	-0.267	2.173	1.777
Fuh-Hwa Digital Economy Fund	2696886	6679205	1069854	1393015	1.512	4.41	20.42***
Fuh-Hwa Small Capital Fund	3509609	6568237	1067262	1320946	0.732	2.759	4.038
Fubon Precision Fund	2706834	5398069	1353319	840751.8	0.706	3.82	4.894*
Fubon Supreme Fund	1331964	1866734	900575	267722.2	-0.401	2.405	1.83
Fubon Aggressive Growth Fund	1731021	3482229	637260	654319.5	0.8	3.309	4.869*
Franklin Templeton SinoAm First Fund	2563619	6229388	313068	1508780	0.26	2.312	1.363
NMR Superior Equity Fund	3183217	5257319	2189713	649557.8	1.042	4.212	10.652***
NMR Growth Fund	894990.2	1769713	462588	342164.8	1.425	3.908	16.408***
NMR High Tech Fund	1374158	3099716	890885	476875.5	1.436	5.073	23.012***
NMR Small Cap Fund	2761002	6197844	375824	1202694	-0.105	3.766	1.155
NMR Taiwan China Focus Fund	649007.8	1374874	301648	249740.6	1.181	4.407	13.852***
NMR Taiwan Aggressive Growth Selection Fund	545381.1	709348	326631	88167.3	-0.07	2.501	0.492
NMR High Tech Selection Fund	1276173	2137836	719510	371360.8	0.849	2.805	5.353*
Mega First Fund	768575.1	3176943	69130	573107.1	1.75	8.359	75.103***
Mega New Emerging Enterprise Fund	789187.8	2864247	327576	456291.1	2.551	10.254	172.632***
Mega High Tech Fund	1001706	2272581	585993	449155.5	1.374	3.871	15.243***
JPMorgan (Taiwan) Growth Fund	2497445	4276718	1588132	728866.7	0.96	3.217	6.842**
JPMorgan (Taiwan) New Technology Fund	6201069	9108518	3732790	1357291	0.394	2.18	2.37
JPMorgan (Taiwan) Smaller Company Fund	2901215	5492636	1513691	1060678	0.674	2.463	3.865
JPMorgan (Taiwan) Value Growth Fund	1052888	2261215	513028	472024	0.791	2.563	4.94*
Jih Sun Jih Sun Fund	1593458	2524489	1071584	422761.5	0.777	2.44	5.003*

