» Default provisions: In most cases, the remedies for default under a PPA do not include acceleration of amounts due, and in many cases PPAs would not be considered as debt in a bankruptcy scenario and could potentially be cancelled. Thus, PPAs may not materially increase Loss Given Default for the utility. In addition, PPAs are not typically considered debt for cross-default provisions under a utility's debt and liquidity arrangements. However, the existence of non-standard default provisions that are debt-like would have a large impact on our treatment of a PPA. In addition, payments due under PPAs are senior unsecured obligations, and any inability of the utility to make them materially increases default risk.

Each of these factors will be considered by Moody's analysts and a decision will be made as to the importance of the PPA to the risk analysis of the utility.

Methods for estimating a liability amount for PPAs

According to the weighting and importance of the PPA to each utility and the level of disclosure, Moody's may approximate a debt obligation equivalent for PPAs using one or more of the methods discussed below. In each case we look holistically at the PPA's credit impact on the utility, including the ability to pass through costs and curtail payments, the materiality of the PPA obligation to the overall business risk and cash flows of the utility, operational constraints that the PPA imposes, the maturity of the PPA obligation, the impact of purchased power on market-based power sales (if any) that the utility will engage in, and our view of future market conditions and volatility.

» Operating Cost: If a utility enters into a PPA for the purpose of providing an assured supply and there is reasonable assurance that regulators will allow the costs to be recovered in regulated rates, Moody's may view the PPA as being most akin to an operating cost. Provided that the accounting treatment for the PPA is, in this circumstance, off-balance sheet, we will most likely make no adjustment to bring the obligation onto the utility's balance sheet.

» Annual Obligation x 6: In some situations, the PPA obligation may be estimated by multiplying the annual payments by a factor of six (in most cases). This method is sometimes used in the capitalization of operating leases. This method may be used as an approximation where the analyst determines that the obligation is significant but cannot otherwise be quantified otherwise due to limited information.

» Net Present Value: Where the analyst has sufficient information, Moody's may add the NPV of the stream of PPA payments to the debt obligations of the utility. The discount rate used will be our estimate of the cost of capital of the utility.

» Debt Look-Through: In some circumstances, where the debt incurred by the IPP is directly related to the off-taking utility, there may be reason to allocate the entire debt (or a proportional part related to share of power dedicated to the utility) of the IPP to that of the utility.

» Mark-to-Market: In situations in which Moody's believes that the PPA prices exceed the market price and thus will create an ongoing liability for the utility, we may use a net mark-to-market method, in which the NPV of the utility's future out-of-the-money net payments will be added to its total debt obligations.

» Consolidation: In some instances where the IPP is wholly dedicated to the utility, it may be appropriate to consolidate the debt and cash flows of the IPP with that of the utility. If the utility purchases only a portion of the power from the IPP, then that proportion of debt might be consolidated with the utility.

If we have determined to impute debt to a PPA for which the accounting treatment is not on-balance sheet, we will in some circumstances use more than one method to estimate the debt equivalent obligations imposed by the PPA, and compare results. If circumstances (including regulatory treatment or market conditions) change over time, the approach that is used may also vary.

Moody's Related Research

Industry Outlooks:

» US Regulated Utilities: Regulation Provides Stability as Business Model Faces Challenges, July 2013 (156754)

» Asian Power Utilities (ex-Japan): Broad Stable Outlook; India an Outlier, March 2013 (149101)

Rating Methodologies:

» US Electric Generation & Transmission Cooperatives, April 2013, (151814)

» How Sovereign Credit Quality May Affect Other Ratings, February 2012 (139495)

» Unregulated Utilities and Power Companies, August 2009 (118508)

» Regulated Electric and Gas Networks, August 2009 (118786)

» Natural Gas Pipelines, November 2012 (146415)

» US Public Power Electric Utilities with Generation Ownership Exposure, November 2011 (135299)

» US Electric Generation & Transmission Cooperatives, April 2013 (151814)

» US Municipal Joint Action Agencies, October 2012 (145899)

» Government Related Issuers: Methodology Update, July 2010 (126031)

» Global Regulated Water Utilities, December 2009 (121311)

To access any of these reports, click on the entry above. Note that these references are current as of the date of publication of this report and that more recent reports may be available. All research may not be available to all clients.

The credit ratings assigned in this sector are primarily determined by this credit rating methodology. Certain broad methodological considerations (described in one or more secondary or cross-sector credit rating methodologies) may also be relevant to the determination of credit ratings of issuers and instruments in this sector. Potentially related secondary and cross-sector credit rating methodologies can be found here.

For data summarizing the historical robustness and predictive power of credit ratings assigned using this credit rating methodology, see link.

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MOODY'S
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STANDARD & POOR'S

Standard & Poor's Research

Industry Economic And Ratings Outlook:

U.S. Regulated Utilities Will Likely Stay On A Stable Trajectory For The Rest Of 2012 And Into 2013

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Industry Economic And Ratings Outlook:

U.S. Regulated Utilities Will Likely Stay On A Stable Trajectory For The Rest Of 2012 And Into 2013

Standard & Poor's Ratings Services' believes the outlook for credit quality in the U.S. investor-owned regulated electric, gas, and water utility sectors for the remainder of 2012 and into 2013 will remain stable. These companies have weathered the challenging economic environment of the past few years with little lasting effect on their financial risk profiles. The essential service that utilities provide and the rate-regulated nature of the business enable them to generate reasonably steady and predictable cash flows through timely recovery of their costs from ratepayers, despite economic conditions and ongoing heavy investment needs. As a result, we expect their credit quality to remain stable.

Economic Outlook

Standard & Poor's Ratings Services' base-case outlook for the remainder of 2012 and into 2013 for the U.S. investor-owned regulated electric, gas, and water utility sectors is stable based on the fundamentals described below. Our analysis of these utilities considers the general macroeconomic environment and, in particular, economic indicators that are most correlated with customer consumption. Standard & Poor's baseline assumptions that contribute to our current stable view of the regulated utilities include the following indicators:

- Real GDP growth of 2.04% in 2012 (from 1.74% in 2011) and 2.11% in 2013;
- An unemployment rate of 8.17% in 2012 and 8.04% in 2013;
- An increase in disposable income of 2.71% in 2012 and 2.84% 2013; and
- A still-weak housing market, with housing starts at around 750,000 in 2012 and 930,000 in 2013; and
- 10-year Treasury yield at 1.83% in 2012 and 2.17% in 2013.

In addition, we have assumed generally responsive regulatory decisions and continued solid liquidity and capital market access for this sector.

Although we expect the U.S. economy to remain sluggish with only modest growth in customer consumption, we anticipate ratings stability for the regulated utility sector based on our expectations of sustained demand for a very critical commodity, responsive regulatory attention to cost recovery for needed capital investments, and investors' continued appetite for utility debt and equity offerings.

Effects on ratings

U.S. regulated electric, gas and water utility companies' credit quality has continued its gradual shift toward greater stability. At the end of the second quarter of 2012, most U.S. investor-owned utility companies that we rate had stable outlooks. We took relatively few rating actions during the second quarter of 2012, and upgrades outpaced downgrades. We raised our corporate credit ratings on nine entities (both holding companies and operating subsidiaries--and five of these related to a single entity, Northeast Utilities) and lowered ratings on four (three of which related to NSTAR). The main reasons prompting the upgrades related to a merger with a stronger entity in the case of Northeast Utilities' (NU) upgrades; improving financial metrics; and reduced business risk. The downside actions were attributable to NSTAR's merger with lower rated NU, and with increased business risk at Spain-based Iberdrola S.A. given deteriorating economic conditions in Spain. In the past three months we revised several outlooks based on stronger financial metrics and improving business risk factors, placed ratings on CreditWatch, and removed ratings from CreditWatch.

The limited number of rating changes reflects an economic outlook that, despite a slow and uneven economic recovery, is stable in our base case. Our baseline forecast indicates slow economic growth and subdued job gains this year and into next. We're forecasting baseline real GDP growth to rise to 2.0% this year, which is a bit stronger than 1.74% in 2011, though much weaker than the 3% rate in 2010. For 2013, we expect 2.1% growth, which is much softer than our projection of 2.4% in May and reflects the stronger dollar and weaker growth from abroad that cuts into net export growth. The unemployment rate of 8.1% is two percentage points below its recession peak, though no notable improvement is likely in the foreseeable future. We also expect continuation of a weak housing market, high foreclosures, and only moderate increases in consumer spending in nearby years. While we continue to believe the risk of another recession in the U.S. is 20%, the outlook is better than it was late last year, when the recession risk was 40%. However, we believe that another recession is possible if the eurozone crisis spreads to the U.S. (and the rest of the world), if there's a sharp near-term spike in austerity measures in the U.S., or if financial markets lock up again. Under such a dire scenario, regulatory commissions will likely be reluctant to approve higher base rates for consumers. On the other hand, if the economy grows faster than we are expecting, regulatory risk could lessen as concerns about rate increases abate. (See the Economic Research article, "U.S. Risks To The Forecast: Lazy Hazy Crazy Days Of Summer," published June 25, 2012.)

Table 1

2012-2013 Scenarios For The U.S. Regulated Utilities Industry

	Forecast/scenarios*						Actual
	--Pessimistic--		--Baseline--		--Optimistic--		
	June 2012		June 2012		June 2012		
	2012	2013	2012	2013	2012	2013	2011
Macroeconomic indicators							
Real GDP (% change)	1.21	(0.03)	2.04	2.11	2.48	3.85	1.74
CPI (% change)	1.24	0.79	1.68	1.24	2.24	2.22	3.14
Core CPI (% change)	1.99	1.29	2.13	1.74	2.34	2.42	1.66
Number of households (mil.)	120.66	121.85	120.70	122.14	120.69	122.32	119.32
Yearly % change	1.13	0.98	1.16	1.19	1.15	1.35	0.82
ECI, wages and salaries (% change)	1.58	1.06	1.85	1.82	2.03	2.10	1.67
Unemployment rate (%)	8.37	9.08	8.17	8.04	8.01	7.00	8.95
Household obligations ratio (%)	15.29	13.89	15.29	14.11	15.30	14.54	16.08
Industry drivers							
Housing starts (mil. units)	0.67	0.62	0.75	0.93	0.81	1.23	0.61
Disposable income, 2005 $ (% change)	1.30	0.57	1.19	1.80	0.91	1.99	1.21
Disposable income (% change)	2.44	1.16	2.71	2.84	2.88	3.86	3.70
Consumer spending, electricity (% change)	(2.41)	2.78	(2.37)	3.86	(2.38)	4.60	0.97
Deflator electricity prices (% change)	(0.04)	0.63	0.08	1.38	0.20	2.29	1.82

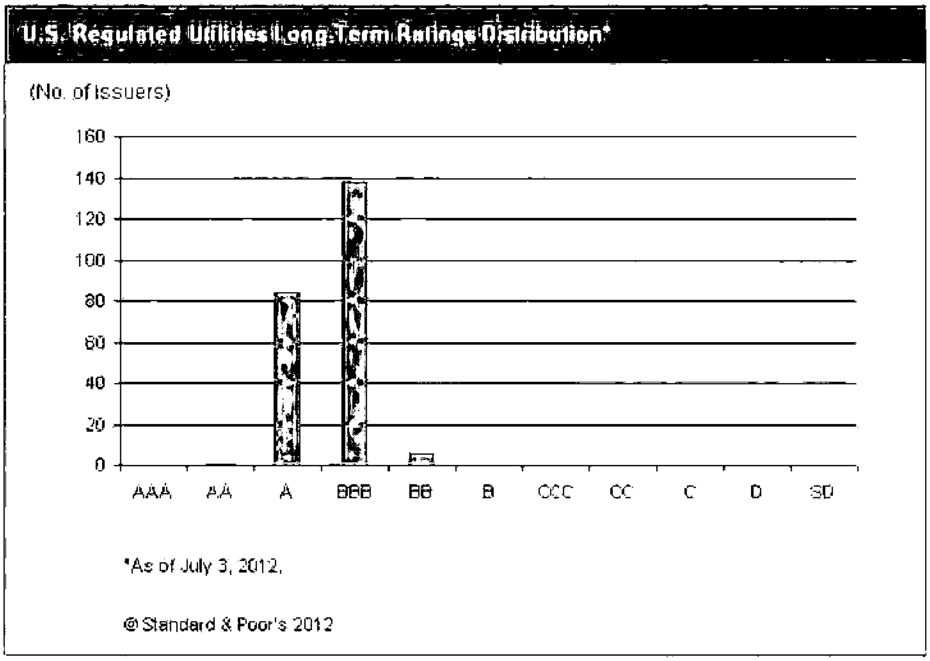
Table 1

2012-2013 Scenarios For The U.S. Regulated Utilities Industry (cont.)							
Natural gas % of electricity fuel use	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Coal % of electricity fuel use	0.44	0.44	0.44	0.44	0.44	0.44	0.45
Petroleum % of electricity fuel use	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Power plant nonresidential (% change)	9.28	(9.61)	9.57	(7.84)	9.78	(6.94)	17.89
Investment in public utilities (% change)	6.70	(6.44)	7.06	(4.41)	7.30	(3.22)	12.37
Investment in electric and gas utilities (% change)	8.81	(8.54)	9.09	(6.90)	9.31	(6.03)	16.17
Employment, utilities (mil.)	0.56	0.56	0.56	0.56	0.56	0.55	0.56
Employment, private (mil.)	110.82	110.82	111.24	113.02	111.33	114.45	109.25
PPI electricity (% change)	(0.34)	1.77	(0.18)	2.53	(0.03)	3.46	2.48
PPI coal (% change)	(0.66)	1.02	(0.45)	2.63	(0.27)	4.34	9.22
'BBB' bond yield (%)	5.21	5.41	5.07	5.12	5.34	5.81	5.66
10-yr. Treasury note yield (%)	1.56	1.66	1.83	2.17	2.22	3.59	2.79
BBB' interest rate spread (%)	3.65	3.76	3.24	2.95	3.11	2.22	2.86

S&P U.S. Economic team's forecasts are constructed using the Global Insight model of the U.S. economy. Industry Economic Table population process maintained by Quality Data Analytics. *Pessimistic and optimistic forecasts are from the "U.S. Risks To The Forecast: Lazy Hazy Crazy Days Of Summer," published on June 25, 2012, on RatingsDirect. Baseline forecast from the U.S. Monthly Forecast Report "Economic Meltdown?". PPI--Producer Price Index.

Standard & Poor's economists publish monthly scenarios of where we think the U.S. economy could be heading. Beyond projecting GDP and inflation, we also include outlooks for other major economic categories. We call this forecast our "baseline scenario," and we use it in all areas of our credit analyses (see table 1). Our current ratings in the regulated utility sectors factor in this scenario. However, we realize that financial market participants also want to know how we think the economy could worsen--or improve--from our baseline scenario. Any point-in-time forecast of the economy will be wrong; it is simply a question of how far wrong. As a result, we also project two additional scenarios, one upside and one downside. We set these scenarios approximately at one standard deviation from the base line (roughly the 20th and 80th percentile of the distribution of possible outcomes). We use the downside case to estimate the credit impact of an economic outlook that is weaker than the expected case.

Chart 1



Industry Credit Outlook

Our present ratings on U.S. regulated utility companies remain firmly entrenched at an average 'BBB+', notably higher than the average 'BB-' category for U.S. industrial companies. The higher ratings are attributable to the large percentage of utilities with "excellent" or "strong" business risk profiles under our criteria. Nonetheless, this is generally balanced with "aggressive" financial risk profiles under our criteria. As a consequence, some 60% of the industry carries a 'BBB' category corporate credit rating ('BBB+', 'BBB', and 'BBB-'), about 37% 'A-' and above, and just 3% non-investment grade ('BB+' and below).

The rating trend, as measured by outlooks and CreditWatch listings, is slightly negative, with approximately 4.8% of all rated domestic utilities having negative outlooks or negative CreditWatch listings. Nevertheless, about 90% of all utility companies carried a stable outlook at the end of June 2012. Therefore, we expect to take only a limited number of prospective rating actions in the near to intermediate term.

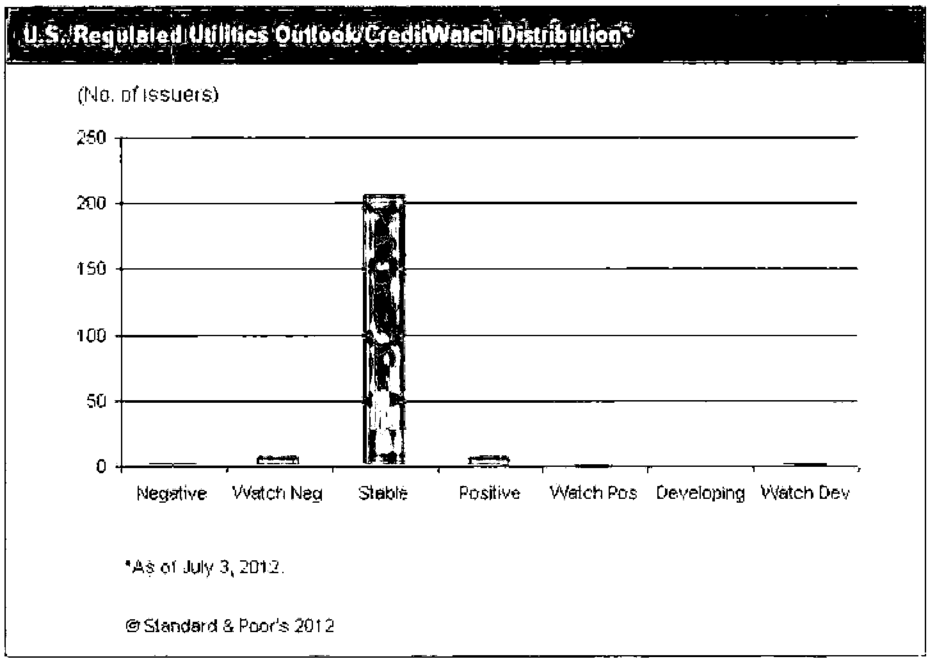
Liquidity is adequate for most utilities. Investor appetite for utility debt remains healthy, with deals continuing to be oversubscribed. The companies' near-term debt maturities appear manageable and we think they will likely refinance these with new debt or borrowings under revolving credit facilities. Credit fundamentals indicate that most, if not all, utilities should continue to have ample access to funding sources and credit. Some have issued common stock to partly fund construction expenditures, which has helped to support capital structure balance. Additionally, many companies are accessing short-term credit markets through commercial paper programs at very low rates. Liquidity is an industry strength and has been improving, and banks are indicating a willingness to lengthen the terms of credit facilities out as far as five years in more and more cases. U.S. regulated utilities have not been significantly hurt by turbulence in the global financial markets. We believe that utilities will continue to tap the short-term debt markets with relative ease following implementation of new bank regulations, though borrowing costs may rise. Utilities' ability to issue short-term debt and access liquidity is crucial, especially in light of the companies' increasing capital budgets to address rising investment requirements.

The amount of medium- to long-term debt issued by the domestic utility industry through June 30, 2012, was about $18.3 billion. Prospectively, we expect the industry's reliance on external capital to increase, largely due to projected increases in construction expenditures. Even if growth is slow, aging infrastructure and retirements of older inefficient coal-burning stations make investing necessary. For 2012, we expect that electric utilities will spend $85 billion, the gas sector will spend about $9.1 billion, and water companies some $1.8 billion.

The real challenge for the industry is the combination of slow growth and huge investment needs. We believe that for the remainder of 2012 and beyond, state regulation will continue to be the single most influential factor for the sector's credit quality. Cost increases, construction projects, environmental compliance, and other public policy directives, together with lackluster growth, will necessitate continued reliance on rate relief requests. Many recent rate orders and alternative rate mechanisms have been credit supportive. Although average returns on equity (ROE) have trended slightly downward, several jurisdictions have granted enhanced rate mechanisms that support greater cash flow stability and help utilities earn closer to their allowed ROEs. To the extent that the economy remains sluggish, use of innovative ratemaking techniques and large rate hikes will become increasingly critical to the sector's sustaining cash flow, earnings power, and ultimately, credit quality. In this regard, rate recovery mechanisms that allow for the timely adjustment of rates outside of a fully litigated rate proceeding because of changing commodity prices and other expenses will be particularly important to the sector's credit quality.