Equity Fund	Mean	Max.	Min.	Std. Dev.	Skew	Kurt	J-B
Jih Sun Top Five Fund	1398400	17137078	527461	2441707	6.305	41.185	2964.655***
Jih Sun Hi-Tech Fund	1899599	3569833	812543	771942.7	0.573	2.056	4.042
Jih Sun New Taiwan Enterprises Fund	599924.3	1707954	241692	299165.1	1.419	5.588	27.051***
KGI Pioneer Fund	352939.7	670700	220022	105156.1	1.496	5.071	24.275***
Prudential Financial High Growth Fund	5659033	8410300	3354015	1079135	-0.095	2.433	0.656
Prudential Financial Maxime Fund	5134574	6225130	2892440	673700.3	-1.410	5.188	23.37***
Prudential Financial OTC Fund	2458225	6108802	580121	1071362	0.943	3.941	8.133**
Prudential Financial First Fund	1307993	2794222	580285	479968.7	0.969	3.861	8.248**
Prudential Financial High Tech Fund	2347305	4907625	1291323	770129.9	1.181	4.594	13.887***
Prudential Financial Small and Medium Capital Fund	2521007	5476266	975852	915961	0.788	3.826	5.8*
Prudential Financial New Century Fund	1594773	2436165	882045	451386.4	0.401	2.021	2.939
Prudential Financial Taiwan Enterprise Fund	1751546	5313121	379043	1044706	1.136	4.637	13.372***
FSITC OTC Fund	729126.5	1069526	424250	207896.7	0.21	1.487	4.524
FSITC Great China Fund	899396.1	2170797	304334	483296.6	0.986	3.418	7.455**
UPAMC All Weather Fund	1595707	2607669	728432	429997.4	0.26	2.606	0.781
UPAMC Optima Fund	1099883	2109055	808655	238056.9	1.375	6.433	35.466***
UPAMC Long Ma Fund	979954.3	2029057	587240	237120.3	2.442	10.034	162.052***
UPAMC Small And Medium Cap Fund	736961.6	1582542	353294	272539.8	1.261	4.657	16.702***
UPAMC Infrastructure Fund	743131.9	1283510	543286	139934.5	1.413	5.299	24.343***
UPAMC Pentium Fund	1956486	3477949	986107	424551.6	1.266	6.306	31.78***
UPAMC Quality Growth Fund	6962130	13888006	1604700	3785367	0.339	2.438	1.423
FSITC Small Capital Fund	1030565	2571736	618996	410998.9	1.792	6.403	44.785***
FSITC High-Tech Fund	1065612	2388472	473083	498645	1.066	3.055	8.336**
Yuanta Duo Fu Equity Fund	5376762	12309927	1536736	2609009	0.341	2.678	1.043
Yuanta 2001 Fund	1065697	2290903	338707	424029.7	0.095	3.194	0.136
Fubon Fubon Fund	4077647	6967300	1201083	1219154	-0.427	3.626	2.054
Fubon Elite Fund	1613743	4594939	665985	757566.6	1.837	7.322	58.98***
Fubon Technology Fund	622523.3	1093661	363477	174535.5	1.072	4.155	10.876***
Capital Marathon Fund	10354192	22288458	4724943	4270486	0.510	2.682	2.102
Capital OTC Fund	2760038	4229421	1265703	843735.2	-0.105	1.974	2.01
Jih Sun Upstream Fund	4901279	10874952	2084033	2717457	1.168	3.321	10.201***
Jih Sun Small Cap Fund	1289823	2995310	464557	497991.1	1.248	5.154	19.926***
SinoPac Fund	3937679	6922907	546972	2066549	-0.267	1.821	3.073
SinoPac Hi-Tech Fund	1056407	2335121	449103	471286.7	0.792	2.745	4.719*
SinoPac Small and Medium Fund	2993615	7100910	231325	1867675	0.255	2.203	1.641
SinoPac Pilot Fund	561704.7	1233038	292717	237745.3	1.015	3.206	7.626**
Cathay Dragon Fund	8805508	13316551	25425	4161003	-1.061	2.907	8.275**
Taishin 2000 High Technology Equity Fund	1364228	2162191	725236	326485.7	0.74	2.949	4.02
ABITL Da Li Fund	650053.3	1071078	283049	254182.2	0.305	1.724	3.667
Shinkong National Development Fund	621200.6	1586859	358844	260227	2.095	7.405	67.757***

Equity Fund	Mean	Max.	Min.	Std. Dev.	Skew	Kurt	J-B
Shinkong Innovative Technology Fund	1045381	3695282	381038	551934.5	2.801	13.938	276.883***
Shinkong OTC Market Fund	1054632	5337400	340967	862363.7	3.151	15.196	345.510***
Shinkong Great China Fund	1551893	7460644	418182	1345121	2.492	10.313	133.599***
Taishin Taiwan Small and Mid Capital Fund	406407.6	881577	201578	191739.1	0.948	3.194	6.66**
Taishin China Equity Fund	648380	1690884	196012	421317.1	0.848	2.703	5.435*
Union Technology Fund	268827.8	421839	163401	71769.23	0.609	2.366	3.46
Union China Fund	298297.3	522313	162419	106379.8	0.567	1.948	4.384
Hua Nan Vision Tech Fund	423754.6	1373255	82005	245190.3	1.564	6.882	45.57***
Yuanta OTC Fund	2641553	8268796	1038018	1364484	1.74	6.451	44.042***
Yuanta Hi-Tech Equity Fund	4731269	8691048	3205338	1032370	1.002	4.313	10.53***
Yuanta International Trade Fund	2583326	5197283	1212050	895270.1	0.642	3.231	3.12
Yuanta Buffett Equity Fund	1287606	2261370	549507	518434.3	0.329	1.929	2.895
Yuanta High-Performance Fund	1583512	6831908	495510	1279886	2.607	9.89	136.872***
Yuanta Small-Medium Cap Fund	963131.7	4919786	247898	835509.9	2.898	12.995	244.738***
Yuanta Excellence Equity Fund	4710862	7637052	3308463	843086.1	1.126	5.057	17.048***
Yuanta Mainstream Equity Fund	5422964	15763946	1034716	2990655	0.948	4.708	10.939***

Note: The sample period is from March 2005 to December 2015. *, ** and *** indicate significance levels at the 10%, 5% and 1%, respectively.

Tables 2, 3 and 4 provide the results for the conventional, first generation and second generation panel based unit root tests. For the sake of comparison, our study contains three conventional unit root tests, such as the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979), PP (Phillips and Perron, 1988) and KPSS test (Kwiatkowski et al., 1992). In Table 2, the result of three conventional unit root tests is consistent and does not support to Gibrat's Law for all 121 equity funds in Taiwan. Furthermore, we also incorporate three first generation panel-based unit root tests, for example, Levin-Lin-Chu test (Levin et al., 2002), Im-Pesaran-Shin test (Im et al., 2003), and MW test (Maddala and Wu, 1999), into our study. In Table 3, three first generation panel-based unit root tests are significant, indicating that Gibrat's Law not apply. Additionally, Table 4 shows that, among the second generation panel-based unit root tests, Bai-Ng test (Bai and Ng, 2004) support the Gibrat's Law whereas Pesaran test (Pesaran, 2003) Moon-Perron test (Moon and Perron, 2004) and Choi test (Choi, 2002) indicate that Gibrat's Law not hold in the 121 equity funds.

Table 2 Panel Unit Root Tests - Conventional Unit Root Tests

ADF	PP	KPSS
455.300(0) ***	381.473(3) ***	0.165[4]

Note: *, ** and *** represent 10%, 5% and 1 % significance levels. The number in parenthesis indicates the lag order selected based on the recursive t-statistic, as suggested by Perron (1989). The number in the brackets indicates the truncation for the Bartlett Kernel, as suggested by Newey and West (1994). ADF and PP test the null hypothesis of neither has a single root, while KPSS test the null hypothesis with a single root.

Table 3 Panel Unit Root Tests - First Generation Panel Unit Root Test

	t_p^*	$\hat{p}$	t_p^{*B}	t_p^{*C}	
Levin, Lin and Chu (2002)	-2.887***	-0.131***	-7.449***	-6.410***	
	(0.002)	(0.000)	(0.000)	(0.000)	
	t_bar_{NT}	$W_{t,bar}$	$Z_{t,bar}$	$t\_bar_{NT}^{DF}$	$Z_{t,bar}^{DF}$
Im, Pesaran and Shin (2003)	-2.082	-7.066***	-7.063***	-1.828	-3.852***
		(0.000)	(0.000)		(0.000)
	P_{MW}	Z_{MW}			
Maddala and Wu (1999)	408.307***	7.317***			
	(0.000)	(0.000)			

Note: Levin et al. (2002): t_p^* denotes the adjusted t-statistic computed with a Bartlett kernel function and a common lag truncation parameter given by $\overline{K} = 3.21T^{1/3}$. Corresponding p-value is in parentheses. $\hat{p}$ is the pooled least squares estimator. Corresponding standard error is in parentheses. t_p^{*B} denotes the adjusted t-statistic computed with a Bartlett kernel function and individual bandwidth parameters (Newey and West, 1994). t_p^{*C} denotes the adjusted t-statistic computed with a Quadratic Spectral kernel function and individual bandwidth parameters. Finally t_p^* denotes the adjusted t-statistic computed with a Bartlett kernel function and a common lag truncation parameter. Corresponding p-value is in parentheses. *, ** and *** represent 10%, 5% and 1 % significance levels. Im et al. (2003): $t\_bar_{NT}^{DF}$ (respectively t_bar_{NT}) denotes the mean of Dickey Fuller (respectively Augmented Dickey Fuller) individual statistics. $Z_{t,bar}^{DF}$ is the standardized $t\_bar_{NT}^{DF}$ statistic and associated p-values are in parentheses. $Z_{t,bar}$ is the standardized t_bar_{NT} statistic based on the moments of the Dickey Fuller distribution. $W_{t,bar}$ denotes the standardized t_bar_{NT} statistic based on simulated approximated moments. The corresponding p-values are in parentheses. ** indicates significant at the 5% level. Maddala and Wu (1999): P_{MW} denotes the Fisher's test statistic defined as $P_{MW} = -2\sum \log(p_i)$; where p_i are the p-values from ADF unit root tests for each cross-section. Under H_0; P_{MW} has X^2 distribution with 2N of freedom when T tends to infinity and N is fixed. ZMW is the standardized statistic used for large N samples: under H_0; Z_{MW} has a N (0, 1) distribution whenT and N tend to infinity.