Our outlook for the electric, gas, and water industries is stable based on expectations on a continued slow economic recovery, generally supportive regulatory decisions that include mechanisms for timely cost recovery, receptive capital markets, and access to liquidity.

Chart 2



Recent Rating Activity

Merger-related actions

We lowered our ratings on NSTAR (A-/Stable A-2) and subsidiaries NSTAR Electric Co. and NSTAR Gas Co. to 'A-' from 'A+' and raised our ratings on Northeast Utilities (NU; A-/Stable A-2) and subsidiaries Connecticut Light & Power Co., Public Service Co. of New Hampshire, Western Massachusetts Electric Co., and Yankee Gas Services Co., to 'A-' from 'BBB+' after they received final regulatory approval for their all-stock merger. All ratings were removed CreditWatch where we placed them with negative and positive implications, respectively, on Oct. 18, 2010. Subsequent to the transaction, NSTAR was renamed NSTAR LLC, and NSTAR ceased to exist. As surviving entity, NSTAR LLC assumed all obligations that were previously issued by NSTAR, and became a subsidiary and an intraholding company of NU. The stable outlook is based on the company's consistent, regulated electric and natural gas businesses that have low operating risk and which we expect will generate cash flow that is sufficient for the ratings.

Given the large capital spending program and prospects for modest load growth, we expect that NU will generate consolidated adjusted funds from operations (FFO) to total debt of about 17%-18% over the next few years and adjusted total debt to total capitalization of below 54%. We will lower the ratings on NU if adjusted FFO to total debt declines below 15% on a consistent basis and debt leverage exceeds 55%. Given the company's heavy construction program, we don't anticipate an upgrade during our current forecast period. However, if adjusted FFO to total debt consistently exceeds 20%, we could raise the ratings by one notch.

Downgrades

We lowered our long-term corporate credit ratings on Iberdrola USA (BBB+/Stable/A-2) to 'BBB+' from 'A-' on May 3, 2012, when we lowered our ratings on parent Spain-based utility Iberdrola S.A. (BBB+/Stable/A-2) and subsidiaries. We removed the ratings from CreditWatch, where we placed them with negative implications on April 4, 2012.

The downgrades reflect our revision of our assessment of parent Iberdrola's business risk profile to "strong" from "excellent" under our criteria as a result of ongoing industry challenges and a deteriorating Spanish economy. We believe that the difficulties in Iberdrola's key domestic market could impair the group's profitability because it derives about 47% of revenues from its Spanish operations. We anticipate that Iberdrola's profit margins in its electricity generating unit could deteriorate in the near term, which is likely to squeeze the group's cash flows. In this segment, the group is exposed to what we see as increasingly difficult and volatile conditions in the liberalized and oversupplied Spanish electricity market. Furthermore, we think that the increase in the budget deficit that we foresee in Spain could increase political risk for sensitive industries such as utilities as the government implements fiscal austerity measures. Also, worsening economic conditions could add to regulatory uncertainty in a jurisdiction in which regulatory determinations are not independent from the government.

The stable outlook reflects our opinion that Iberdrola should be able to maintain FFO to debt of about 20%, which we view as commensurate with the ratings. We believe that the group can sustain this ratio despite industry and economic challenges, any potential delays in the receipt of proceeds from the securitization of the Spanish tariff deficit, and any further deficit accumulation. The rating on Iberdrola could remain unchanged even if we were to downgrade Spain by up to two notches. This is because under our criteria, there is a maximum possible rating differential of two notches between the ratings on Iberdrola and those on its related investment-grade sovereign in the eurozone. These criteria apply to Iberdrola because we assess it as having "high" exposure to domestic country risk. That said, in the event of a further downgrade of Spain, we would evaluate Iberdrola's credit quality separately from that of Spain.

Upgrades

We raised our ratings on PNM Resources Inc. (PNMR, BBB-/Stable/-) and subsidiaries Public Service Co. of New Mexico and Texas-New Mexico Power Co. to 'BBB-' from 'BB' on April 13, 2012. The upgrades reflect PNMR's lower business risk as a result of the company's focus on core electric operations following the previously completed divestitures of two unregulated businesses, as well as on its management of regulatory environments. We revised our assessment of the business risk profile to "excellent" under our criteria to reflect the consolidated entity's lower business risk. We believe the company will continue to maintain financial stability by targeting a 50% adjusted debt in the capital structure, bolstering operating cash flows through timely cost recovery, and improving regulatory relationships in New Mexico.

We raised our corporate credit ratings on Rochester Gas & Electric Corp. (RG&E, BBB+/Stable/--) to 'BBB+' from 'BBB' on April 24, 2012, as a result of improved financial measures, which we expect the company to maintain over the intermediate term, and a business profile that has benefited from constructive regulatory outcomes. A recent multiyear rate settlement includes several supportive recovery mechanisms that enhance the company's ability to earn its authorized ROE. We base our ratings on RG&E on the utility's stand-alone credit quality because the ultimate parent, Spanish utility holding company Iberdrola S.A., has assumed the debt of RG&E's parent company, Iberdrola USA. We regard the U.S. utility subsidiaries, which include RG&E, Central Maine Power Co., and New York State Electric & Gas Corp., as effectively under Iberdrola S.A.'s direct control, and none individually is a significant source of cash flow for the holding company. Our ratings on RG&E therefore do not reflect significant support from Iberdrola S.A., and we effectively cap them at the rating on the parent. RG&E's excellent business risk profile under our criteria benefits from a low-operating-risk transmission and distribution business strategy. The company's financial risk profile is aggressive in our assessment and we believe a sizable capital spending program could cause pressure. The stable outlook reflects improvement in bondholder protection parameters, decreasing regulatory risk, and our expectations that financial measures will remain in line with current results. Our baseline forecast shows FFO to total debt of 16%, debt leverage below 55%, and debt to EBITDA of 4x over the near-to-intermediate term. Fundamental to our forecast is the expectation that RG&E employ a low-risk strategy of investing in the regulated transmission and distribution business, maintaining its balanced capital approach, managing regulatory risk, and producing stable cash flow. We could lower the ratings if we see a decline in cash flow measures to a point where FFO to total debt falls below 15% and total debt to capital remains above 55% on a sustained basis.

Outlook revisions

We revised the outlook on Entergy Corp. (BBB/Stable/--) and its affiliates to stable from negative due to sustained improvement at the company's regulated utility operations at the same time it faced moderation in wholesale power prices and the relicensing process of two of its larger merchant nuclear plants, Indian Point Units 2 and 3. The company's business risk profile is firmly in the strong category under our criteria. The moderation in wholesale power prices increased the contribution of the regulated utility business to as much as 75% of operating income and cash flow, and we expect this trend to persist over the intermediate term. Despite the declining contribution of the merchant generation business, we do not view the overall level of business risk as declining. Nevertheless, given the combination of Entergy's strong business risk profile and significant financial risk profile under our criteria, we expect that the ratings can accommodate some of the uncertainty that surrounds the relicensing process as long as Entergy continues to effectively manage its regulated utility operations and merchant generation operations by, among other things, preserving its merchant hedging strategy while ensuring adequate liquidity. We expect that the consolidated financial risk profile will remain in the significant category over the next 12 to 24 months. Our baseline forecast is for adjusted FFO to total debt of just over 20% and adjusted total debt to total capital remaining at 60%. We could lower the ratings by one notch if a meaningful reduction in cash flow from the potential shut-down of Indian Point Units 2 and 3 when the licenses expire and further softness in the wholesale power markets results in adjusted FFO to total debt of below 18% on a sustained basis. We consider an upgrade unlikely given Entergy's current business mix and credit protection measures.

We revised our outlook on CMS Energy Corp. (BBB-/Positive/--) and subsidiary Consumers Energy Co. to positive from stable based on the company's effective management of regulatory risk, the gradual improvement in Michigan's economy, and our expectation that Michigan legislators won't lift the 10% customer choice cap—which limits the percent of sales that can be provided by alternative suppliers—in the intermediate term. The positive outlook indicates at least a one-in-three probability that we could raise the ratings over the next year if these expectations are sustained. Furthermore, the outlook reflects our baseline forecast that FFO to debt will generally be greater than 13% and debt to EBITDA will be consistently lower than 5x. We could raise the rating if the company is able to continue to manage its regulatory risk while maintaining FFO to debt of about 13%-15% and debt to EBITDA lower than 5x. Significant risks include rate case order outcomes and assumed continued economic stability. We would revise the outlook to stable if state legislators lift the 10% customer choice cap or FFO to debt drops below 12% on a sustained basis.

We revised our outlook on Wisconsin Energy Corp. (WEC; A-/ Positive/A-1) and subsidiaries Wisconsin Electric Power Co. and Wisconsin Gas LLC to positive from stable on June 7, 2012, based on our expectation of at least a one-in-three probability that the company will continue to achieve modest improvements in its financial measures that would support a one-notch upgrade over the intermediate term. Higher ratings are possible if the company continues to modestly reduce debt and strengthen its overall financial condition, if regulation in Wisconsin remains more credit supportive than in other states, and if the economy continues to show signs of sustained improvement. We could raise the ratings one notch within the next 12 to 18 months with sustained financial performance above our base-case forecast level of adjusted FFO to total debt of 23% and adjusted debt to total capital of about 55%. Fundamental to our forecast are expectations of a continued slow economic recovery in the company's service territory and a limitation of stock buybacks or dividend increases to those already announced by WEC, and the outcome of pending rate filings in Wisconsin and Michigan.

We revised the rating outlook on Ameren Corp. and regulated subsidiaries Ameren Illinois Co. and Ameren Missouri to stable from positive and affirmed the 'BBB-' ratings on April 3, 2012. At the same time, we affirmed the 'BB-' ratings on AmerenEnergy Generating Co., removed the ratings from CreditWatch with negative implications, and assigned a negative outlook. We view Ameren Corp.'s decision to offer liquidity to AmerenEnergy in the form of a put option with AmerenEnergy Resource Generating Co. (AERG) as solidifying AmerenEnergy's liquidity position. AmerenEnergy has the option to sell its combined cycle gas generating facility Grand Towers and gas peakers Elgin and Gibson City to AERG for a minimum of $100 million. This agreement demonstrates a credible liquidity plan, in our view. The stable rating outlook on Ameren takes into account continued weakness at AmerenEnergy and Ameren's willingness to provide cash to shore up AmerenEnergy's liquidity. The outlook also reflects a gradual improvement in the company's management of regulatory risk. We expect that parent Ameren will continue to support AmerenEnergy on a limited basis even over the longer term. Our ratings on AmerenEnergy reflect a stand-alone credit profile with limited support from parent Ameren Corp. Its stand-alone credit rating would be in the 'B' rating category without Ameren's support. The stable outlook on Ameren is based on our view that the company has reinforced its limited support for the subsidiary. The negative outlook on AmerenEnergy reflects the continued low price of electricity that materially stresses profit margins.

CreditWatch listings

Subsequent to the July 2, 2012, completion of the merger between Duke Energy Corp. (A-/Watch Neg/-A-2) and Progress Energy Inc. (BBB+/Watch Dev/A-2) we placed our ratings on Duke Energy and subsidiaries on CreditWatch with negative implications. At the same time, we revised the CreditWatch implications on Progress Energy and subsidiaries to developing from positive. Our rating actions were based on the abrupt change in executive leadership disclosed after the merger. The CreditWatch listings reflect unresolved issues on corporate governance, merger integration execution, and management of pending operational challenges. We are evaluating whether the combined entity warrants an excellent business risk profile under our criteria in light of potential integration challenges and corporate governance issues. Standard & Poor's expects to resolve the CreditWatch listings in the near term after a closer review and assessment of the implications of the change in leadership and its impact on the combined entity.

We placed our ratings on DPL Inc. (BBB-/Watch Neg/—) and subsidiary Dayton Power & Light Co. (DP&L) on CreditWatch with negative implications. The CreditWatch reflects the potential for a downgrade after we gain more clarity on the timing and transition to full market rates for DP&L. We revised our assessment of DPL and DP&L's business risk profiles to strong from excellent to reflect increased competition in Ohio along with expected growth of the unregulated retail business. We expect increasing competitive pressure due to lower wholesale electric prices will materially stress DPL's profit margins. DPL's financial position has little cushion due to the large amount of acquisition debt layered on by parent AES Corp. (BB-/Stable/--). Our baseline forecast shows FFO to total debt of around 11% and total debt to total capital at approximately 57%. We will resolve the CreditWatch when we have more clarity on the timing and transition to full market rates for DP&L.

Table 2

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Related Criteria And Research

- U.S. Risks To The Forecast: Lazy Hazy Crazy Days Of Summer, June 25, 2012
- Liquidity Descriptors For Global Corporate Issuers, Sept. 28, 2011
- Use Of CreditWatch And Outlooks, Sept. 14, 2009
- Business Risk/Financial Risk Matrix Expanded, May 27, 2009
- Assessing U.S. Utility Regulatory Environments, Nov. 7, 2007

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

Argued March 16, 2012 Decided June 8, 2012

No. 11-1045

STATE OF NEW YORK, ET AL.,
PETITIONERS

v.

NUCLEAR REGULATORY COMMISSION AND UNITED STATES OF AMERICA,
RESPONDENTS

STATE OF NEW JERSEY, ET AL.,
INTERVENORS

Consolidated with 11-1051, 11-1056, 11-1057

On Petitions for Review of Orders
of the Nuclear Regulatory Commission

Monica Wagner, Deputy Bureau Chief, Office of the Attorney General for the State of New York, argued the cause for petitioners States and Prairie Island Indian Community Petitioners. With her on the briefs were *Eric T. Schneiderman*, Attorney General, Office of the Attorney General for the State of New York, *John J. Sipos* and *Janice A. Dean*, Assistant Attorneys General, *Barbara D. Underwood*, Solicitor General, *Brian A. Sutherland*, Assistant Solicitor General of Counsel, *Jeffrey S. Chiesa*, Attorney General, Office of the Attorney General for the State of New Jersey, *Kevin P. Auerbacher*, Assistant Attorney General, *Ruth E. Musetto*, Deputy Attorney General, *William H. Sorrell*, Attorney General, Office of the Attorney General for the State of Vermont, *Thea Schwartz*, Assistant Attorney General, *George Jepsen*, Attorney General, Office of the Attorney General for the State of Connecticut, *Robert Snook*, Assistant Attorney General, and *Joseph F. Halloran*.

Geoffrey H. Fettus argued the cause for petitioners the Environmental Groups. With him on the briefs were *Andres J. Restrepo* and *Diane Curran*.

Robert M. Rader, Senior Attorney, U.S. Nuclear Regulatory Commission, argued the cause for respondents. With him on the brief were *John E. Arbab*, Attorney, U.S. Department of Justice, *Stephen G. Burns*, General Counsel, U.S. Nuclear Regulatory Commission, and *John F. Cordes Jr.*, Solicitor.

David A. Repka argued the cause for intervenors Nuclear Energy Institute, et al., in support of respondents. With him on the brief were *Brad Fagg* and *Jerry Bonanno*. *Anne W. Cottingham* entered an appearance.

Before: SENTELLE, *Chief Judge*, TATEL and GRIFFITH, *Circuit Judges*.

Opinion for the Court filed by *Chief Judge* SENTELLE.

SENTELLE, *Chief Judge*: Four states, an Indian community, and a number of environmental groups petition this Court for review of a Nuclear Regulatory Commission ("NRC" or "Commission") rulemaking regarding temporary storage and permanent disposal of nuclear waste. We hold that the rulemaking at issue here constitutes a major federal action necessitating either an environmental impact statement or a finding of no significant environmental impact. We further hold that the Commission's evaluation of the risks of spent nuclear fuel is deficient in two ways: First, in concluding that permanent storage will be available "when necessary," the Commission did not calculate the environmental effects of failing to secure permanent storage—a possibility that cannot be ignored. Second, in determining that spent fuel can safely be stored on site at nuclear plants for sixty years after the expiration of a plant's license, the Commission failed to properly examine future dangers and key consequences. For these reasons, we grant the petitions for review, vacate the Commission's orders, and remand for further proceedings.

I. Background

This is another in the growing line of cases involving the federal government's failure to establish a permanent repository for civilian nuclear waste. *See, e.g.*, *In re Aiken County*, 645 F.3d 428, 430–31 (D.C. Cir. 2011) (recounting prior cases). We address the Commission's recent rulemaking regarding the prospects for permanent disposal of nuclear waste and the environmental effects of temporarily storing such material on site at nuclear plants until a permanent disposal facility is available.

After four to six years of use in a reactor, nuclear fuel rods can no longer efficiently produce energy and are considered "spent nuclear fuel" ("SNF"). Blue Ribbon Commission on America's Nuclear Future, *Report to the Secretary of Energy* 10–11 (2012). Fuel rods are thermally hot when removed from reactors and emit great amounts of radiation—enough to be fatal in minutes to someone in the immediate vicinity. *Id.* Therefore, the rods are transferred to racks within deep, water-filled pools for cooling and to protect workers from radiation. After the fuel has cooled, it may be transferred to dry storage, which consists of large concrete and steel "casks." Most SNF, however, will remain in spent-fuel pools until a permanent disposal solution is available. *Id.* at 11.

Even though it is no longer useful for nuclear power, SNF poses a dangerous, long-term health and environmental risk. It will remain dangerous "for time spans seemingly beyond human comprehension." *Nuclear Energy Inst., Inc. v. Envtl. Prot. Agency*, 373 F.3d 1251, 1258 (D.C. Cir. 2004) (per curiam). Determining how to dispose of the growing volume of SNF, which may reach 150,000 metric tons by the year 2050, is a serious problem. *See* Blue Ribbon Commission, *supra*, at 14. Yet despite years of "blue ribbon" commissions, congressional hearings, agency reports, and site investigations, the United States has not yet developed a permanent solution. That failure, declared the most recent "blue ribbon" panel, is the "central flaw of the U.S. nuclear waste management program to date." *Id.* at 27. Experts agree that the ultimate solution will be a "geologic repository," in which SNF is stored deep within the earth, protected by a combination of natural and engineered barriers. *Id.* at ix, 29. Twenty years of work on establishing such a repository at Yucca Mountain was recently abandoned when the Department of Energy decided to withdraw its license application for the facility. *Id.* at 3. At this time, there is not even a prospective site for a repository, let alone progress toward the actual construction of one.

Due to the government's failure to establish a final resting place for spent fuel, SNF is currently stored on site at nuclear plants. This type of storage, optimistically labeled "temporary storage," has been used for decades longer than originally anticipated. The delay has required plants to expand storage pools and to pack SNF more densely within them. The lack of progress on a permanent repository has caused considerable uncertainty regarding the environmental effects of temporary SNF storage and the reasonableness of continuing to license and relicense nuclear reactors.

In this case, petitioners challenge a 2010 update to the NRC's Waste Confidence Decision ("WCD"). The original WCD came as the result of a 1979 decision by this court remanding the Commission's decision to allow the expansion of spent-fuel pools at two nuclear plants. *Minnesota v. NRC*, 602 F.2d 412 (D.C. Cir. 1979). In *Minnesota*, we directed the Commission to consider "whether there is reasonable assurance that an off-site storage solution [for spent fuel] will be available by . . . the expiration of the plants' operating licenses, and if not, whether there is reasonable assurance that the fuel can be stored safely at the sites beyond those dates." *Id.* at 418. The WCD is the Commission's determination of those risks and assurances.

The original WCD was published in 1984 and included five "Waste Confidence Findings." Briefly, those findings declared that: 1) safe disposal in a mined geologic repository is technically feasible, 2) such a repository will be available by 2007–2009, 3) waste will be managed safely until the repository is available, 4) SNF can be stored safely at nuclear plants for at least thirty years beyond the licensed life of each plant, and 5) safe, independent storage will be made available if needed. Waste Confidence Decision, 49 Fed. Reg. 34,658, 34,659–60 (Aug. 31, 1984). The Commission updated the WCD in 1990 to reflect new understandings about waste disposal and to predict the availability of a repository by 2025. *See* Waste Confidence Decision Review, 55 Fed. Reg. 38,474, 38,505 (Sept. 18, 1990). The Commission reviewed the WCD again in 1999 without altering it. *See* Waste Confidence Decision Review: Status, 64 Fed. Reg. 68,005, 68,006–07 (Dec. 6, 1999).