Table 4 Panel Unit Root Tests - Second Generation Panel Unit Root Test

	$\hat{r}$	$Z_{\hat{e}}^c$	$P_{\hat{e}}^c$	MQ_c	MQ_f
Bai and Ng (2004)	2	0.347	253.704	1	2
		(0.364)	(0.354)		
	t_a^*	t_b^*	$\hat{p}_{pool}^*$	t_a^{*B}	t_b^{*B}
Moon and Perron (2004)	-31.504***	-15.212***	0.855	-32.107***	-15.604***
	(0.000)	(0.000)		(0.000)	(0.000)
	P_m	Z	L^*		
Choi (2002)	22.917***	-15.380***	-17.093***		
	(0.000)	(0.000)	(0.000)		
	P^*	$CIPS$	$CIPS^*$		
Pesaran (2007)	4	-2.399**	-2.344**		
		(0.010)	(0.010)		

Note: Bai and Ng (2004): $\hat{r}$ is the estimated number of common factors, based on IC criteria functions. $P_{\hat{e}}^c$ be is a Fisher's type statistic based on p-values of the individual ADF tests. $Z_{\hat{e}}^c$ be is a standardized Choi's type statistic for large N samples. P-values are in parentheses. The first estimated value $\hat{r}$ is derived from the filtered test MQ_f and the second one is derived from the corrected test MQ_c. *, ** and *** represent 10%, 5% and 1 % significance levels. Moon and Perron (2004): t_a^* and t_b^* are the unit root test statistics based on de-factored panel data. Corresponding p-values are in parentheses. $\hat{p}_{pool}^*$ is the corrected pooled estimates of the auto-regressive parameter. t_a^{*B} and t_b^{*B} are computed with a Bartlett kernel function in spite of a Quadratic Spectral kernel function. Choi (2002): the P_m test is a modified Fisher's inverse chi-square test. The Z test is an inverse normal test. The L^* test is a modified logit test. Corresponding p-values are in parentheses. Pesaran (2007): *CIPS* is the mean of individual Cross sectionally augmented ADF statistics (CADF). *CIPS** denotes the mean of truncated individual CADF statistics. Corresponding p-values are in parentheses. *P** denotes the nearest integer of the mean of the individual lag lengths in ADF tests.

The SPSM identifies the whole panel into a group of stationary series and a group of non-stationary series. Therefore, to classify how many and which firms in the panel support the Gibrat's Law (non-stationary process) we proceed to the SPSM procedure mixed with the Panel KSS test. Table 5 shows that, the null hypothesis of unit root in fund size is rejected when the Panel KSS test is first applied to the whole panel, producing a value of -2.947 with a very small p-value approximating to zero. After implementing the SPSM procedure, we find UPAMC Pentium Fund with the minimum KSS value of -10.18 among the panel. Then, UPAMC Pentium Fun is removed from the panel and the Panel KSS test is implemented again to the remaining set of series. After that, we find that the Panel KSS test still rejected the unit root null with a value of -2.888 (p-value of nearly zero), and Hua Nan Yung Chong Fund is found to be stationary with the minimum KSS value of -9.042 among the panel this time. Then, Hua Nan Yung Chong Fund is removed from the panel and the Panel KSS test is implemented again to the remaining set of series. The procedure is continued until the Panel KSS test failed to reject the unit root null hypothesis at 10% significance level. To check the robustness of our test, we continue the procedure until the last sequence. Obviously, the SPSM procedure using the Panel KSS test provide strong stationary evidence in the fund net assets for 108 out of the 121 equity funds in Taiwan. This result indicates that Gibrat's Law only holds true for 13 of these 121 equity funds, respectively, JPMorgan (Taiwan) Growth Fund, Fidelity Taiwan Growth Fund, Shinkong Fu-Kuei Fund, Shinkong Great China Fund, Capital High Tech Fund, Jih Sun New Taiwan Enterprises Fund, JPMorgan (Taiwan) Taiwan Fund, HSBC Taiwan Phoenix Fund, Cathay High-Tech Fund, Shinkong Innovative Technology Fund, Allianz Global Investors Taiwan Technology Fund, UPAMC Optima Fund, UPAMC Quality Growth Fund in Taiwan.

Table 5 Results of KSS Test on Taiwan Fund Net Assets

Sequence	$S_N p$ statistic	Min.ADF statistic	Series
1	-2.947(0.000)	-10.180	UPAMC Pentium Fund
2	-2.888(0.000)	-9.042	Hua Nan Yung Chong Fund
3	-2.836(0.000)	-7.127	Prudential Financial Taiwan Enterprise Fund
4	-2.800(0.000)	-6.131	Capital Marathon Fund
5	-2.772(0.000)	-5.833	Cathay Greater China Fund
6	-2.746(0.000)	-5.446	Fuh-Hwa Small Capital Fund
7	-2.723(0.000)	-5.335	Capital Small and Medium Cap. Fund
8	-2.700(0.000)	-5.279	Cathay Small Cap Growth Fund
9	-2.677(0.000)	-5.258	NMR Growth Selection Fund
10	-2.654(0.000)	-5.201	SinoPac Small and Medium Fund
11	-2.632(0.000)	-5.102	Eastspring Investments Essence Fund
12	-2.609(0.000)	-4.818	Cathay Dragon Fund
13	-2.589(0.000)	-4.413	Yuanta International Trade Fund
14	-2.573(0.000)	-4.359	Capital OTC Fund
15	-2.556(0.000)	-4.343	Yuanta Excellence Equity Fund
16	-2.539(0.000)	-4.324	BlackRock Baoli Fund
17	-2.523(0.000)	-4.192	UPAMC Infrastructure Fund
18	-2.507(0.000)	-4.078	JPMorgan (Taiwan) New Technology Fund
19	-2.492(0.000)	-3.980	Deutsche Far Eastern DWS Technology Fund
20	-2.477(0.000)	-3.969	THE RSIT Digital Fund

Sequence	$S_N p$ statistic	Min.ADF statistic	Series
21	-2.462(0.000)	-3.934	Eastspring Investments High-Tech Fund
22	-2.448(0.000)	-3.917	JPMorgan (Taiwan) Smaller Company Fund
23	-2.433(0.000)	-3.890	Yuanta Hi-Tech Equity Fund
24	-2.419(0.000)	-3.889	Prudential Financial High Tech Fund
25	-2.404(0.000)	-3.875	UPAMC Long Ma Fund
26	-2.388(0.000)	-3.847	UPAMC All Weather Fund
27	-2.373(0.000)	-3.788	Prudential Financial Maxime Fund
28	-2.358(0.000)	-3.774	Prudential Financial First Fund
29	-2.343(0.000)	-3.679	NMR Taiwan Aggressive Growth Selection Fund
30	-2.329(0.000)	-3.597	JPMorgan (Taiwan) Value Growth Fund
31	-2.315(0.000)	-3.596	NMR High Tech Selection Fund
32	-2.301(0.000)	-3.571	ABITL Da Li Fund
33	-2.287(0.000)	-3.510	Mega Citizen Fund
34	-2.273(0.000)	-3.506	Taishin Taiwan Small and Mid Capital Fund
35	-2.259(0.000)	-3.410	Fubon Precision Fund
36	-2.246(0.000)	-3.402	Fuh-Hwa Fund
37	-2.232(0.000)	-3.381	Eastspring Investments E-Tech Fund
38	-2.219(0.000)	-3.357	UPAMC Tung Hsin Fund
39	-2.205(0.000)	-3.356	Taishin 2000 High Technology Equity Fund
40	-2.192(0.000)	-3.355	Jih Sun Small Cap Fund
41	-2.177(0.000)	-3.352	KGI Pioneer Fund
42	-2.163(0.000)	-3.258	NMR Small Cap Fund
43	-2.139(0.000)	-3.227	HSBC Taiwan Mid and Small Cap Fund
44	-2.135(0.000)	-3.207	FSITC OTC Fund
45	-2.121(0.000)	-3.203	Jih Sun Hi-Tech Fund
46	-2.108(0.000)	-3.124	Shinkong National Development Fund
47	-2.094(0.000)	-3.080	Yuanta Mainstream Equity Fund
48	-2.081(0.000)	-3.076	Dah-Fa Fund
49	-2.068(0.000)	-3.067	Invesco Capital Appreciation Fund
50	-2.054(0.000)	-2.979	Mega High Tech Fund
51	-2.041(0.000)	-2.977	Yuanta Buffett Equity Fund
52	-2.028(0.000)	-2.939	SinoPac Hi-Tech Fund
53	-2.015(0.000)	-2.924	Fubon Supreme Fund
54	-2.002(0.000)	-2.907	Deutsche Far Eastern DWS Taiwan Flagship Fund
55	-1.989(0.000)	-2.906	NMR Superior Equity Fund
56	-1.975(0.000)	-2.903	SinoPac Fund
57	-1.961(0.000)	-2.828	Eastspring Investments Small Medium Capital Fund
58	-1.947(0.000)	-2.810	HSBC Taiwan Blue-Chips Fund
59	-1.934(0.000)	-2.785	Invesco Taiwan Technology Fund
60	-1.920(0.000)	-2.778	Jih Sun Upstream Fund
61	-1.907(0.000)	-2.770	PineBridge Taiwan Giant Fund