In 2008, the Commission proposed revisions to the Waste Confidence Findings, and, after considering public comments, made revisions in 2010. Waste Confidence Decision Update, 75 Fed. Reg. 81,037 (Dec. 23, 2010). That decision, under review in this case, reaffirmed three of the Waste Confidence Findings and updated two. First, the Commission revised Finding 2, which, as of 1990, expected that a permanent geologic repository would be available in the first quarter of the twenty-first century. As amended, Finding 2 now states that a suitable repository will be available "when necessary," rather than by a date certain. *Id.* at 81,038. In reaching that conclusion, the Commission examined the political and technical obstacles to permanent storage and determined that a permanent repository will be ready by the time the safety of temporary on-site storage can no longer be assured. *Id.*

Finding 4 originally held that SNF could be safely stored at nuclear reactor sites without significant environmental effects for at least thirty years beyond each plant's licensed life, including the license-renewal period. *Id.* at 81,039. In revising that finding, the Commission examined the potential environmental effects from temporary storage, such as leakages from the spent-fuel pools and fires caused by the SNF becoming exposed to the air. Concluding that previous leaks had only a negligible near-term health effect and that recent regulatory enhancements will further reduce the risk of leaks, the Commission determined that leaks do not pose the threat of a significant environmental impact. *Id.* at 81,069–71. The Commission also found that pool fires are sufficiently unlikely as to pose no significant environmental threat. *Id.* at 81,070–71. As amended, Finding 4 now holds that SNF can be safely stored at plants for at least sixty years beyond the licensed life of a plant, instead of thirty. *Id.* at 81,074. In addition, the Commission noted in its final rule that it will be developing a plan for longer-term storage and will conduct a full assessment of the environmental impact of storage beyond the sixty-year post-license period. *Id.* at 81,040. Based on the revised WCD, the Commission released a new Temporary Storage Rule ("TSR") enacting its conclusions and updating its regulations accordingly. *See* Consideration of Environmental Impacts of Temporary Storage of Spent Fuel after Cessation of Reactor Operation, 75 Fed. Reg. 81,032 (Dec. 23, 2010); 10 C.F.R. § 51.23(a). Petitioners challenge the amended 10 C.F.R. § 51.23(a) based on both Finding 2 and Finding 4.

II. The Commission's Obligations Under NEPA

The National Environmental Policy Act of 1969 ("NEPA"), 42 U.S.C. § 4321 *et seq.*, requires federal agencies such as the Commission to examine and report on the environmental consequences of their actions. NEPA is an "essentially procedural" statute intended to ensure "fully informed and well-considered" decisionmaking, but not necessarily the best decision. *Vermont Yankee Nuclear Power Corp. v. NRDC*, 435 U.S. 519, 558 (1978). Under NEPA, each federal agency must prepare an Environmental Impact Statement ("EIS") before taking a "major Federal action[] significantly affecting the quality of the human environment." 42 U.S.C. § 4332(2)(C). An agency can avoid preparing an EIS, however, if it conducts an Environmental Assessment ("EA") and makes a Finding of No Significant Impact ("FONSI"). *See Sierra Club v. Dep't of Transp.*, 753 F.2d 120, 127 (D.C. Cir. 1985); *see also Theodore Roosevelt Conservation P'ship v. Salazar*, 616 F.3d 497, 503–04 (D.C. Cir. 2010) (explaining NEPA procedures in detail). The issuance or reissuance of a reactor license is a major federal action affecting the quality of the human environment. *See New York v. Nuclear Regulatory Comm'n*, 589 F.3d 551, 553 (2d Cir. 2009).

The parties here dispute whether the WCD itself constitutes a major federal action. To petitioners, the WCD is a major federal action because it is a predicate to every decision to license or relicense a nuclear plant, and the findings made in the WCD are not challengeable at the time a plant seeks licensure. The Commission contends that because the WCD does not authorize the licensing of any nuclear reactor or storage facility, and because a site-specific EIS will be conducted for each facility at the time it seeks licensure, the WCD is not a major federal action. To the Commission, the WCD is simply an answer to this court's mandate in *Minnesota* to ensure that plants are only licensed while the NRC has reasonable assurance that permanent disposal of the resulting waste will be available. The Commission also contends that the WCD constitutes an EA supporting the revision of 10 C.F.R. § 51.23(a), and because the EA found no significant environmental impact, an EIS is not required.

We agree with petitioners that the WCD rulemaking is a major federal action requiring either a FONSI or an EIS. The Commission's contrary argument treating the WCD as separate from the individual licensing decisions it enables fails under controlling precedent.

We have long held that NEPA requires that "environmental issues be considered at every important stage in the decision making process concerning a particular action." *Calvert Cliffs' Coordinating Comm., Inc. v. Atomic Energy Comm'n*, 449 F.2d 1109, 1118 (D.C. Cir. 1971). The WCD makes generic findings that have a preclusive effect in all future licensing decisions—it is a pre-determined "stage" of each licensing decision. NEPA established the Council on Environmental Quality ("CEQ") "with authority to issue regulations interpreting it." *Dep't of Transp. v. Public Citizen*, 541 U.S. 752, 757 (2004). The CEQ has defined major federal actions to include actions with "[i]ndirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable." 40 C.F.R. §§ 1508.8, 1508.18; *Public Citizen*, 541 U.S. at 763; *see also Andrus v. Sierra Club*, 442 U.S. 347, 358 (1979) (holding that the CEQ's NEPA interpretations are entitled to substantial deference); *accord CTIA-Wireless Ass'n v. FCC*, 466 F.3d 105, 115 (D.C. Cir. 2006). It is not only reasonably forseeable but eminently clear that the WCD will be used to enable licensing decisions based on its findings. The Commission and the intervenors contend that the site-specific factors that differ from plant to plant can be challenged at the time of a specific plant's licensing, but the WCD nonetheless renders uncontestable general conclusions about the environmental effects of plant licensure that will apply in every licensing decision. *See* 10 C.F.R. § 51.23(b).

Petitioners' argument continues by suggesting that the WCD lacks an EIS and must be reversed on that basis. Not necessarily. No EIS is required if the agency conducts an EA and issues a FONSI sufficiently explaining why the proposed action will not have a significant environmental impact. *Public Citizen*, 541 U.S. at 757–58. Though we give considerable deference to an agency's decision regarding whether to prepare an EIS, the agency must 1) "accurately identif[y] the relevant environmental concern," 2) take a "hard look at the problem in preparing its EA," 3) make a "convincing case for its finding of no significant impact," and 4) show that even if a significant impact will occur, "changes or safeguards in the project sufficiently reduce the impact to a minimum." *Taxpayers of Michigan Against Casinos v. Norton*, 433 F.3d 852, 861 (D.C. Cir. 2006) (internal quotation omitted). An agency's decision not to prepare an EIS must be set aside if it is "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law." *Public Citizen*, 541 U.S. at 763 (quoting 5 U.S.C. § 706(2)(A)).

III. Availability of a Permanent Repository

With these NEPA obligations in mind, we turn to the Commission's conclusion that a permanent repository for SNF will be available "when necessary." In so concluding, the Commission examined the historical difficulty—now measured in decades rather than years—in establishing a permanent facility. *See, e.g.*, Waste Confidence Decision Update, 75 Fed. Reg. at 81,049. Though a number of commenters suggested that the social and political barriers to building a geologic repository are too great to conclude that a facility could be built in any reasonable timeframe, the Commission believes that the lessons learned from the Yucca Mountain program and the Blue Ribbon Commission on America's Nuclear Future will ensure that, through "open and transparent" decisionmaking, a consensus would be reached. *Id.* Further, the Commission noted that the Nuclear Waste Policy Act mandates a repository program, demonstrating the continued commitment and obligation of the federal government to pursue one. The scientific and experiential knowledge of the past decades, the Commission explained, would enable the government to create a suitable repository by the time one is needed. *Id.*

A.

Petitioners argue that the Commission's conclusion regarding permanent storage violates NEPA in two ways: First, it fails to fully account for the significant societal and political barriers that may delay or prevent the opening of a repository. Second, the Commission's conclusion that a permanent repository will be available "when necessary" fails to define the term "necessary" in any meaningful way and does not address the effects of a failure to establish a repository in time. Petitioners further contest the Commission's claim that the WCD constitutes an EA for permanent disposal, let alone the

EIS they contend is required here.

The Commission responds by contending that it "candidly acknowledged" the societal and political challenges, and crafted the WCD to account for those risks. Overcoming political obstacles is not the responsibility of the Commission, it contends, and the NRC's conclusion that institutional obstacles will not prevent a repository from being built is entitled to substantial deference. The Commission contends that the selection of a precise date for Finding 2 is not required by NEPA or any other laws governing the NRC, and the Commission used the "when necessary" formulation as far back as 1977. *See NRDC v. Nuclear Regulatory Comm'n*, 582 F.2d 166, 170, 175 (2d Cir. 1978).

As for examining the environmental effects of failing to establish a repository, the Commission contends that the WCD is an EA supporting the revision of 10 C.F.R. § 51.23(a). No EIS is necessary regarding permanent disposal because, the Commission argues, the WCD is not a major federal action, and conducting an EIS for this issue would be the sort of "abstract exercise" the Supreme Court declined to require in *Baltimore Gas and Electric Company v. NRDC*, 462 U.S. 87, 100 (1983). Further, the Commission's existing "Table S-3" already considers the environmental effects of the nuclear fuel cycle generally and found no significant impacts. Therefore, the Commission believes, no EIS is required.

B.

The Commission's "when necessary" finding is already imperiled by our conclusion that the WCD is a major federal action. We hold that the WCD must be vacated as to its revision to Finding 2 because the WCD fails to properly analyze the environmental effects of its permanent disposal conclusion.

While we share petitioners' considerable skepticism as to whether a permanent facility can be built given the societal and political barriers to selecting a site, we need not resolve whether the Commission adequately considered those barriers. Likewise, we need not decide whether, as the Commission contends, an agency's interpretation of the political landscape surrounding its field of expertise merits deference. Instead, we hold the WCD is defective on far simpler grounds: As we have determined, the WCD is a major federal action because it is used to allow the licensing of nuclear plants. *See supra* Part II. Therefore, the WCD requires an EIS or, alternatively, an EA that concludes with a finding of no significant impact. The Commission did not supply a suitable FONSI here because it did not examine the environmental effects of failing to establish a repository.

Even taking the Commission's word that the WCD constitutes an EA for the permanent storage conclusion, *see* Waste Confidence Decision Update, 75 Fed. Reg. at 81,042, the EA is insufficient because a finding that "reasonable assurance exists that sufficient mined geologic repository capacity will be available when necessary," *id.* at 81,041, does not describe a probability of failure so low as to dismiss the potential consequences of such a failure. Under NEPA, an agency must look at both the probabilities of potentially harmful events and the consequences if those events come to pass. *See, e.g., Carolina Envtl. Study Grp. v. U.S.*, 510 F.2d 796, 799 (D.C. Cir. 1975). An agency may find no significant impact if the probability is so low as to be "remote and speculative," or if the combination of probability and harm is sufficiently minimal. *See, e.g., City of New York v. Dep't of Transp.*, 715 F.2d 732, 738 (2d Cir. 1983) ("The concept of overall risk incorporates the significance of possible adverse consequences discounted by the improbability of their occurrence."). Here, a "reasonable assurance" that permanent storage will be available is a far cry from finding the likelihood of nonavailability to be "remote and speculative." The Commission failed to examine the environmental consequences of failing to establish a repository when one is needed.

The Commission argues that its "Table S-3" already accounts for the environmental effects of the nuclear fuel cycle and finds no significant impact. Not so. Table S-3, like the Commission itself, presumes the existence of a geologic repository. Therefore, it cannot explain the environmental effects of a failure to secure a permanent facility. The Commission also complains that conducting a full analysis regarding permanent storage would be an "abstract exercise." Perhaps the Commission thinks so because it perceives the required analysis to be of the effects of the permanent repository itself. But we are focused on the effects of a *failure* to secure permanent storage. The Commission apparently has no long-term plan other than hoping for a geologic repository. If the government continues to fail in its quest to establish one, then SNF will seemingly be stored on site at nuclear plants on a permanent basis. The Commission can and must assess the potential environmental effects of such a failure.

IV. Temporary On-Site Storage of SNF

In concluding that SNF can safely be stored in on-site storage pools for a period of sixty years after the end of a plant's life, instead of thirty, the Commission conducted what it purports to be an EA, which found that extending the time for storage would have no significant environmental impact. *See* Waste Confidence Decision Update, 75 Fed. Reg. at 81,074. This analysis was conducted in generic fashion by looking to environmental risks across the board at nuclear plants, rather than by conducting a site-by-site analysis of each specific nuclear plant. Two key risks the Commission examined in its

EA were the risk of environmental harm due to pool leakage and the risk of a fire resulting from the fuel rods becoming exposed to air. *See id.* at 81,069–71. We conclude that the Commission's EA and resulting FONSI are not supported by substantial evidence on the record because the Commission failed to properly examine the risk of leaks in a forward-looking fashion and failed to examine the potential consequences of pool fires.

A.

Petitioners challenge the finding of no significant impact on two bases: First, petitioners argue that a generic analysis is simply inappropriate and that the Commission was required to look at each plant individually. A site-by-site analysis is necessary, petitioners argue, because the risks of leaks and fires are affected by site-specific factors such as pool configuration, leak detection systems, the nature of SNF stored in the pool, and the location of the pool within the plant. Overall, petitioners argue that NEPA requires the Commission to fully analyze the environmental effects of on-site storage, and a generic analysis cannot fulfill that statutory mandate.

Second, petitioners argue that even if generic analysis is appropriate, the Commission's generic EA in this case was insufficient. They maintain that the Commission did not adequately account for leaks from on-site pools because the Commission only looked at past leaks to see if they caused environmental damage, rather than examining the risks of future leaks. Also, as petitioners point out, the Commission's own studies have shown that previous leaks "did, or potentially could, impact ground-water resources relative to established EPA drinking water standards." NRC, *Liquid Radioactive Release Lessons Learned Task Force Final Report* 13 (2006). Petitioners also argue that the Commission's analysis of the effects of pool fires was deficient because the Commission declined to examine the consequences of pool fires due to the low probability of such an occurrence. In petitioners' view, the Commission could only avoid examining the consequences of pool fires in a full EIS if it found the risk so low as to be "remote and speculative"—a finding the Commission did not make. Finally, Petitioners contend that the Commission completely failed to look at non-health environmental factors such as effects on the Prairie Island Indian Community's homeland, which is located near one of the plants governed by the rule.

The Commission responds by stating that its examination of past leaks properly demonstrated that the potential for environmental harm from leakage is negligible. The Commission argues that the effects of past leaks have been shown to be quite minimal, and the Commission's leakage task force has recommended twenty-six specific measures to minimize the risk even further. Also, the NRC exercises oversight over the pools and will ensure that they do not become unsafe over the sixty-year period. With regard to fires, the Commission contends that it engaged in an "exhaustive consideration" of the risk and found that such an event is extremely unlikely. In the Commission's view, a site-by-site analysis of pool-fire risk is unnecessary because the Commission relied on studies which accounted for all of the variations cited by petitioners and essentially looked at the most dangerous combinations of site-specific factors. Even looking to a worst-case scenario, the Commission says, the risk of fires was still extremely low.

Responding to petitioners' argument that the Commission failed to determine that the risk of fires was "remote and speculative," the Commission suggests that it did not dismiss the risk out of hand as "remote and speculative" but rather examined it thoroughly and found it to be so low that the consequences could not possibly overcome the low probability. Therefore, the Commission did not need to conduct a full EIS for pool fires. Finally, the Commission argues that petitioners did not raise the issue of non-health impacts during the rulemaking, and thus they cannot raise that issue on petition now.

B.

Both the Supreme Court and this court have endorsed the Commission's longstanding practice of considering environmental issues through general rulemaking in appropriate circumstances. *See, e.g.*, *Baltimore Gas*, 462 U.S. at 100 ("The generic method chosen by the agency is clearly an appropriate method of conducting the hard look required by NEPA."); *see also Minnesota*, 602 F.2d at 416–17. Though *Baltimore Gas* dealt with the nuclear fuel cycle itself, which is generally focused on things that occur outside of individual plants, we see no reason that a comprehensive general analysis would be insufficient to examine on-site risks that are essentially common to all plants. This is particularly true given the Commission's use of conservative bounding assumptions and the opportunity for concerned parties to raise site-specific differences at the time of a specific site's licensing. Nonetheless, whether the analysis is generic or site-by-site, it must be thorough and comprehensive. Even though the Commission's application of its technical expertise demands the "most deferential" treatment by the courts, *Baltimore Gas*, 462 U.S. at 103, we conclude that the Commission has failed to conduct a thorough enough analysis here to merit our deference.

1.

The Commission admits in the WCD Update that there have been "several incidents of groundwater contamination originating from leaking reactor spent fuel pools and associated structures." 75 Fed. Reg. at 81,070. The Commission brushes away that concern by stating that the past leaks had only a negligible near-term health impact. *Id.* at 81,071. Even setting aside the fact that near-term health effects are not the only type of environmental impacts, the harm from past leaks—without more—tells us very little about the potential for future leaks or the harm such leaks might portend. The WCD Update seeks to extend the period of time for which pools are considered safe for storage; therefore, a proper analysis of the risks would necessarily look *forward* to examine the effects of the additional time in storage, as well as examining past leaks in a manner that would allow the Commission to rule out the possibility that those leaks were only harmless because of site-specific factors or even sheer luck. The WCD Update has no analysis of those possibilities other than to say that past leaks had "negligible" near-term health effects. *Id.* A study of the impact of thirty additional years of SNF storage must actually concern itself with the extra years of storage.

The Commission also notes that a taskforce has made recommendations for improvements to spent-fuel pools, which the NRC "has addressed, or is in the process of addressing." *Id.* But those improvements are thus far untested, and we have no way of deferring to the Commission's conclusion that they will ensure the absence of environmental harm. Finally, the Commission refers to its monitoring and regulatory compliance program as a buffer against pool degradation. *Id.* That argument is even less availing because it amounts to a conclusion that leaks will not occur because the NRC is "on duty." With full credit to the Commission's considerable enforcement and inspection efforts, merely pointing to the compliance program is in no way sufficient to support a scientific finding that spent-fuel pools will not cause a significant environment impact during the extended storage period. This is particularly true when the period of time covered by the Commission's predictions may extend to nearly a century for some facilities.

Despite giving our "most deferential" treatment to the Commission's application of its technical and scientific expertise, we cannot reconcile a finding that past leaks have been harmless with a conclusion that future leaks at all sites will be harmless as well. The Commission's task here was to determine whether the pools could be considered safe for an additional thirty years in the future. That past leaks have not been harmful with respect to groundwater does not speak to whether and how future leaks might occur, and what the effects of those leaks might be. The Commission's analysis of leaks, therefore, was insufficient.

2.

Even though the Commission engaged in a more substantial analysis of fires than it did of leaks, that analysis is plagued by a failure to examine the consequences of pool fires in addition to the probabilities. Petitioners, citing *Limerick Ecology Action, Inc. v. Nuclear Regulatory Commission*, 869 F.2d 719, 739 (3d Cir. 1989), argue that the Commission could only avoid conducting an EIS if it found the risk of fires to be "remote and speculative." The Commission, citing *Carolina Environmental Study Group v. United States*, 510 F.2d at 799, argues that it did not need to examine the consequences of fires because it found the risk of fires to be very low.