Sequence	$S_N p$ statistic	Min.ADF statistic	Series
62	-1.892(0.000)	-2.751	Fubon Taiwan Heart Fund
63	-1.878(0.000)	-2.741	Jih Sun Jih Sun Fund
64	-1.864(0.000)	-2.686	NMR High Tech Fund
65	-1.849(0.000)	-2.629	Paradigm Small Capital Fund
66	-1.836(0.000)	-2.618	Eastspring Investments Export Fund
67	-1.822(0.000)	-2.583	Prudential Financial New Century Fund
68	-1.808(0.000)	-2.550	Union Technology Fund
69	-1.794(0.000)	-2.510	Yuanta High-Performance Fund
70	-1.781(0.000)	-2.498	FSITC Great China Fund
71	-1.767(0.000)	-2.489	NMR Taiwan China Focus Fund
72	-1.753(0.000)	-2.488	SinoPac Pilot Fund
73	-1.738(0.000)	-2.483	Yuanta Duo Fu Equity Fund
74	-1.723(0.000)	-2.468	FSITC High-Tech Fund
75	-1.707(0.000)	-2.465	HSBC Taiwan Electronics Fund
76	-1.691(0.000)	-2.365	Prudential Financial Small and Medium Capital Fund
77	-1.676(0.000)	-2.350	Invesco Mainstream Fund
78	-1.661(0.000)	-2.308	Fubon Technology Fund
79	-1.647(0.000)	-2.273	Yuanta OTC Fund
80	-1.632(0.000)	-2.270	Capital Large Cap. Growth Fund
81	-1.617(0.000)	-2.254	UPAMC Small And Medium Cap Fund
82	-1.602(0.001)	-2.247	Paradigm Taiwan Fund
83	-1.585(0.001)	-2.232	NMR Growth Fund
84	-1.569(0.001)	-2.190	Fuh-Hwa High Growth Fund
85	-1.552(0.000)	-2.179	Cathay Fund
86	-1.536(0.000)	-2.161	Manulife Taiwan High Dividend Fund
87	-1.518(0.004)	-2.098	Union China Fund
88	-1.502(0.002)	-2.07	Fubon Elite Fund
89	-1.485(0.002)	-2.043	Taishin China Equity Fund
90	-1.468(0.002)	-1.997	Mega New Emerging Enterprise Fund
91	-1.451(0.006)	-1.954	HSBC Taiwan Success Fund
92	-1.435(0.012)	-1.920	Manulife Dynamic Fund
93	-1.419(0.006)	-1.870	Fubon Fubon Fund
94	-1.404(0.012)	-1.869	Prudential Financial High Growth Fund
95	-1.387(0.018)	-1.825	Allianz Global Investors Taiwan Fund
96	-1.371(0.016)	-1.812	Mega First Fund
97	-1.354(0.017)	-1.806	Prudential Financial OTC Fund
98	-1.336(0.028)	-1.801	Franklin Templeton SinoAm First Fund
99	-1.316(0.012)	-1.770	FSITC Small Capital Fund
100	-1.296(0.015)	-1.719	Fubon Aggressive Growth Fund
101	-1.277(0.046)	-1.648	Hua Nan Vision Tech Fund
102	-1.260(0.027)	-1.643	Mirae Asset Apollo Fund

Sequence	$S_N p$ statistic	Min.ADF statistic	Series
103	-1.240(0.025)	-1.634	Shinkong OTC Market Fund
104	-1.220(0.065)	-1.604	Yuanta Small-Medium Cap Fund
105	-1.198(0.073)	-1.570	Fuh-Hwa Digital Economy Fund
106	-1.176(0.031)	-1.513	Cathay Technology Fund
107	-1.155(0.090)	-1.478	Yuanta 2001 Fund
108	-1.134(0.084)	-1.458	Jih Sun Top Five Fund
109	-1.101(0.105)	-1.438	JPMorgan (Taiwan) Growth Fund
110	-1.086(0.126)	-1.433	Fidelity Taiwan Growth Fund
101	-1.057(0.120)	-1.419	Shinkong Fu-Kuei Fund
112	-1.024(0.107)	-1.392	Shinkong Great China Fund
113	-0.987(0.101)	-1.384	Capital High Tech Fund
114	-0.943(0.093)	-1.360	Jih Sun New Taiwan Enterprises Fund
115	-0.891(0.219)	-1.305	JPMorgan (Taiwan) Taiwan Fund
116	-0.831(0.138)	-1.246	HSBC Taiwan Phoenix Fund
117	-0.672(0.330)	-1.107	Cathay High-Tech Fund
118	-0.561(0.403)	-0.971	Shinkong Innovative Technology Fund
119	-0.424(0.431)	-0.872	Allianz Global Investors Taiwan Technology Fund
120	-0.200(0.554)	-0.654	UPAMC Optima Fund
121	0.255(0.610)	0.255	UPAMC Quality Growth Fund

Note: Entry in parenthesis stands for the bootstrap p-value. The significance level is 10%. The maximum lag is set to be 10. The bootstrap replications are 5000.

4.3 Economic and Policy Implications

Fund sizes shown in Table 1 vary from 0.26 billion (smallest) to 10.35 billion NT dollars (largest), and 10 of the 13 not significant funds are small ones under 3 billion NT dollars. In Taiwan's mutual fund market, the institutional investors prefer the well-performed funds characterized over 3 billion NT dollars. In comparison with European and American investor behavior, Taiwanese non-institutional investors well noted for their short-termism. Typically, they have been very willing to take an active role in managing their assets and desired to take short-term profit, rather than wait long-term for returns, which might fluctuate more. This has led to the active use of mutual funds, in a way very similar to purchasing equities. Although current performances of some funds are better than past performances, these investors are inclined to redeem the fund when target gains made in a short term.

Obviously, the SPSM procedure using the Panel KSS test provide strong stationary evidence in the fund net assets for 108 out of the 121 equity funds in Taiwan. This result indicates that Gibrat's Law only holds true for 13 of these 121 equity funds. According to Gibrat's Law, size is nothing to do with the efficiency (mutual fund returns), therefore, from our empirical findings that we find that 106 out of 121 equity funds in Taiwan do not support Gibrat's Law and this means that size does matter with the efficiency (mutual fund returns) for most of the mutual funds during 2005-2015 in Taiwan. Investors in this market can invest more in mutual funds with big scale of size than those of mutual funds with small scale of size. They can achieve more profits from this large size of mutual funds. Our empirical support this argument.

5. Conclusions

Using quarterly data over the March 2005 to December 2015 period, this paper employs the SPSM with panel KSS unit root tests to assess the non-stationary properties of the fund net assets of 121 equity funds in Taiwan, and empirically tests whether Gibrat's Law holds in Taiwan's fund size. The results from the Conventional Unit Root Tests of ADF, PP and KPSS all not support the hypothesis that Gibrat's Law holds throughout Taiwan's mutual fund size. That means, fund growth rate is related of fund size. The first generation panel-based unit root tests of the Levin-Lin-Chu, Im-Pesaran-Smith and MW has the same result. The second generation panel-based unit root tests of Bai-Ng, Choi, Pesaran and Moon-Perron has also the same result. When we conduct the SPSM with panel KSS unit root tests, we find that Gibrat's Law is only true for 13 of these 121 equity funds (ca. 11%) in Taiwan.

These results indicate that Gibrat's Law holds for most of the equity funds in Taiwan with smaller fund size under 3 billion NT dollars, whereas most of the equity funds with larger fund size violate Gibrat's Law. The institutional investors in Taiwan prefer the well-performed funds characterized over 3 billion NT dollars. In comparison to European and American investor behavior, Taiwanese non-institutional investors are well noted for their short-termism. In other words Taiwanese non-institutional investors are inclined to redeem the fund when target gains are made in a short term, although the fund performance is still good. Our empirical results have practical important implications for investment trust company and investors.

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