We disagree with both parties. As should be clear by this point in our opinion, an agency conducting an EA generally must examine both the probability of a given harm occurring *and* the consequences of that harm if it does occur. Only if the harm in question is so "remote and speculative" as to reduce the effective probability of its occurrence to zero may the agency dispense with the consequences portion of the analysis. *See Limerick Ecology Action, Inc.*, 869 F.2d at 739. But, contra petitioners, the finding that the probability of a given harm is nonzero does not, by itself, mandate an EIS: after the agency examines the consequences of the harm in proportion to the likelihood of its occurrence, the overall expected harm could still be insignificant and thus could support a FONSI. *See Carolina Envtl. Study Grp.*, 510 F.2d at 799 ("Recognition of the minimal probability of such an event is not equatable with nonrecognition of its consequences."). Here, however, the Commission did not undertake to examine the consequences of pool fires at all. Depending on the weighing of the probability and the consequences, an EIS may or may not be required, and such a determination would merit considerable deference. *C.f.*, *City of New York*, 715 F.2d at 751–52 (deferring to an agency's weighing of a "catastrophic" harm against an "infinitesimal probability"). But unless the risk is "remote and speculative," the Commission must put the weights on both sides of the scale before it can make a determination.

3.

As for petitioners' remaining argument that the Commission did not consider non-health environmental effects, we agree with the Commission that petitioners did not properly raise those issues in the rulemaking. Petitioners essentially present two non-health impacts: decrease in property values and risk of harm to the Prairie Island Indian Community's homeland. The Tribe did mention its small size and close proximity to the Prairie Island Nuclear Generating Plant, but it did not assert specifically how it might be harmed by either the rulemaking itself or the licensing the rulemaking enables. With regard to property values, petitioners point to a study considering the economic impact of the Indian Point plant. But that study actually *assumes* a diminution in values caused by current plant operation and simply extends it mathematically—it in no way asserts whether or how any harm to property values might occur nor how that harm is related to a change in the physical environment. Petitioners' failure to raise these objections to the agency waives them. *See Public Citizen*, 541 U.S. at 764. We note, as did the Supreme Court in *Public Citizen*, that primary responsibility for compliance with NEPA lies with the Commission, not petitioners; nonetheless, the non-health effects alluded to here are not "so obvious that there is no need for a commentator to point them out." *Id.* Given, however, that we are invalidating the Commission's conclusions as a whole, petitioners will have the opportunity to properly raise and clarify these concerns on remand.

* * *

Overall, we cannot defer to the Commission's conclusions regarding temporary storage because the Commission did not conduct a sufficient analysis of the environmental risks. In so holding, we do not require, as petitioners would prefer, that the Commission examine each site individually. However, a generic analysis must be forward looking and have enough breadth to support the Commission's conclusions. Furthermore, as NEPA requires, the Commission must conduct a true EA regarding the extension of temporary storage. Such an analysis must, unless it finds the probability of a given risk to be effectively zero, account for the consequences of each risk. On remand, the Commission will have the opportunity to conduct exactly such an analysis.

V. Conclusion

We recognize that the Commission is in a difficult position given the political problems concerning the storage of spent nuclear fuel. Nonetheless, the Commission's obligations under NEPA require a more thorough analysis than provided for in the WCD Update. We note that the Commission is currently conducting an EIS regarding the environmental impacts of SNF storage beyond the sixty-year post-license period at issue in this case, and some or all of the problems here may be addressed in such a rulemaking. In any event, we grant the petitions for review, vacate the WCD Update and TSR, and remand for further proceedings consistent with this opinion.

So ordered.

The record on small companies: A review of the evidence

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Abstract It is now exactly 20 years since the publication of the two pioneering papers — Banz, R. (1981) 'The Relationship between Return and Market Value of Common Stock', *Journal of Financial Economics*, 9, 3–18, and Reinganum, M. (1981) 'Misspecification of Capital Asset Pricing: Empirical Anomalies Based on Earnings' Yields and Market Values', *Journal of Financial Economics*, 9, 19–46 — on the performance of small capitalisation companies. The discovery of the so-called 'small size effect' generated a lively debate on market efficiency and asset pricing and led to a considerable amount of further research that shed light on the nature and market behaviour of this important asset class. The purpose of this paper is to review the empirical evidence on small companies with particular emphasis on the implications relevant to practising fund managers. The weight of the evidence suggests that conventional risk measures (betas) fail to reflect the inherent risks of small firms. Such firms are, however, riskier in terms of higher mortality, lower liquidity, higher short-term borrowings and higher volatility of earnings. The evidence also suggests that the outperformance of small cap stocks, even at the pinnacle of its manifestation, was driven by a relatively limited number of such stocks. Such good performers possess a number of key characteristics. They have lower than average market-to-book and price-earnings ratings, and their market value is higher than the average capitalisation of the small cap sector; they have been listed in the market for longer than a year and have not raised additional equity capital in the last year. They have reasonably stable earnings growth profile, do not belong to sectors with excessive swings in analyst forecasts and current ratings do not depend on hugely over-optimistic analyst forecasts.

Keywords: *performance; size effect; small companies*

Introduction

Small cap stocks, in terms of market value, have a long-established tradition in the investment community as an important and distinct asset class. They have always attracted the following of expert analysts and have formed the basis of specialist funds. Interest in small firms exploded in the early 1980s, when a series of academic papers documented a significant long-run return differential between large and small capitalisation stocks. Small companies continue to attract wide investment interest in spite of their dramatic performance reversal in recent years. Although they make up only a small proportion of the total market capitalisation, in terms of numbers they constitute a large and vital segment of the market.

From the academic viewpoint, the evidence on small cap outperformance provided a direct challenge to the broad concept of market efficiency and conventional asset pricing models. At the beginning, the bulk of the research endeavour was to document the 'anomaly' and test its robustness under various methodologies and independent datasets. This effort has provided considerable insights into some aspects of small firms' behaviour, and in the process discovered a number of other intriguing empirical irregularities.[1] Nevertheless, it is fair to say that, after almost 20 years of its discovery, the underlying logic and sometimes the practical significance[2] of the so-called 'size effect' still remains a matter of debate. We have, however, gained considerable insights into the pricing of financial assets, the operating characteristics of small companies and the special risk characteristics of such firms. It could be argued that the discovery of the small size effect represents a turning point in the direction of academic thinking on asset pricing.

The purpose of this paper is to review the empirical evidence on small companies. It aims to establish the key facts about the characteristics of this asset class rather than to rehearse old explanations for the small size effect.[3] More specifically, this paper's emphasis is on aspects of small companies' behaviour that appear well substantiated by empirical evidence and have practical implications to practising fund managers. Although the review is based on both the USA and the UK evidence, the emphasis is inevitably on the latter. Given the paucity of studies for the London market, it relies heavily on the author's own published and previously unpublished research.

The performance of small caps

Since the initial discovery of the size effect in the USA by Banz (1981) and Reinganum (1981), a stream of other studies documented broadly similar results for a number of other countries as well. Hawawini and Keim (1999) provide a comprehensive review of the international evidence. Levis (1985) published the first detailed study on the performance of small companies for the London market. The study documents an average 6.5 per cent annual raw premium for the smaller decile of UK firms during the period January 1958 to December 1982; it is based on a sample ranging from around 1,500 in the late 1950s to 2,400 in the mid-1970s. In line with the US evidence, the size premium is consistent across the whole spectrum of market size deciles, suggesting that a significant, albeit lower, size premium could be achieved at levels of market capitalisation more amenable to fund managers' requirements.

This study attracted considerable media[4] attention which eventually led to the 1987 launch of the Hoare Govett Smaller Companies (HGSC), the Hoare Govett 1000 (HG1000) and the FTSE Small Companies indices. The HGSC index is value weighted and defines small companies as the bottom 10 per cent of the London market according to market capitalisation. The index is broadly equivalent to the weighted average of the first nine deciles classification in the Levis (1995) study. It covers an average of about 1,600 companies with a maximum market capitalisation of about £500m. At the same time, the largest company in the HG 1000 index is usually about £100m. The definition of a small firm has also shifted in recent years. A survey reveals that 63 per cent of investment managers now include businesses with a market capitalisation of more than £350m in their definition of a small company; the proportion of fund managers taking this view has doubled during the past year.[5]

The HGSC index shows a premium of 6.3 per cent over the FTSE All Share for the period 1955–88 but it records a dramatic reversal of small companies' performance in more recent years. Thus, the average return differential for the period 1955–2000 has declined to a mere 3.6 per cent per annum. The turning point for small companies' performance in the UK appears to be in the third quarter of 1988. Before then, small companies enjoyed six consecutive years of strong outperformance. With the exception of the 1957–64 period, this was indeed the longest spell of small company supremacy. Sometimes it is argued that the small company premium disappeared, both in the USA and in the UK, as soon as it became widely publicised. This is a far-fetched interpretation of causality. It is important to note that, at the time of the size effect reversal, the UK economy was undergoing some significant changes. For the record, four key developments can be noted. First, the FTA index lost 5.24 per cent of its value during the single month of August 1988. Secondly, this same month was the first time for a long period that the market witnessed an inverted term structure in interest rates. Treasury bill rates increased from 6.9 per cent in May 1988 to 10.9 in August 1988. Thirdly, in the 12 months to August 1988, the sterling rate strengthened by 6.8 per cent against a basket of main currencies. Fourthly, the CBI business confidence indicator dropped by 67 per cent in the 12 months to August 1988, starting a period of prolonged deterioration in business confidence across the UK manufacturing industry.

The international evidence

The size effect has also ceased to exist in the US markets since the mid-1980s. In fact, Siegel (1994) claims that the entire outperformance by small cap stocks from the end of 1926 to 1996 is due to the nine-year period from 1975 through 1983. More recently, Horowitz *et al.* (1998), in an extension of the pioneering Banz and Reinganum studies, find that during the period 1980–96, the average return for the smallest size decile — across NYSE, AMEX and NASDAQ — is 1.33 per cent per month compared with 1.34 per cent per month for the largest decile.[6] Ibbotson (1997) also reports a negative 1.7 per cent annual size premium during the 1980s and a positive premium of just 1.2 per cent in the period 1990–96.

Figure 1 shows the size effect for seven European countries over the period 1988–98.[7] With the exception of France, where small companies outperformed large ones, and Spain, where the performance of small and large companies is almost identical, the other five countries — Germany, Netherlands, Spain, Sweden and Switzerland — had exactly the same experience as the UK in the last decade: large firms performed better than small firms. Thus, it appears that in the 1990s small companies lagged considerably in market performance across almost all major capital markets.[8] This is again in sharp contrast to evidence relating to earlier periods, suggesting a positive size effect. For example, Hawawini and Keim (1999) report positive size premia of about 6–9 per cent per annum for France,

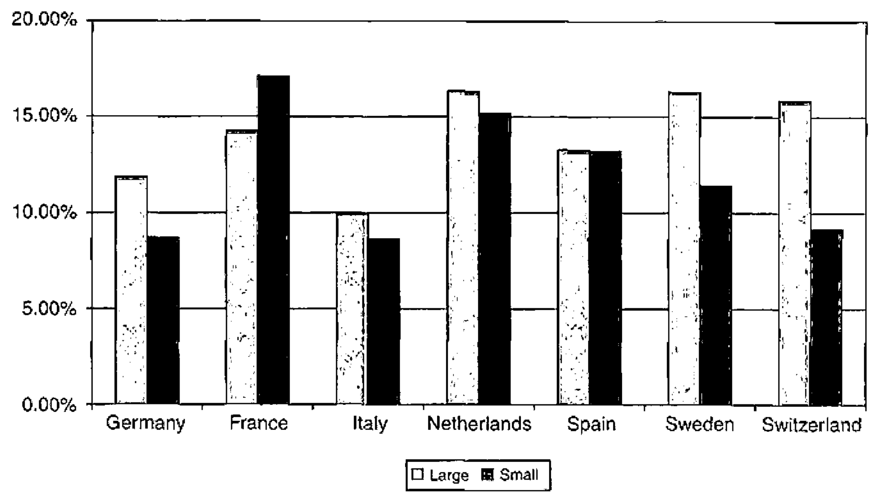

Figure 1 Annual average returns 1988–98

Germany, Spain and Switzerland for long periods before 1989. It is important also to note that in 1998 small companies in Europe generally underperformed their larger counterparts only by a narrow margin. This is in sharp contrast to the disastrous performance recorded by UK small cap stocks.

At this stage two clarification points are in order. The first relates to the robustness of the size effect and its interrelation with other stock characteristics, while the second addresses the definition of firm size. The search for an explanation of the effect revealed a number of other irregularities in asset pricing which appeared not to be completely independent of size. A number of studies, for example, show that the small size effect is concentrated in certain months of the year, while others report that the size spread is related to other stock characteristics. Blume and Stambaugh (1983) and Stoll and Whaley (1983) report a high rank correlation between size and price, while Keim (1988) and Jaffe *et al.* (1989) find similar correlations between size and earnings yield and price-to-book ratios.

The main question surrounding these findings is whether these additional effects are independent of or are related to market size. The evidence on this issue is rather controversial. While, for example, Reinganum (1981) and Banz and Breen (1986) argue that the size effect subsumes the PE effect, Basu (1983) maintains quite the opposite, ie size-related anomalies disappear when one controls for the PE effect. Using more recent data covering the period 1962–94, Hawawini and Keim (1999) report pairwise significant correlations between size, E/P, CF/P, P/B and price for NYSE and AMEX stocks. Interestingly, however, the strongest correlation is observed between market size and price (0.78), suggesting that the size effect may be some manifestation of a low price effect.

The evidence for the UK raises even further questions about the robustness of the size effect. Using data for the London Stock Exchange for the period April 1961 to March 1985, Levis (1989a) shows significant differences in risk-adjusted returns for portfolios formed on size, PE, dividend yield and price. It appears, however, that small firms tend to be firms with low PE ratios and share prices. Hence, when controlling for the possible interactions between the four ranking criteria, it becomes difficult to distinguish among the four effects in general and between size and share price in particular. He concludes that 'the weight of the evidence raises questions about the strength of firm size as an independent determinant of the stock generating process. Its strong dependence with the other firm attributes suggest that it cannot be viewed as either an independent anomaly or a profitable investment strategy on its own' (p. 695).

The second issue relates to the definition of firm size. Although the finance literature almost invariably uses market value as the metric for company size, this is not common practice in other disciplines. The general business literature, for example, tends to define company size using other relevant metrics such as size of assets, volume of sales, book value of assets and number of employees. Berk (1995a) examines the market performance of small firms using various definitions of size. In a sample in which both market value and book-to-market (BM) have a strong cross-sectional relation to average return, he fails to find a similar significant relation between average return and other, non-market, measures of firm size. Thus, although quite often market size is inferred as equivalent to economic size, it is clear that small stocks are different from small firms. Nevertheless, following long-established practice, the terms are used interchangeably in this paper.

These basic observations tend to suggest that the performance of small companies is not isolated from macroeconomic fundamentals, and there is probably a certain cyclicality in the small size premium. These issues are discussed in the following two sections.

It is also worth noting that there are some marked differences in the pattern and underlying characteristics of small and large companies. They relate to the risk profiles, underlying fundamentals and market characteristics of small firms. These issues are reviewed in the fourth, fifth and sixth sections.

Time varying performance

The reversal in the fortunes of smaller companies during the period August 1998 to December 1992 and later on from 1995 to the end of 1998 was widespread and dramatic. This was not the first time, however, that smaller companies had gone through a bad spell. Levis (1985) shows noticeable variations in the performance of size decile portfolios during the 1960s and 1970s as well. Such cycles in the size effect are of course not unique to the London market. Reinganum (1992), for example, provides evidence for the period 1926–89 suggesting that the outperformance of smaller firms in the NYSE follow a five-year cycle. He examines the stock returns' behaviour of different size portfolios in period 1926–89 by estimating the autocorrelations of returns over different investment horizons. His results show that, over a one-year horizon, the autocorrelations are positive but not significantly different from zero. The autocorrelations become negative for investment horizons of three-years or longer, peaking in year five. This cyclical pattern of behaviour raises the possibility that the small-firm effect may be driven by economic fundamentals and may be even predictable.

Brown *et al.* (1983) also document considerable variability over time in the performance of small firms. More specifically, it appears that the size effect reverses itself over sustained periods. Fama and French (1988) provide broader and more detailed evidence consistent

Table 1 Autocorrelation of returns

	Return horizon (years)					
	1	2	3	4	5	6
Small	0.217	−0.266	−0.505	−0.573	−0.465	−0.257
	(1.79)	(−1.89)	(−3.89)	(−4.24)	(−1.99)	(−0.68)
Q2	0.098	−0.345	−0.478	−0.510	−0.346	−0.158
	(0.83)	(−2.31)	(−3.65)	(−5.63)	(−2.56)	(−0.73)
Q3	0.085	−0.337	−0.455	−0.475	−0.333	−0.177
	(0.66)	(−2.52)	(−4.14)	(−4.38)	(−2.29)	(−0.95)
Q4	0.002	−0.279	−0.316	−0.344	−0.257	−0.208
	(0.02)	(−2.03)	(−3.32)	(−3.51)	(−1.68)	(−1.08)
Large	−0.067	−0.198	−0.135	−0.174	−0.162	−0.242
	(−0.39)	(−1.49)	(−1.39)	(−2.66)	(−1.11)	(−1.25)
FTA	−0.078	−0.224	−0.101	−0.120	−0.121	−0.261
	(−0.44)	(−1.70)	(−0.91)	(−1.39)	(−0.66)	(−1.06)

Source: Levis and Kalliontzi (1993)

Table 2 Duration of size effect cycles and annualised rates of return for five size portfolios during the cycle

			% Annualised rate of return			
	Months	Cycle	Small	MV2	MV3	Large
May 60–May 62	25	Down	10.5	13.8	12.8	11.5
Jun 62–Mar 64	22	Up	28.6	25.3	17.8	13.0
Apr 64–May 68	50	Down	13.7	14.9	15.1	18.2
Jun 68–Sep 73	64	Up	28.4	20.9	16.9	12.1
Oct 73–Sep 75	24	Down	2.3	−0.8	1.9	9.1
Oct 75–Feb 79	41	Up	54.2	49.6	39.8	28.4
Mar 79–Dec 81	34	Down	19.2	16.5	19.0	20.4
Jan 81–Nov 87	83	Up	40.4	31.0	28.5	26.4
Dec 87–Mar 91	40	Down	2.6	3.8	11.2	17.6

Source: Levis and Kalliontzi (1973)

with the proposition that stock returns are predictable over longer time periods. They test separately various industry returns and size decile portfolios. The estimates for industry portfolios suggest that predictable variation due to mean reversion is about 35 per cent of 3–5-year variances. Returns, however, are more predictable for portfolios of small firms. Predictable variation is estimated to be about 40 per cent of 3–5-year return variances for small-firm portfolios. The equivalent variation falls to around 25 per cent for portfolios of large firms. On the basis of this evidence, they argue that the negative autocorrelations of portfolio returns are largely due to a common macroeconomic phenomenon, and stock returns are related to the business conditions.[9] Poterba and Summers (1988), using an alternative approach that overcomes some of the methodological problems of Fama and French (1988), also find evidence of negative serial correlations over long-term horizons.

To test the mean reversion proposition in the UK context, Table 1 shows slopes in regressions of $r(t,t+12)$ on $r(t-T,i)$ for return horizons from 1 to 6 years, using size quintiles data for the 1956–91 sample period.[10] The slopes are negative for investment horizons of 2–6 years. They peak in the third and fourth year and decline again in years five and six. As in the case of the US, this U-shaped pattern of regression slopes is particularly pronounced for smaller firms' portfolios.

Table 2 provides descriptive statistics of the size premia during the business cycle in the period 1960–91. The first full cycle covers the period May 1960 to March 1964; the second extends from April 1964 to September 1973, the third from October 1973 to February 1979, while the last full cycle, in the period under consideration in this study, covers the period March 1979 to November 1987. Since then, the downward part of a cycle has been witnessed, which ended in March 1991. The length of a full cycle ranges from 47 months (May 1960 through March 1964) to 117 months (March 1979 through November 1987). The upward half-part of a cycle is always longer than its declining counterpart. The average duration of the down cycle is 34 months, while the equivalent length of the up cycle is 52 months. The irregular length of the small-firm cycle does not lend itself to easy forecasts. This table also reports the annualised rates of return for each of the four size portfolios during each half cycle. The results clearly demonstrate that small companies tend to underperform in economic contractions and outperform during periods of economic expansion.

In spite of the persistent evidence of predictability of long horizon returns, the source of this predictability remains a subject of continuous controversy. Some argue that it is due to some form of irrationality (such as fads, speculative bubbles or noise trading) that forces stock prices to deviate temporarily from their fundamental values and generates negatively autocorrelated and, hence, predictable returns. The irrational type of arguments proposed by Shiller (1984), DeBondt and Thaler (1985 and 1987) and Lakonishok *et al.* (1994) can take a variety of different forms. Although a full discussion of this type of research is outside the scope of this paper, it is worth mentioning that the 'noise trading' story may be of some direct relevance to the size effect. It is argued that small companies, being held predominantly by private investors at least in the US, are more prone to sentiment swings than their larger counterparts. Others maintain that it is a consequence of rational time variation in expected returns as business conditions, investment opportunities and risk aversion change through time. The fact that the variation in expected returns is largely common across assets and is related to business conditions in plausible ways, adds credence to the rational type of explanation.

Small companies and macroeconomic conditions

Modern finance theory suggests that prices of financial assets are determined by the expected changes in future cash flows and the discount rate applied to them. Thus, the observed differences in the returns of different size firms should be related to the different reactions of the cash flows and discount rates for such firms to changes in the economic environment. Such disparate reactions to economic conditions are likely to be due to the differences in the underlying fundamental characteristics of small, medium and large firms.

There is a plethora of anecdotal and *ad hoc* statistical evidence that small companies are more sensitive to hikes in interest rates, changes to monetary policy and recessions in general. Jensen *et al.* (1997, 1998), for example, argue that the relationships between stock returns and firm size varies across monetary periods. The premium for small firms is positive and significant in periods when monetary policy is in an expansive mode, but insignificant or negative in cases when policy is restrictive.[11] Anderson (1997) also reports that the size premium is positively related to inflation and the term structure of interest rates, while Speidell and Stone (1997) and Levis and Liodakis (1999) find that changes in industrial production lead to small stock returns in all major capital markets.

Chan *et al.* (1985) argue that returns are different because they have different sensitivities to the risk factors determining asset prices.[12] They show that small firms are more exposed to production risk and changes in the risk premium. The significant coefficient for the risk premium factor suggests that smaller firms are more exposed to economic downturns. Thus, firm size proxies for some unmeasured risks not captured by the conventional risk measures.

He and Ng (1994) examine whether size and BM are proxies for risks associated with the Chen *et al.* (1986) macroeconomic factors or are just measures of a stock's sensitivity to relative distress. They find that the macroeconomic risks related to the CRR factors are not able to explain the role of BM in the cross section of average returns on NYSE, AMEX and NASDAQ stocks. Instead, they find that size, BM and relative distress are related. Moreover, their results imply that BM and size do not capture similar risk characteristics important for pricing stocks.

The above studies assume stationarity both in the time series behaviour of the risk coefficients and the equivalent behaviour of risk premiums. Such tests are usually referred to as unconditional tests of asset pricing models because the moments are considered to be independent of any *ex ante* known information. They are generally more popular because they require rather short testing periods, during which betas and risk premia are considered to be time invariant. But unconditional tests of asset pricing models completely ignore the dynamic behaviour of expected returns, which is somewhat inconsistent with the evidence documenting predictable time-variation in returns.

Conditional asset pricing

More recent research has concentrated on the time-series properties of risk premia rather than long-term averages. Conditional asset pricing models are in fact motivated by the empirical evidence reporting the existence of time-series return predictability and by the belief that investors update their expectations using the latest available information in the market. Using this approach, Ferson and Harvey (1991, 1993) and Ferson and Korajczyk (1994) demonstrate that the time variation in expected returns is mostly attributed to changes in risk premia rather than movements in the betas. By averaging the risk premia over time (as done in the unconditional tests), the properties of their dynamic behaviour are missed. Specifically, in some states of the economy, some factors may be rewarded, whereas they may not be priced in some others. Thus, if the risk premium associated with a certain factor is highly volatile, its average may turn out to be statistically insignificant when, in fact, it may be important to explain the cross section of returns in some states of the economy. For example, Ferson and Harvey (1991), using a version of the Fama and MacBeth (1973) methodology, report that the average market risk premium is not statistically significant in a multibeta model. Using a conditional asset pricing model, however, they find that the expected compensation for the stock market is larger at some times and smaller at other times, depending on the economic conditions. In particular, they show that it varies counter-cyclically. This type of conditional model is better suited for studying the performance of small companies over time.

In sharp contrast to the voluminous research in the USA relating the cross-sectional behaviour of stock returns to the macroeconomy and individual risk characteristics, there is very little work relating to the UK market.[13] In an attempt to account for the differences in risk characteristics between size and value strategies, Levis (1995a) tests a conditional APT model for the period 1970–91 using UK data. Using the standard Fama and McBeth (1973) methodology and 20 market size portfolios, he tests an APT model with the same five macroeconomic factors[14] — market, growth of industrial production, inflation, term structure and default premium — as Chen *et al.* (1985). His results show that the average market betas for small firms are lower than their larger counterparts.[15] The beta coefficients of the other four economic factors are less consistent. Small firms, for example, are more likely to be adversely affected by unexpected increases in inflation and deterioration in credit conditions.

Analysis of the time series pattern of the betas for each of the economic factors suggests large variation for the smallest and largest portfolios and relatively stable exposure coefficients for the intermediate portfolios. It is also worth noting that the market betas of smaller firms have increased consistently since the early 1970s and ended the period considerably higher than those of larger firms; on the contrary the betas of this latter portfolio declined from about 1.1 in the early 1970s to just below 0.9 in 1991. Thus, since the late 1980s betas of smaller firms on the London Exchange appear consistent with the pattern of betas documented in US studies.

Levis (1995a) also documents considerable variability over time in the risk premia for each of the five economic factors. This is particularly pronounced for the market and the growth rate of industrial production premia; they take a wide range of values and can change signs over a relatively short time period. The market risk premium associated with the size procedure increases during economic downturns and peaks near business cycle troughs. This is consistent with the notion that the required rates of return for different types of risk are not constant over time; they vary with economic cycles and certain size companies are more susceptible than others to different types of economic environments.

Risk characteristics of small companies

Although the studies discussed in the previous section suggest that there are risk differences, in terms of exposure to macroeconomic conditions, between small and large companies, they do not suggest why.[16] Smallness by itself does not necessarily imply higher risk, and differences in market capitalisations do not explain why small and large companies have different responses to economic news. Moreover, the traditional beta measure of risk does not appear sufficiently robust to capture the risk exposure of small companies.

Of course the failure to capture the riskiness of the small companies by conventional risk measures could be attributed to some type of beta mis-estimation. Chan and Chen (1988) show that when more accurate estimates of betas are employed, no size-related differences in average returns are observed. In a related paper, Handa *et al.* (1989) argue that the size effect is sensitive to the return measurement intervals used for beta estimation and present results suggesting that it can be explained by betas estimated with annual returns. Of course it may sometimes be possible to devise some type of beta estimate to accommodate the problem in hand but, in general, Jegadeesh (1992) demonstrates that betas do not explain the cross-sectional differences in average returns.

Chan and Chen (1991), in one of the most important contributions to the literature, explore the fundamental risk characteristics of smaller companies. They argue that small firms are marginal firms in the sense that their prices tend to be more sensitive to changes in the economy and are more exposed to adverse economic conditions. More specifically, small firms are more likely to be inefficient producers, to have high financial leverage and limited access to capital markets, particularly at periods of tight credit conditions. As a result of such fundamental differences with larger (healthier) companies, marginal companies react differently to the same piece of macroeconomic news. The evidence in the previous section is consistent with this interpretation. They also provide a battery of tests that are consistent with the broad underlying rationale of their proposition. More specifically they show: First, a total of 66 per cent of the constituents of the bottom size quintile found themselves in this position as a result of dropping from higher size quintiles, suggesting that this grouping contains a large proportion of firms that have not been doing well. The proportion of companies moving up the quintile ladder is relatively small. Secondly, after controlling for differences in industrial classification, the average return to assets of the bottom quantile firms during 1966–84 is about 5 per cent lower than the equivalent return of the firms in the top quartile. (The operating income before depreciation over total assets for quartile 1 is 12.1 per cent, while the equivalent ratio for quartile 5 is 17.8 per cent.) The differences in the average interest expenses over operating income before depreciation ratio are even more striking; the interest expenses of firms in the first quartile amount to 25 per cent of operating income before depreciation, while those of the top quartile firms are only 14.4 per cent. Thirdly, among the firms that have cut their dividends in half or more the year before, 50 per cent are in the bottom size quintile. Fourthly, the probability that a small company is highly leveraged[17] is almost four times higher than that of a large company.

There is only limited research currently available focusing on these types of risk. This is rather unfortunate, since firm mortality, dividend policy and leverage may have a significant impact on expected cash flows and discount rates. There is, however, some evidence that appears to corroborate the results of Chan and Chen (1991). Queen and Roll (1987), for example, show that there is a strong inverse relation between unfavourable mortality and size. About one-quarter of the smallest firms are halted, delisted or suspended from trading within a decade, and about 5 per cent actually meet this fate within a year. In contrast, less than 1 per cent of the largest firms expire from unfavourable causes even over the longest observation period.

A high mortality rate among small firms is also observed in the UK.[18] A firm, of course, may be delisted for different reasons, such as a straight takeover, suspension or liquidation. Figure 2 shows that the probability of such incidents occurring is significantly higher for small to medium-size companies. On the basis of the record during the period 1958–88, companies in deciles 3–6 are more likely to be the

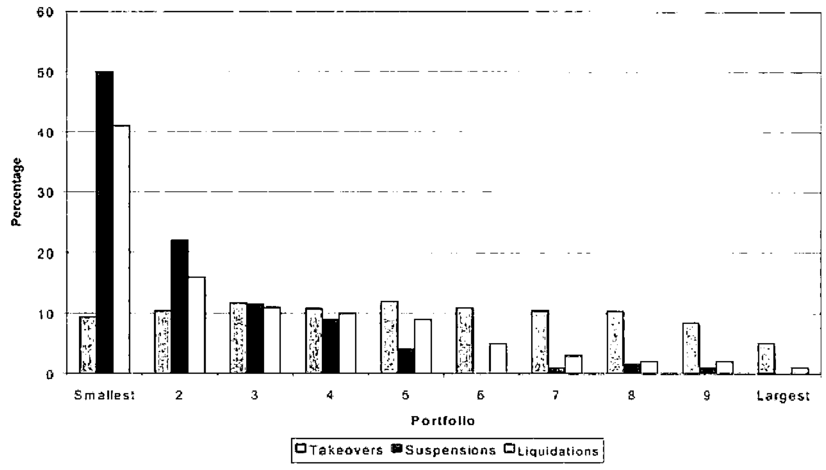

Figure 2 Drop-outs size distribution

targets of takeovers than companies in deciles 9 and 10. During the same period, 95 per cent of the suspended companies belonged to deciles 1–5, with a staggering 50 per cent coming exclusively from the first smallest decile. Liquidations were also heavily concentrated in deciles 1–6 with 45 per cent from the first decile alone. Thus, there is little doubt that smaller companies are more vulnerable than their larger counterparts to some type of event risk.

To access the life-cycle profile of the typical UK small company, Levis (1989b) examines the interquintile movement of quintile size portfolios over a five-year period. Although the analysis has been conducted over a full 10-year period in the 1980s, the basis year 1984 shown in the graph represents a good basis for assessing the life cycle of small companies. During the period 1984–88, the HGSC index outperformed the FTA index by an average of 7.2 per cent per annum. Thus, one would expect to find some substantial upward interquintile movement during this period. In this sense, the results are rather surprising. A remarkable 57 per cent of the smaller companies that started in the smallest quintile in January 1984, excluding those that have dropped out of the sample for various reasons, are still in the same grouping at the end of 1988. Of the total population of companies that started in quintile 4 in January 1984, only 21 per cent moved to the top quintile, while 26 per cent moved down to smaller quintiles. In short, the evidence from the London market is consistent with the proposition that, even at the best of times, the outperformance of small companies is driven by a relatively small number of such companies with exceptional performance. Most of the small cap universe is static and is composed of companies that migrated to this group as a result of past bad performance or are almost permanently stuck in this position following years of indifferent performance.

Table 3 shows three measures of gearing for firms in five market size portfolios: short-term borrowings over assets, long-term borrowings over assets and total borrowing over assets. Short-term borrowings refer to loans

Table 3 Borrowing ratios for five market size portfolios 1971–90

Portfolio	Short loan/total assets	Long loans/total assets	Total loans/total assets
MV1	11.1	4.9	15.9
MV2	10.4	5.8	16.2
MV3	8.5	6.9	15.3
MV4	7.5	9.0	16.4
MV5	6.4	12.5	19.1

Source: Levis and Kalliontzi (1993)

shorter than a year. The data were collected from Datastream, and cover the period 1971–90. The number of firms included in the sample varies from year to year, ranging from 330 in 1971 to 1,232 in 1989. Market size portfolios were constructed in the same way as for rates of return, but they are based on the total number of firms for whom data were available in each of the 20 years. The results reveal significant differences between small and large firms. While all firms appear to use roughly the same amount of total loans as a percentage of their total assets, there are nevertheless significant differences in the composition of these borrowings. Smaller firms rely more on short loans; the average ratio of short loans to assets decreases monotonically with firm size. It starts from 11.1 per cent for MV1 and declines to 6.4 per cent for MV5. In contrast, the ratio of long loans to total assets follows a reverse pattern. The average ratio for MV1 is 4.9 per cent and increases to 12.5 per cent for firms in the largest market size portfolio.

Finally, it is worth mentioning again the liquidity issue that is widely recognised as one of the key impediments to successful small companies' strategies. Liquidity, or the lack of it, is also regarded by the managers of small companies themselves as the key disadvantage for their shares. In a recent survey of 165 companies, 36 per cent cited this as the most detrimental factor to the performance of their shares.[19] Keim (1989) reports that small firms have, on average, 11 times the percentage spread of large firms. The differentials in bid-ask spreads between small and large can be significant, but they are not the only components of the total transaction costs. Bhagat (1993) estimates that the total round-trip trading costs can range from 200 to 300 basis points under normal implementation conditions and could be even higher in the face of unfavourable market impact and/or opportunity costs.[20] These costs detract from overall performance. With an annual turnover of 150 per cent, the performance barrier to simply break even with the passive alternative would be as high as 300 to 450 basis points.

In short, the evidence in both the USA and the UK clearly demonstrates that small companies differ from their larger counterparts in a number of key fundamental characteristics which make them more vulnerable to macroeconomic conditions. The increased riskiness may be reflected directly in their expected earnings or, equally importantly, may affect their valuation by the increased risk premia required for such companies by the investors. The next two sections discuss the earnings record of small companies.

Size and earnings fundamentals

Corporate earnings are normally regarded as a main measure of general

Table 4 Earnings growth profile and PE ratios for size deciles, 1980–89

Market size	% EPS growth	PE ratio	% of total in sample	% in sample with high EPS growth	% in sample with low EPS growth
Small	19.5	13.7	6.3	7.5	5.1
2	14.5	14.4	7.7	7.7	7.6
3	16.0	13.4	8.1	8.7	7.5
4	16.0	13.8	8.9	9.9	8.0
5	14.0	13.9	9.8	10.2	9.4
6	9.4	12.8	10.5	10.3	10.6
7	7.7	12.7	11.8	10.4	13.3
8	7.0	13.4	11.9	11.0	12.8
9	9.4	12.5	12.8	12.8	12.8
Large	5.8	7.5	12.2	11.5	12.9
Market	10.9	12.7	100.0	100.0	100.0

Source: Levis (1991)

macroeconomic activity.[21] They are also essential for most contemporary stock valuation models. There is solid evidence suggesting that over sufficiently long periods, stock performance maps reasonably well on earnings. Easton and Harris (1991) for the USA and Strong (1993) for the UK, among others, show that stock returns are associated with both earnings levels and earnings changes.[22] Probably the most telling evidence is provided by Fama and French (1992, 1993, 1995). Their time-series regressions of annual returns on fundamentals (equity income/book equity, earnings before interest and sales) clearly demonstrate that the size factor in returns is related to the size factor in fundamentals. This is consistent with the hypothesis that the size factor in fundamentals is the source of the size factor in returns.

Ragsdale *et al.* (1993) show that in the period 1975–81 of small-stock market outperformance in the US, the aggregate net income of the small-capitalisation quintile of stocks grew at a compound annual rate of 18.5 per cent, while that of the largest capitalisation quintile grew at only 9.1 per cent. During the 1984–90 period of small-stock market underperformance, the smallest stocks reported negative aggregate net income for the period, while the largest quintile reported positive aggregate net income and grew 4.3 per cent on a compound annual basis. Thus, the reversal of the market performance of small stocks is mapped to the pattern of earnings in the two periods. Ragsdale *et al.* (1993) also show that earnings fundamentals play a significant role in explaining both the strong performance of small stocks during 1974–83 and their underperformance in the 1984–90 period. More specifically, they identified the increased leverage ratio of smaller firms as one of the factors that might have contributed to the shifts of relative earnings performance of small stocks.

The UK evidence on the link between earnings growth, market size and stock valuation remains tenuous. Levis (1991) examines the history of earnings growth for ten market size groups. The results in column 2 of Table 4 show that small companies have outpaced the EPS growth of their larger counterparts by as much as 13 per cent per annum in nominal terms during the period 1980–89. Moreover, the evidence points to a gradual decline in EPS growth as one moves towards the larger size deciles. The remarkable earnings

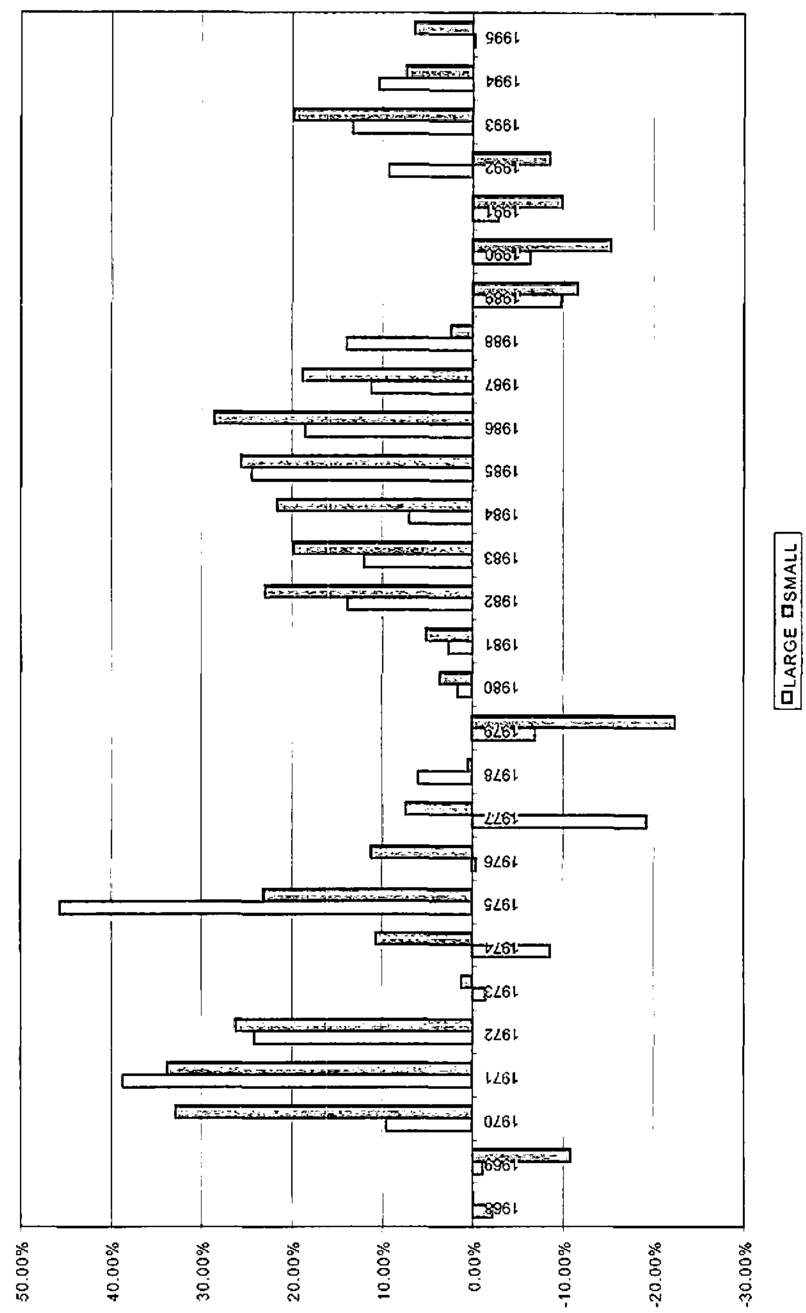

Figure 3 Annual earnings growth by market size 1969–95

outperformance of small firms during this period appears to be reflected in the stock returns. During the 1980s, small and medium-size companies were trading at multiples markedly higher than their very counterparts and still managed to outperform.

Using more recent data, Dimson and Marsh (1999b) show that during the period 1955–88 the average dividend growth of the HGSC index was 1.9 per cent higher than that of non-HGSC companies. The pattern reversed during 1989–97, where the annualised dividend growth for HGSC companies was 3.4 per cent lower than that of their larger counterparts. On the basis of this evidence, they conclude that the reversal of the size effect is linked to the fundamentals. A closer examination of the earnings record of UK firms during the 1990s, however, reveals that the relative earnings growth of small firms was not as disastrous as suggested by their stock returns. Figure 3 shows that small firms suffered negative earnings growth in four consecutive years from 1989 to 1992; at the height of the recession — 1990 and 1991 — large companies have also recorded negative changes in the earnings, albeit somewhat less dramatic than those observed for small firms. What is even more interesting, and to a certain extent puzzling, is the earnings behaviour of small companies in the following three years, 1993–95. With the exception of 1994, the earnings growth of small firms was better than that of large firms. The superiority in earnings growth ranges from about 9 per cent in 1993 to a solid 6 per cent in 1995. Thus it appears that in recent years the UK market experienced a remarkable decoupling between fundamentals and stock returns performance. A similar type of pattern has also emerged in the US. While earnings growth in the Russell 2000 index was almost twice as large as the equivalent growth for the S&P 500 in the first two quarters of 1998, the price performance gap continued to move against small caps.

Taking a long-term perspective, Fama and French (1995) show that, after controlling for BM differences, small firms tend to have lower earnings on book equity than large firms. The size effect in earnings is, however, largely due to the low profits of small stocks after 1980. In contrast to the UK evidence, profitability in the US shows little relation to size before 1981. It appears that the recession in the US in 1981 and 1982 turned to a prolonged depression for small stocks. They observe, however, that 'for some reason, which remains unexplained, small stocks do not participate in the boom of the middle and late 1980s' (p. 132).

In spite of the overall superior earnings growth by small firms in the 1980s, documented in Table 6, however, it is important to note that the proportion of smaller/larger companies with above/below median growth is not markedly different from their proportional representations in the sample. In other words, the high annual average EPS growth of small companies appears to be predominantly due to the very fast growth of some companies in these groups rather than to the universal faster growth record of such companies. Moreover, low growth does not appear to be a unique, across the board, characteristic of large companies. While, for example, the very large companies accounted for 12.2 per cent of the population in the sample, the high EPS growth group contained not less than 11.5 per cent of these companies.

Table 5 sheds some further light into this issue. The standard deviation of earnings growth within the first five size deciles is almost twice as large as the

Table 5 Average EPS growth and within group standard deviation (SD) of EPS growth

	1980–82		1982–84		1984–86		1986–88		1987–89	
	Growth	SD	Growth	SD	Growth	SD	Growth	SD	Growth	SD
Small	2.7	1.17	29.8	1.53	15.7	0.83	24.5	1.24	21.0	1.39
2	6.7	1.19	10.4	1.04	20.6	1.46	26.6	1.46	21.7	1.35
3	3.0	1.00	15.6	1.13	19.1	1.19	25.4	1.12	20.3	1.07
4	−3.5	0.77	15.8	0.94	20.3	0.94	16.4	0.93	21.1	1.04
5	0.1	1.00	9.6	0.89	21.4	1.23	16.7	1.12	19.0	1.15
6	−0.7	0.82	12.7	0.98	9.5	0.70	18.5	1.08	20.5	1.18
7	−3.9	0.59	9.9	0.87	11.9	1.04	19.1	1.15	17.7	0.96
8	−4.4	0.58	6.8	0.86	12.1	0.83	7.4	0.79	7.5	0.77
9	−2.1	0.65	10.2	0.77	10.6	0.73	9.3	0.78	13.5	0.83
Large	−2.2	0.64	6.8	0.65	6.0	0.63	9.1	0.66	11.4	0.74

Source: Levis (1991)

volatility of large companies. It is this particular aspect of risk that is of more concern to investors than volatility in prices. It means the fundamental performance of smaller companies, as a group, is much more difficult to assess and predict than that of large companies. It appears that sometime in 1988 the market suddenly realised that smaller companies could not any more match their past earnings growth; thus it became apparent that their PE ratings were out of step with future prospects. The unavoidable correction was already well under way. Table 5, for example, shows a jump in the earnings volatility and a significant narrowing of the gap in earnings growth between small and large companies during the period 1987–89. Bank of England (1991) reports that large companies were the sole group to experience operating profits growing faster in 1989 than in 1988. This group also saw the most rapid growth in overseas sales. Income gearing rose rapidly for all three groups; for the smallest, this is most likely to have reflected their relative dependence on bank finance combined with some distress borrowing.

The volatile nature of small firms' earnings is another key ingredient in understanding the differences in market performance across different-size firms. We know that there is a significant, albeit modest, association between earnings and stock returns during the same time period, but this says very little about the relation between current earnings and future returns. On the other hand, Ou and Penman (1989) show that financial statement information, applied mechanically across companies can be used to predict subsequent-year earnings changes and systematically earn abnormal investment returns. Thus, the relation between current earnings and future returns may differ across different-size firms depending on how predictable future earnings are.

Ettredge and Fuller (1991) show that a larger number of small firms report negative earnings over any single period; but firms with negative earnings in any one year appear to perform much better in the following year than firms with positive earnings. Firms with negative earnings have better risk-adjusted returns in the following year. They argue that the market appears excessively to discount stocks of firms reporting losses and subsequently corrects for this over-reaction. Alternatively, it might be that the market systematically underestimates subsequent earnings recoveries by firms reporting losses.

The differential performance of small firms is sometimes perceived as being

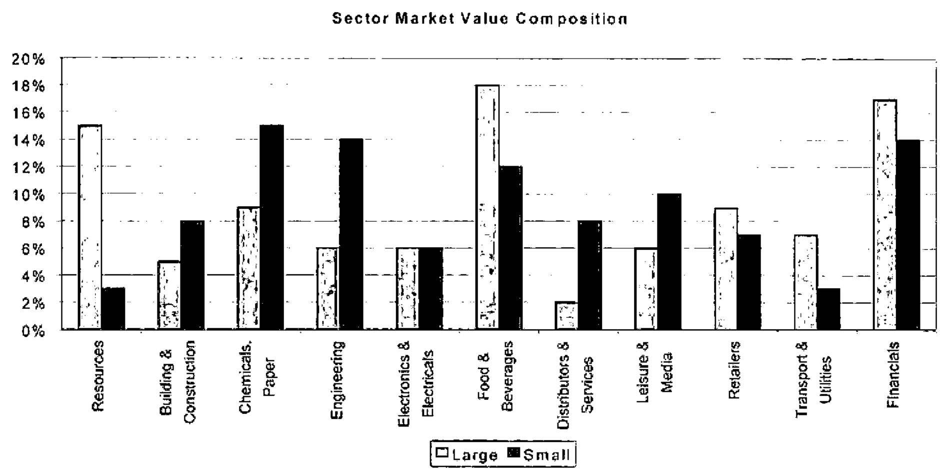

Figure 4 Sector market value composition of large vs small companies (average 1968–97)

linked to the fortunes of certain industries at certain points in time. The argument is based on the fact that small and large firms are not evenly distributed across all industrial sectors. Figure 4 shows the sector market value composition of large and small firms and provides considerable support for this view. In five out of the 11 industrial sectors — building and construction, chemicals, paper and packaging, engineering, distributors and services, and leisure and media — small firms account for a higher proportion of the sector in terms of market capitalisation; in contrast, resources, food and beverages, transport and utilities and financials are dominated by large firms.

Although the uneven distribution of large and small companies may result in sector-related performance differences, the evidence provides very limited support towards this argument. Figure 5, panels A–D, show the performance of small and large companies for 11 industrial sectors for the 30-year period 1968–97 and three 10-year sub-periods. Although there are some differences in the performance of individual sectors in the two 10-year periods of 1968–77 and 1978–87, the size effect is certainly not driven by a single industrial sector. Smaller firms appear to have outperformed their larger counterparts in almost every single sector. In a similar vein, the dramatic underperformance of smaller firms during 1988–97 is widespread across all industries. In some industrial sectors, such as resources, building and construction, chemicals and paper, and retailers, smaller firms suffered an absolute decline in market values. At the same time, it is worth noting that the strong market performance of the FTSE 100 index is to a certain extent driven by the strong performance of utilities and financials, both sectors heavily populated by larger companies. Thus, it is evident that size rather than industry is the key factor in determining market performance.[23] From the perspective of the practising fund manager, this evidence suggests that a small cap strategy based on sector plays is likely to be only of limited value. The size effect is somewhat linked to the industrial performance but it is not determined by it.

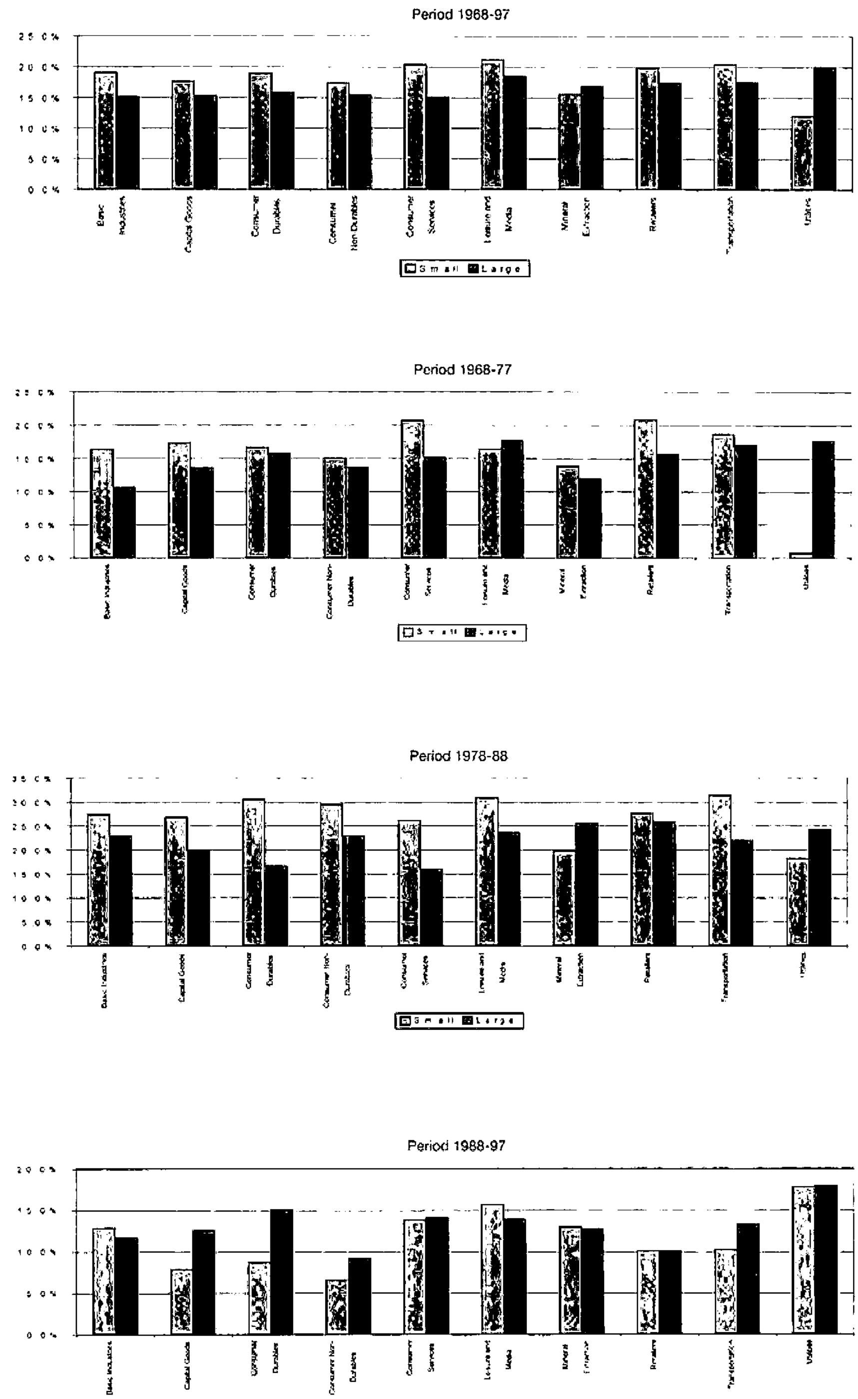

Figure 5 Average returns by industrial sector

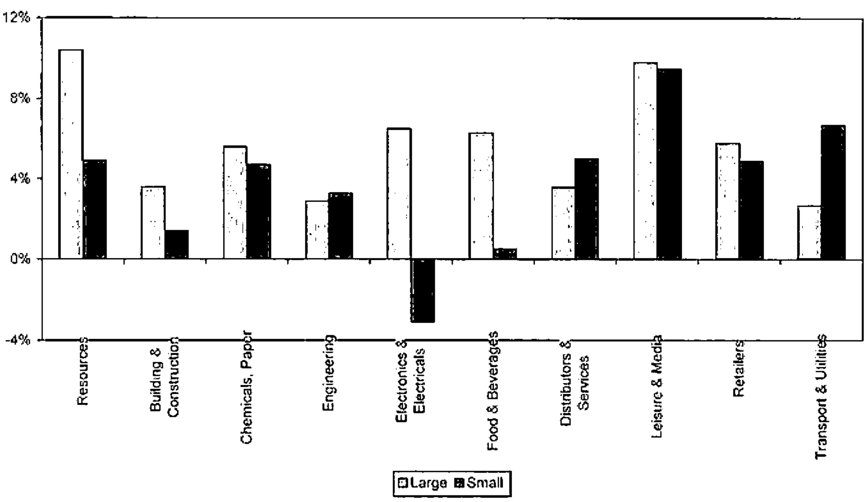

Figure 6 EPS growth by industrial sector (annual average for the period 1968–97)

Figure 6 shows the average annual earnings growth for the 30-year period 1968–97 for the same industries, except for financials, as in Figure 8. Although it is difficult to draw any firm conclusions about the association between earnings and market performance from a visual inspection of the two figures, there appears to be a broad consistency between the two sets of data. It is reassuring, for example, to observe that large companies across almost all industries performed better than smaller ones both in terms of stock price and earnings growth. The notable exception is the case of distributors and services where small companies are superior on both counts. The leisure and media sector is also an interesting example, as it exhibits some of the strongest performances both in price and earnings terms. Of course identifying a broad historical consistency between earnings and prices across large and small firms does not answer the fundamental question concerning the disparity in market performance between the two size groups. Taking this evidence together with our clues on the risk characteristics of small companies and their association with economic conditions, however, leads one to believe that the solution to our puzzle lies in the market's expectations about the path of future earnings.

Earnings forecasts

The mere existence of strong average earnings growth rates in the 1980s and the sluggish earnings performance of small companies in the 1990s is not, in itself, sufficient to explain their corresponding stock market performances in the two decades. First, we saw that, in spite of the lower average earnings growth by the small companies in the 1990s, their year-on-year growth after 1993 outpaced the equivalent growth of large firms. Secondly, earnings growth on its own does not convey the full picture about the true profitability of a company. Return on equity (ROE) is often an equally if not more important component of value.[24] Thirdly, the dramatic and persistent underperformance of small firms in the late 1980s and early 1990s indicates that the deterioration of earnings must have taken the market by surprise. Earnings growth forecasts, for example, may be biased if analysts fail to incorporate all available information. Anomalous behaviour in earnings forecasts may be associated with anomalous behaviour by market participants in price formation. Even when the available forecasts are efficient, however, the market may be slow or completely fail to incorporate such information into their pricing process.

The evidence of inefficient upwardly biased earnings forecasts, across the whole spectrum of stocks, is now well established.[25] In fact, Dreman and Berry (1995) argue, on the basis of their study of analysts' forecasts for US stocks from 1972 through 1991, that only 'a minority of estimates fall within a range around reported earnings considered acceptable to many professional investors' (p. 30). There is, however, a controversy as to whether analysts under-react or over-react to available information. While, Abarbanell (1991), Abarbanell and Bernard (1992) and Ali *et al.* (1992) report that analysts systematically under-react to new information, DeBondt and Thaler (1990) maintain that analysts systematically over-react. Easterwood and Nutt (1999) provide evidence that appears consistent with both views. They report that analysts systematically react to information in an optimistic manner by under-reacting to negative information and over-reacting to positive news. A third view that is attracting considerable attention maintains that analysts and investors simply observe abnormal earnings and price performance over a relatively short time period and extrapolate these trends to the future.[26]

The apparent differences in the quality of forecasts across different types of firms may have an impact on their valuation. If forecasts for small companies, for example, are less efficient than those associated with large companies, as the evidence tends to suggest, then at least some of the variability in the size effect may be linked to the pattern of these forecasts. In an early study, for example, Givoly and Lakonishok (1984) examine the actual and forecasted earnings of small firms for the 20-year period from 1963 to 1981. They demonstrate that growth of economic fundamentals is inversely related to size, and this relationship is almost monotonic. They document significant differences between large and small firms for a variety of growth measures such as gross margin, net operating income, sales etc. They conclude that the size effect in the USA before 1983 is due to the understatement of the economic growth of such firms.

Earnings of smaller firms may be under/over-estimated because information on small firms is scarce as a result of their shorter histories and/or of their limited analysts' following.[27] This of course is not surprising. Not only are there potentially greater financial gains for investors in the identification of mispriced securities for large firms, but there are also greater economic incentives for analysts' following of large firms. In any case, the end result is that analysts' earnings forecasts for small firms are generally inferior to those produced for large firms. Elgers and Murray (1992), using I/B/E/S consensus financial analyst forecasts and forecasts based upon the anticipatory behaviour of security prices, show that firm size is positively associated with earnings forecasting accuracy. Moreover, Brown *et al.* (1987) find that forecasts based on time series models may be more efficient for small companies than analysts' forecasts.[28] This may be regarded as an opportunity for some active and skilled managers[29] because of its possible implications for the pricing of such stocks. An analysis by Arbel and Strebel (1982) suggests that, over a 10-year period, the shares of those firms neglected by institutions outperform significantly the shares of firms widely held by institutions. This superior performance persists over and above any small-firm effect. This had led to the widespread belief that the size effect is more likely a 'neglect' effect.

We know that the release of interim and annual earnings is associated with both increased trading volume and increased stock return variability. Forthcoming earnings announcements stimulate private information acquisition by investors in the period prior to announcement. In addition, there is an increase in public available information prior to anticipated announcements. Both private and public information are expected to increase in the pre-announcement period. Freeman (1987) shows that the level of pre-disclosure information available for a firm increases with firm size. More recently, Byard (1998) finds that the average quality of both public and private information increases during the 30 days prior to annual earnings announcement. Firm size is found to have little or no impact upon the average quality of public information available to analysts. The average quality of the private information acquired by analysts is, however, found to be increasing with size, which is consistent with size-related incentives for analysts to engage in private information acquisition.

A variation of this 'neglect' effect is also reported in the early study of Foster *et al.* (1984). They show that small firms are likely to react more negatively (positively) to negative (positive) earnings forecasts[30] in the two days surrounding the announcement. The return differentials between small and large firms are quite marked; while the cumulative abnormal return in the two days around a negative forecast error is only −0.81 per cent for large firms, it rises to −1.83 per cent for the smallest size decile portfolio. The corresponding price reaction differential to positive forecast errors is even more pronounced — a positive 0.5 per cent for large firms against 2.58 per cent for the small firms. The equivalent stock returns around a longer window of 60 days around the announcement provide even further support to the apparent over-reaction of small firms to unexpected earnings announcements. Similar results are reported by Bernard and Thomas (1990) as well. They find that the failure of stock prices to reflect fully the implications of current earnings for future earnings is significantly more pronounced for small companies. Given that there are no significant differences in the predictability of future earnings from a series of historical earnings between large and small firms, the evidence suggests some pattern of excessive over-reaction to earnings announcements of small firms.

Mott and Coker (1993) provide further and more detailed evidence on the asymmetric response between small and large companies earnings' surprises. They show that small cap stocks over the period 1988–93 reported fewer positive surprises than negative ones in any given quarter. An average 19.8 per cent of the companies reported positive surprises over the period, whereas 25.6 per cent of the companies posted earnings disappointments. Furthermore, they show that, on average, a positive surprise results in an increase in stock prices of 2.1 per cent relative to Russell 2000 in the first month after reporting earnings; this figure rises to 12.9 per cent over the ensuing 12 months. In contrast, negative surprises underperform both the universe and the market across all periods. Overall, negative surprises fall 0.9 per cent relative to the Russell 2000 in the

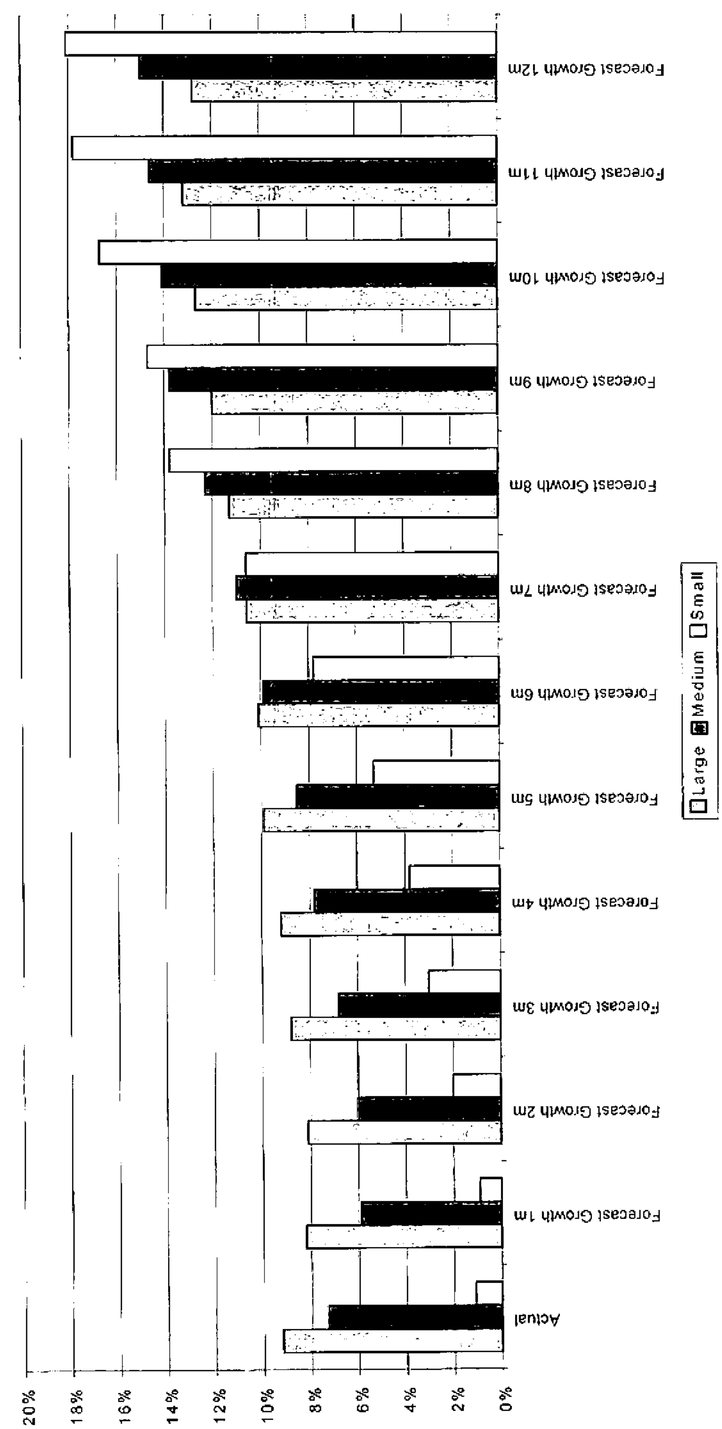

Figure 7 Actual and forecast earnings growth by size 1988–97

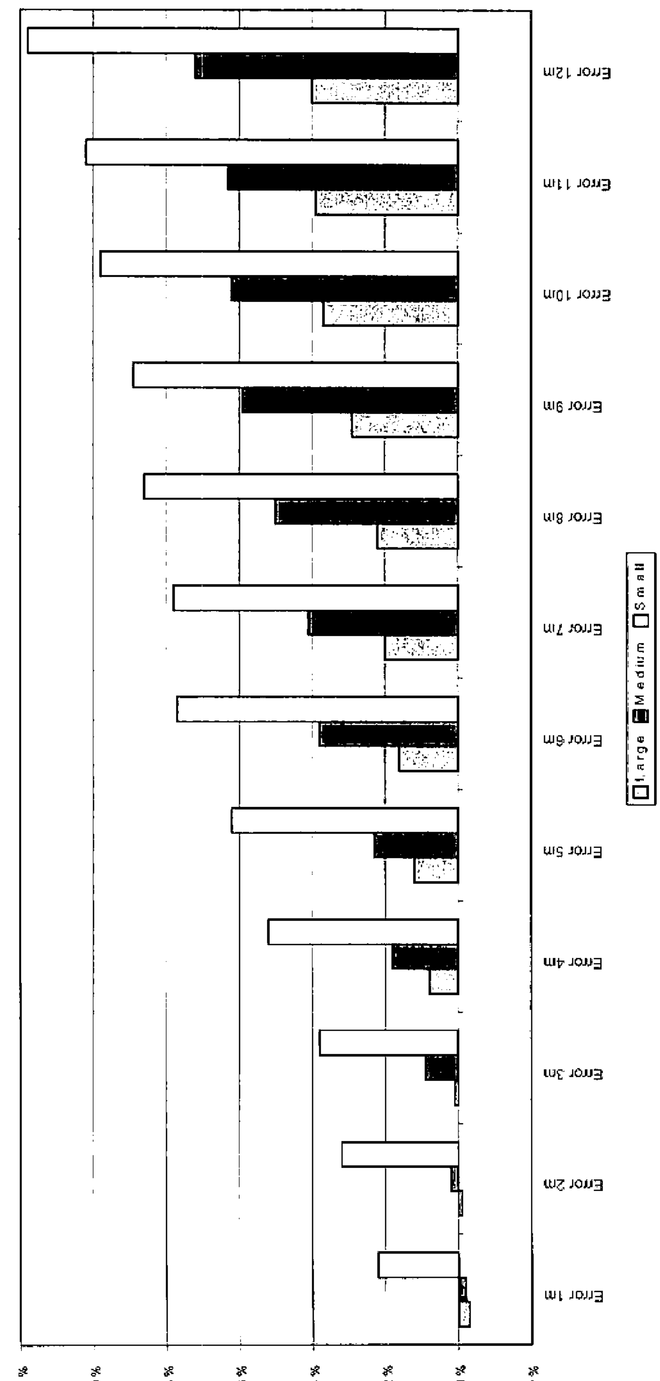

Figure 8 Forecast errors by size 1988–1997

Table 6 One year buy and hold returns for size portfolios with positive and negative surprises (1987–97)

	Small		Large	
	Positive (%)	Negative (%)	Positive (%)	Negative (%)
1987	−1.41	−8.09	−8.47	−17.88
1988	23.33	3.48	23.67	10.89
1989	−3.38	−17.61	10.67	−3.20
1990	12.41	−9.65	7.59	−2.39
1991	41.65	3.77	19.74	2.23
1992	43.26	22.56	22.89	16.27
1993	35.92	9.01	13.21	3.42
1994	13.19	−7.26	12.67	8.98
1995	39.79	15.61	29.18	6.77
1996	9.81	−14.36	14.33	−2.12
Average	21.46	−0.25	14.55	2.30

Source: Levis and Liodakis (1999)

first month after reporting earnings, with the relative decline falling to 3.5 per cent at the end of a 12-month period.

A number of UK studies, such as Patz (1989), Capstaff *et al.* (1995), Hussain (1998) and Levis and Liodakis (2001) also suggest that, at a given horizon, analysts' forecasts for large firms are superior to those of small firms. More specifically, Capstaff *et al.* (1995) find that UK analysts, like their US counterparts, generally over-react to earnings-related news across the whole market size spectrum. This tendency, however, is more pronounced for small companies. Analysts' forecasts of smaller firms appear to impound even less earnings related information and are generally more over-optimistic and overstated than equivalent forecasts for large firms. Unfortunately the extent of the differences in the forecast bias and efficiency for small firms is not known as this study does not provide detailed statistical evidence on this issue. It is not also clear whether the biases in small companies forecasts are consistent across different forecast horizons. Moreover, the Capstaff *et al.* (1995) study is based on the period February 1987 to December 1990. This is a period with relatively narrow coverage for UK small companies in the I/B/E/S universe and it spans over August 1988, the month that has been identified as the turning point for the performance of small companies in UK.

The preliminary investigation on analyst forecasts is based on a longer time period — January 1987 to March 1998 — and covers the entire universe of I/B/E/S forecasts for UK companies, ie an average of about 1,300 companies per year. The evidence provides some relevant insights to the small companies performance record in recent years.

Figures 7 and 8 show that analysts' forecasts in general are optimistic and inefficient; this is particularly pronounced for longer (6–12 months) investment horizons. In fact, for shorter investment horizons, analysts' forecasts for large companies appear to be pessimistic.

The extent of the over-optimism varies across the 10-year period of the analysis. The bias in forecasts is particularly pronounced during the recession in the early 1990s, suggesting that analysts were rather slow to grasp the implications of the economic downturn for corporate profitability.

Analyst forecasts are particularly biased for small companies in general and during the recession period in particular. The

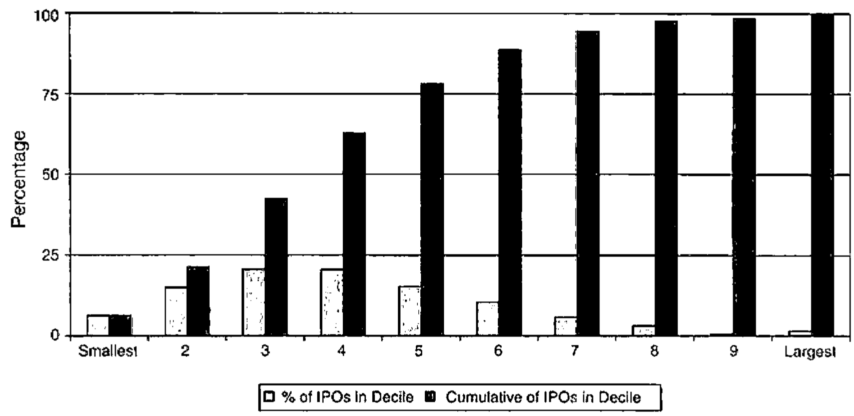

Figure 9 Size of IPOs

evidence suggests a monumental failure by analysts to adjust their expectations for small companies at the end of the 1980s and beginning of the 1990s.

There are significant differences in error forecasts across different industries. It is interesting to note that the largest forecast errors are found in technology stocks, health and household products, while the lowest are in financials and utilities. The mapping of industry loading across small and large stocks and forecast errors is pointing to an obvious pattern, but further analysis is necessary before drawing any definite conclusions.

Table 6 shows that the impact of earnings surprises, both positive and negative, on subsequent stock prices is markedly larger for small companies. The sharp reversal in the small firms performance in 1989 and 1990 are directly related to the huge negative earnings surprises observed for this group of companies at the time.[31]

Support for the over-reaction argument is offered from a surprisingly different stream of literature as well. A number of studies[32] in the USA and UK document significant long-run market and operating underperformance for initial public offerings (IPOs) and seasoned equity offerings. IPOs in the UK, for example, appear to underperform seasoned firms by an average of about 12 per cent in the three years following their initial listing. Figure 9 shows that, during the period 1980–88, about 98 per cent of the IPOs belonged to the first nine size deciles at the time of their listing. Although it may be tempting to infer an association between long-run underperformance of IPOs and small cap underperformance, it is worth bearing in mind that the period 1980–88 was overall a period of good performance for small companies. There is another important piece of evidence, however, that appears to be relevant. In the four-year period 1985–88, there was an unprecedented growth in IPO activity in the London market; a total of 477 new issues were listed in the Main and now defunct Unlisted Securities Markets. In the same four-year period, the London market also experienced a burst of seasoned equity offerings.[33] Levis (1995b) reports a record number of 823 seasoned equity offerings during this period. Thus, it appears that in the three years leading to turning point for the performance of small companies the London market was enduring a glut of equity issuing activity involving a disproportional number of small to medium-size firms.

The reversal of the size effect is not due to the long-run underperformance of IPO and SEOs. Nevertheless, it is worth noting that Loughran (1993) finds that of the 5.7 per cent difference in returns between NYSE and NASDAQ stocks in the first five deciles (based on NYSE ranking), 60 per cent is due to the poor (long-run) performance of IPOs on NASDAQ. A difference of 2.3 per cent remains after purging NASDAQ returns of an IPO effect; IPOs are much more heavily concentrated on NASDAQ than on NYSE. The link between the size effect and issuing activity lies in the earnings forecasts for IPOs.

In their study of earnings forecasts for IPOs and their relation to long-run performance, Rajan and Servaes (1997) show that analysts are excessively over-optimistic about the earnings and growth performance of IPOs; this over-optimism is not just a reflection of a positive sentiment sweeping across the whole market. Moreover, firms with the highest growth projections at the time of the IPO substantially underperform various benchmarks, whereas firms with the lowest growth projections outperform these benchmarks. The difference in returns between the two extreme quartiles, in terms of growth projections, is more than 100 per cent. Rajan and Servaes (1997) argue that this evidence 'indicates that investors appear to believe the inflated long-term growth' (p. 509). Loughran and Ritter (1995) and Levis and Michailides (2001) for the UK also argue that firms take advantage of such 'windows of opportunity' to issue stock, while Lerner (1994) demonstrates similar patterns for privately held venture-backed biotechnology firms. The high expectations for future earnings growth appears to be fuelled by strong pre-listing performances of these companies. Jain and Kini (1994) analyse the earnings performance of IPO firms. They show that these firms perform very well prior to the IPO, but very poorly afterwards.

In short, there are some good grounds for believing that the reversal of the size effect is related to the issuing activity. If new companies are searching for windows of opportunity to come to the market, their valuations are likely to be optimistic at the time of the flotation and are adjusted downwards when their true potential becomes better understood. The tendency of IPOs and SEOs to populate the small size groupings, stacks heavy odds against the long-term performance of these companies.

Conclusions

The long history of strong outperformance by small cap stocks in the UK ended in the late 1980s. Since then, their average performance has lagged significantly behind their largest counterparts. The size effect is not entirely independent of other firm characteristics such as price-earnings rating, book-to-price ratio and price. It goes through long cycles, which broadly correspond to the general economic cycles, but this cyclical pattern of the size effect was broken in recent years. Tests of conditional asset-pricing models suggest that small firms have different sensitivities to the risk factors determining stock prices. Small firms, for example, are more likely to be adversely affected by unexpected increases in inflation and deterioration in credit conditions. Thus, conventional risk measures (betas) fail to reflect the inherent risks of small firms. Such firms are, however, riskier in terms of higher mortality, lower liquidity, higher short-term borrowings and higher volatility of earnings.

The positive size effect in the 1980s is associated with strong underlying growth in the corresponding earnings of small firms. Although the average earnings growth performance of small firms remained quite robust in the second part of the 1990s, their intra-group volatility increased markedly. The earnings growth of the small cap sector appears to be driven by a relatively small number of companies in this sector. Although there are some differences in market and earnings growth performance across different sectors, the apparent size effect cannot be accounted for by sectoral differences. The analysts' earnings forecasts for small firms are consistently more optimistic than equivalent forecasts for large firms.

The reversal of the size effect may also be associated with large volumes of equity issuing activity. Large volumes of equity issuance activity are associated with high initial prices resulting from over-optimistic prices. Price over-optimism is associated with subsequent long-term underperformance.

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Notes

1 Size interactions with other portfolio formation procedures such as price-earnings ratio, dividend yield and price. For UK evidence on these issues see Levis (1989a).
2 See, for example, Fouse (1989).
3 For a review of the evidence and explanations see Jacobs and Levy (1989), Dimson and Marsh (1989), Dimson and Marsh (1999a) and Hawawini and Keim (1999).
4 See for example, Clive Wolman, 'Thinking Small Can Bring Big Benefits', *Financial Times*, 22nd June, 1985, and Barbara Elis, 'When It Pays to Think Small', *Guardian*, 7th June, 1986.
5 Extel Small Companies Sector Survey 1998.
6 Almost identical results are obtained for the NASDAQ market on its own.
7 See Levis and Steliaros (1999).
8 Speidell and Graves (1998) report a similar pattern of underperformance for small firms across other European and emerging equity markets in recent years.
9 It should be noted that the Fama and French (1988) approach suffers from various econometric problems. The most obvious one arises from the use of overlapping observations in their regressions, which ultimately results in biased regression coefficients. Although they attempt to correct this bias by using a Monte Carlo approach, it is difficult to ascertain to what extent their results are biased owing to the autocorrelation of overlapping returns. Similar results are obtained, however, by Campell *et al.* (1997) using variance ratio tests.
10 The results are based on Levis and Kalliontzi (1993).
11 They classify a restrictive policy environment as a period of increases in Fed discount rates and an expansive one as a period of declines in discount rates.
12 Their approach is based on the standard arbitrage model developed by Chen *et al.* (1983).
13 Taylor and Poon (1991) and Clare and Thomas (1994) are the two known exceptions of unconditional factor models for the UK. Their results are rather ambivalent owing to short time periods and limited data sets.
14 In the absence of a precise asset pricing theory, a number of other economic variables were also tested; they include changes in the exchange rate, monthly changes in retail sales and the CBI confidence indicator.
15 Similar results are documented by Levis (1985), Corhay *et al.* (1987) and Strong (1996).
16 Berk (1995b) argues that the negative relation between market value and return stems directly from the theoretical inverse relation between market value and risk. Accordingly, the size effect should not be regarded as an anomaly.
17 Chan and Chen (1991) define leverage as the ratio of the sum of the book value of current liabilities, long-term debt and preferred stock over the market value of equity as of the end of the previous year.
18 See, for example, Levis (1989b).
19 Extel Small Companies Sector Survey 1998.
20 Market impact is the price dislocation caused by demand for liquidity beyond the size prevailing at the current bid and offered prices. Opportunity costs refer to the costs of unexecuted trades represented by unused cash.
21 Lucas (1977) considers the cyclicality of corporate earnings as one of the seven main features of macroeconomic fluctuations.
22 Although earnings play a key role in understanding the cross-sectional behaviour of stock returns, Lev (1989) argues that they explain only a small percentage (less than 10 per cent) of the contemporaneous change in stock prices.
23 Levis (1987), for example, demonstrates that size is not a determining factor in Investment Trusts performance during the period 1957–80.
24 Bryan *et al.* (1998), on the basis of their analysis of

100 international firms, argue that market-to-book ratios are related more directly to returns on book equity than earnings growth
25 See, for example, Fried and Givoly (1982) and Brous (1992).
26 See Lakonishok *et al.* (1994) and La Porta (1996).
27 See Barry and Brown (1984).
28 For evidence on the superiority of analysts' forecasts over time series forecasts see Brown *et al.* (1987) and Kross *et al.* (1990).
29 According to *The Economist* (1998), fund managers such as Scroders and Fidelity consider smaller companies as 'their most promising hunting ground' (12th December, p. 109).
30 Foster *et al.* (1984) define unexpected earnings (forecast error) using a time series model based on historical earnings rather than analysts' forecasts.
31 See Levis and Liodakis (1999).
32 See, for example, Levis (1993, 1995a), Levis and Gerbich (1999) and Levis and Thomas (1995) for the UK, and Ritter (1991) and Loughran and Ritter (1995, 1997) for the US.
33 See Ritter (1984) for a graphical illustration of 'hot issue' markets.

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Equity and the small-stock effect
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Financial News

By Michael Annin

Equity and the Small-Stock Effect

The capital asset pricing model shows risk inherent in return on equity. But something goes wrong when it's used for small-sized companies.

Does the size of a company affect the rate of return it should earn? If smaller companies should earn a higher return than larger firms, then small utilities, because of their size, should be allowed to adjust the rates they charge to customers.

By far the most notable and well-documented apparent anomaly in the stock market is the effect of company size on equity returns. The first study focusing on the impact that company size exerts on security returns was performed by Rolf W. Banz. Banz sorted New York Stock Exchange (NYSE) stocks into quintiles based on their market capitalization (price per share times number of shares outstanding), and calculated total returns for a value-weighted portfolio of the stocks in each quintile. His results indicate that returns for companies from the smallest quintile surpassed all other quintiles, as well as the Standard & Poor's 500 and other large stock indices. A number of other researchers have replicated Banz's work in other countries; nevertheless, a consensus has not yet been formed on why small stocks behave as they do.

One explanation for the higher returns is the lack of information on small companies. Investors must search more diligently for data. For small utilities, investors face additional obstacles, such as a smaller customer base, limited financial resources, and a lack of diversification across customers, energy sources, and geography. These obstacles imply a higher investor return.

The Flaw in CAPM

One of the more common cost of equity models used in practice today is the capital asset pricing model (CAPM). The CAPM describes the expected return on any company's stock as proportional to the amount of systematic risk an investor assumes. The traditional CAPM formula can be stated as:

$$R_s = [\beta_s \, x \, RP] + R_f$$

where:

R_s = expected return or cost of equity on the stock of company "s"

β = the *beta* of the stock of company "s"

RP = the expected equity risk premium

R_f = expected return on a riskless asset.

Table 1: The Size Premium in CAPM
(By Decile Portfolio in NYSE, 1926-94)

Decile	*Beta*	Arithmetic Mean Return	Actual Return in Excess of Riskless Rate**	CAPM Return in Excess of Riskless Rate**	Size Premium (Return in Excess CAPM)
1	0.90	11.01%	5.88%	6.33%	-0.44%
2	1.04	13.09	7.97	7.34	0.63
3	1.09	13.83	8.71	7.70	1.01
4	1.13	14.44	9.32	7.98	1.33
5	1.17	15.50	10.38	8.22	2.16
6	1.19	15.45	10.33	8.38	1.95
7	1.24	15.92	10.79	8.75	2.05
8	1.29	16.84	11.72	9.05	2.67
9	1.36	17.83	12.71	9.57	3.14
10	1.47	21.98	16.86	10.33	6.53

**Betas* are estimated from monthly returns in excess of the 20-year government bond income return, January 1926-December 1994.
**Historical riskless rate measured by the 69-year arithmetic mean income return component of 20-year government bonds.
Source: SBBI 1995 Yearbook

Table 2: CAPM vs. CAPM w/ Size Premium

(By Percentile for Electric, Gas, and Sanitary Services Utilities)

	CAPM	CAPM with Size Premium
90th Percentile	16.42%	18.92%
75th Percentile	12.56%	14.72%
Median	10.89%	12.58%
25th Percentile	9.86%	11.39%
10th Percentile	8.63%	10.65%

(Weighted by Market Capitalization)

	CAPM	CAPM with Size Premium
Industry Composite	11.76%	12.33%
Large Company Composite	12.05%	12.07%
Small Company Composite	13.93%	17.95%

Source: Cost of Capital Quarterly '95 Yearbook by Ibbotson Associates
Note: Public utilities include electric, gas, and sanitary services companies.

Table 1 shows *beta* and risk premiums over the past 69 years for each decile of the NYSE. It shows that a hypothetical risk premium calculated under the CAPM fails to match the actual risk premium, shown by actual market returns. The shortfall in the CAPM return rises as company size decreases, suggesting a need to revise the CAPM.

The risk premium component in the actual returns (realized equity risk premium) is the return that compensates investors for taking on risk equal to the risk of the market as a whole (estimated by the 69-year arithmetic mean return on large company stocks, 12.2 percent, less the historical riskless rate). The risk premium in the CAPM returns is *beta* multiplied by the realized equity risk premium.

The smaller deciles show returns not fully explainable by the CAPM. The difference in risk premiums (realized versus CAPM) grows larger as one moves from the largest companies in decile 1 to the smallest in decile 10. The difference is especially pronounced for deciles 9 and 10, which contain the smallest companies.

Based on this analysis, we modify the CAPM formula to include a small-stock premium. The modified CAPM formula can be stated as follows:

$$R_s = [\beta_s \times RP] + R_f + SP$$

where:

SP = small-stock premium.

Because the small-stock premium can be identified by company size, the appropriate premium to add for any particular company will depend on its equity capitalization. For instance, a utility with a market capitalization of $1 billion would require a small capitalization adjustment of approximately 1.3 percent over the traditional CAPM; at $400 million, approximately 2.1 percent, and at only $100 million, approximately 4 percent.

Again, these additions to the traditional CAPM represent an adjustment over and above any increase already provided to these smaller companies by having higher *betas*.

Implications for Smaller Utilities

These findings carry important ramifications for relatively small public utilities. Boosting the traditional CAPM return by a full 400 basis points for small utilities translates into a substantial premium over larger utilities.

Table 2 shows the results of an analysis of 202 utility companies that calculated cost of equity figures. Composites (arithmetic means) weighted by equity capitalization were also calculated for the largest and smallest 20 companies. The results show the impact size has on cost of equity.

For the traditional CAPM, the large-company composite shows a cost of equity of 12.05 percent; the small company composite, 13.93 percent. However, once the respective small capitalization premium is added in, the spread increases dramatically, to 12.07 and 17.95 percent, respectively. Clearly, the smaller the utility (in terms of equity capitalization), the larger the impact that size exerts on the expected return of that security. ▼

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THE RELATIONSHIP BETWEEN RETURN AND MARKET VALUE OF COMMON STOCKS*

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This study examines the empirical relationship between the return and the total market value of NYSE common stocks. It is found that smaller firms have had higher risk adjusted returns, on average, than larger firms. This 'size effect' has been in existence for at least forty years and is evidence that the capital asset pricing model is misspecified. The size effect is not linear in the market value; the main effect occurs for very small firms while there is little difference in return between average sized and large firms. It is not known whether size *per se* is responsible for the effect or whether size is just a proxy for one or more true unknown factors correlated with size.

1. Introduction

The single-period capital asset pricing model (henceforth CAPM) postulates a simple linear relationship between the expected return and the market risk of a security. While the results of direct tests have been inconclusive, recent evidence suggests the existence of additional factors which are relevant for asset pricing. Litzenberger and Ramaswamy (1979) show a significant positive relationship between dividend yield and return of common stocks for the 1936–1977 period. Basu (1977) finds that price–earnings ratios and risk adjusted returns are related. He chooses to interpret his findings as evidence of market inefficiency but as Ball (1978) points out, market efficiency tests are often joint tests of the efficient market hypothesis and a particular equilibrium relationship. Thus, some of the anomalies that have been attributed to a lack of market efficiency might well be the result of a misspecification of the pricing model.

This study contributes another piece to the emerging puzzle. It examines the relationship between the total market value of the common stock of a firm and its return. The results show that, in the 1936–1975 period, the common stock of small firms had, on average, higher risk-adjusted returns

*This study is based on part of my dissertation and was completed while I was at the University of Chicago. I am grateful to my committee, Myron Scholes (chairman), John Gould, Roger Ibbotson, Jonathan Ingersoll, and especially Eugene Fama and and Merton Miller, for their advice and comments. I wish to acknowledge the valuable comments of Bill Schwert on earlier drafts of this paper.

than the common stock of large firms. This result will henceforth be referred to as the 'size effect'. Since the results of the study are not based on a particular theoretical equilibrium model, it is not possible to determine conclusively whether market value *per se* matters or whether it is only a proxy for unknown true additional factors correlated with market value. The last section of this paper will address this question in greater detail.

The various methods currently available for the type of empirical research presented in this study are discussed in section 2. Since there is a considerable amount of confusion about their relative merit, more than one technique is used. Section 3 discusses the data. The empirical results are presented in section 4. A discussion of the relationship between the size effect and other factors, as well as some speculative comments on possible explanations of the results, constitute section 5.

2. Methodologies

The empirical tests are based on a generalized asset pricing model which allows the expected return of a common stock to be a function of risk β and an additional factor ϕ, the market value of the equity.[1] A simple linear relationship of the form

$$E(R_i)=\gamma_0+\gamma_1\beta_i+\gamma_2[(\phi_i-\phi_m)/\phi_m], \tag{1}$$

is assumed, where

$E(R_i)$ = expected return on security i,
γ_0 = expected return on a zero-beta portfolio,
γ_1 = expected market risk premium,
ϕ_i = market value of security i,
ϕ_m = average market value, and
γ_2 = constant measuring the contribution of ϕ_i to the expected return of a security.

If there is no relationship between ϕ_i and the expected return, i.e., $\gamma_2=0$, (1) reduces to the Black (1972) version of the CAPM.

Since expectations are not observable, the parameters in (1) must be estimated from historical data. Several methods are available for this purpose. They all involve the use of pooled cross-sectional and time series regressions to estimate γ_0, γ_1, and γ_2. They differ primarily in (a) the assumption concerning the residual variance of the stock returns (homoscedastic or heteroscedastic in the cross-sectional), and (b) the treatment of the

[1] In the empirical tests, Φ_i and Φ_m are defined as the market proportion of security i and average market proportion, respectively. The two specifications are, of course, equivalent.

errors-in-variables problem introduced by the use of estimated betas in (1). All methods use a constrained optimization procedure, described in Fama (1976, ch. 9), to generate minimum variance (m.v.) portfolios with mean returns γ_i, $i=0,\ldots,2$. This imposes certain constraints on the portfolio weights, since from (1)

$$E(R_p) \equiv \gamma_i = \gamma_0 \sum_j w_j + \gamma_1 \sum_j w_j \beta_j + \gamma_2 \left[\left(\sum_j w_j \phi_j - \phi_m \sum_j w_j \right) \Big/ \phi_m \right], \qquad i=0,\ldots,2, \tag{2}$$

where the w_j are the portfolio proportions of each asset j, $j=1,\ldots,N$. An examination of (2) shows that $\hat{\gamma}_0$ is the mean return of a standard m.v. portfolio ($\sum_j w_j = 1$) with zero beta and $\phi_p \equiv \sum_j w_j \phi_j = \phi_m$ [to make the second and third terms of the right-hand side of (2) vanish]. Similarly, $\hat{\gamma}_1$ is the mean return on a zero-investment m.v. portfolio with beta of one and $\phi_p = 0$, and $\hat{\gamma}_2$ is the mean return on a m.v. zero-investment, zero-beta portfolio with $\phi_p = \phi_m$. As shown by Fama (1976, ch. 9), this constrained optimization can be performed by running a cross-sectional regression of the form

$$R_{it} = \gamma_{0t} + \gamma_{1t} \beta_{it} + \gamma_{2t} [(\phi_{it} - \phi_{mt})/\phi_{mt}] + \varepsilon_{it}, \qquad i=1,\ldots,N, \tag{3}$$

on a period-by-period basis, using estimated betas $\hat{\beta}_{it}$ and allowing for either homoscedastic or heteroscedastic error terms. Invoking the usual stationarity arguments the final estimates of the gammas are calculated as the averages of the T estimates.

One basic approach involves grouping individual securities into portfolios on the basis of market value and security beta, reestimating the relevant parameters (beta, residual variance) of the portfolios in a subsequent period, and finally performing either an ordinary least squares (OLS) regression [Fama and MacBeth (1973)] which assumes homoscedastic errors, or a generalized least squares (GLS) regression [Black and Scholes (1974)] which allows for heteroscedastic errors, on the portfolios in each time period.[2] Grouping reduces the errors-in-variables problem, but is not very efficient because it does not make use of all information. The errors-in-variables problem should not be a factor as long as the portfolios contain a reasonable number of securities.[3]

Litzenberger and Ramaswamy (1979) have suggested an alternative method which avoids grouping. They allow for heteroscedastic errors in the cross-section and use the estimates of the standard errors of the security

[2]Black and Scholes (1974) do not take account of heteroscedasticity, even though their method was designed to do so.

[3]Black, Jensen and Scholes (1972, p. 116)

betas as estimates of the measurement errors. As Theil (1971, p. 610) has pointed out, this method leads to unbiased maximum likelihood estimators for the gammas as long as the error in the standard error of beta is small and the standard assumptions of the simple errors-in-variables model are met. Thus, it is very important that the diagonal model is the correct specification of the return-generating process, since the residual variance assumes a critical position in this procedure. The Litzenberger–Ramaswamy method is superior from a theoretical viewpoint; however, preliminary work has shown that it leads to serious problems when applied to the model of this study and is not pursued any further.[4]

Instead of estimating equation (3) with data for all securities, it is also possible to construct arbitrage portfolios containing stocks of very large and very small firms, by combining long positions in small firms with short positions in large firms. A simple time series regression is run to determine the difference in risk-adjusted returns between small and large firms. This approach, long familiar in the efficient markets and option pricing literature, has the advantage that no assumptions about the exact functional relationships between market value and expected return need to be made, and it will therefore be used in this study.

3. Data

The sample includes all common stocks quoted on the NYSE for at least five years between 1926 and 1975. Monthly price and return data and the number of shares outstanding at the end of each month are available in the monthly returns file of the Center for Research in Security Prices (CRSP) of the University of Chicago. Three different market indices are used; this is in response to Roll's (1977) critique of empirical tests of the CAPM. Two of the three are pure common stock indices — the CRSP equally- and value-weighted indices. The third is more comprehensive: a value-weighted combination of the CRSP value-weighted index and return data on corporate and government bonds from Ibbotson and Sinquefield (1977) (henceforth 'market index').[5] The weights of the components of this index are derived from information on the total market value of corporate and government bonds in various issues of the *Survey of Current Business* (updated annually) and from the market value of common stocks in the CRSP monthly index file. The stock indices, made up of riskier assets, have both higher returns

[4] If the diagonal model (or market model) is an incomplete specification of the return generating process, the estimate of the standard error of beta is likely to have an upward bias, since the residual variance estimate is too large. The error in the residual variance estimate appears to be related to the second factor. Therefore, the resulting gamma estimates are biased.

[5] No pretense is made that this index is complete; thus, the use of quotation marks. It ignores real estate, foreign assets, etc.; it should be considered a first step toward a comprehensive index. See Ibbotson and Fall (1979).

and higher risk than the bond indices and the 'market index'.[6] A time series of commercial paper returns is used as the risk-free rate.[7] While not actually constant through time, its variation is very small when compared to that of the other series, and it is not significantly correlated with any of the three indices used as market proxies.

4. Empirical results

4.1. Results for methods based on grouped data

The portfolio selection procedure used in this study is identical to the one described at length in Black and Scholes (1974). The securities are assigned to one of twenty-five portfolios containing similar numbers of securities, first to one of five on the basis of the market value of the stock, then the securities in each of those five are in turn assigned to one of five portfolios on the basis of their beta. Five years of data are used for the estimation of the security beta; the next five years' data are used for the reestimation of the portfolio betas. Stock price and number of shares outstanding at the end of the five year periods are used for the calculation of the market proportions. The portfolios are updated every year. The cross-sectional regression (3) is then performed in each month and the means of the resulting time series of the gammas could be (and have been in the past) interpreted as the final estimators. However, having used estimated parameters, it is not certain that the series have the theoretical properties, in particular, the hypothesized beta. Black and Scholes (1974, p. 17) suggest that the time series of the gammas be regressed once more on the excess return of the market index. This correction involves running the time series regression (for $\hat{\gamma}_2$)

$$\hat{\gamma}_{2t} - R_{F_t} = \hat{\alpha}_2 + \hat{\beta}_2 (R_{mt} - R_{F_t}) + \hat{\varepsilon}_{2t}. \tag{4}$$

It has been shows earlier that the theoretical β_2 is zero. (4) removes the effects of a non-zero $\hat{\beta}_2$ on the return estimate $\hat{\gamma}_2$ and $\hat{\alpha}_2$ is used as the final estimator for $\hat{\gamma}_2 - R_F$. Similar corrections are performed for γ_0 and γ_1. The

[6] Mean monthly returns and standard deviations for the 1926–1975 period are:

	Mean return	Standard deviation
'Market index'	0.0046	0.0178
CRSP value-weighted index	0.0085	0.0588
CRSP equally-weighted index	0.0120	0.0830
Government bond index	0.0027	0.0157
Corporate bond index	0.0032	0.0142

[7] I am grateful to Myron Scholes for making this series available. The mean monthly return for the 1926–1975 period is 0.0026 and the standard deviation is 0.0021.

derivations of the $\hat{\beta}_i$, $i=0,\ldots,2$, in (4) from their theoretical values also allow us to check whether the grouping procedure is an effective means to eliminate the errors-in-beta problem.

The results are essentially identical for both OLS and GLS and for all three indices. Thus, only one set of results, those for the 'market index' with GLS, is presented in table 1. For each of the gammas, three numbers are reported: the mean of that time series of returns which is relevant for the test of the hypothesis of interest (i.e., whether or not $\hat{\gamma}_0$ and $\hat{\gamma}_1$ are different from the risk-free rate and the risk premium, respectively), the associated t-statistic, and finally, the estimated beta of the time series of the gamma from (4). Note that the means are corrected for the deviation from the theoretical beta as discussed above.

The table shows a significantly negative estimate for γ_2 for the overall time period. Thus, shares of firms with large market values have had smaller returns, on average, than similar small firms. The CAPM appears to be misspecified. The table also shows that γ_0 is different from the risk-free rate. As both Fama (1976, ch. 9) and Roll (1977) have pointed out, if a test does not use the true market portfolio, the Sharpe–Lintner model might be wrongly rejected. The estimates for γ_0 are of the same magnitude as those reported by Fama and MacBeth (1973) and others. The choice of a market index and the econometric method does not affect the results. Thus, at least within the context of this study, the choice of a proxy for the market portfolio does not seem to affect the results and allowing for heteroscedastic disturbances does not lead to significantly more efficient estimators.

Before looking at the results in more detail, some comments on econometric problems are in order. The results in table 1 are based on the 'market index' which is likely to be superior to pure stock indices from a theoretical viewpoint since it includes more assets [Roll (1977)]. This superiority has its price. The actual betas of the time series of the gammas are reported in table 1 in the columns labeled $\hat{\beta}_i$. Recall that the theoretical values of β_0 and β_1 are zero and one, respectively. The standard zero-beta portfolio with return $\hat{\gamma}_0$ contains high beta stocks in short positions and low beta stocks in long positions, while the opposite is the case for the zero-investment portfolio with return $\hat{\gamma}_1$. The actual betas are all significantly different from the theoretical values. This suggests a regression effect, i.e., the past betas of high beta securities are overestimated and the betas of low beta securities are underestimated.[8] Past beta is not completely uncorrelated with the error of the current beta and the instrumental variable approach to the error-in-variables problem is not entirely successful.[9]

[8]There is no such effect for β_2 because that portfolio has both zero beta and zero investment; i.e., net holdings of both high and low beta securities are, on average, zero.

[9]This result is first documented in Brenner (1976) who examines the original Fama–McBeth (1973) time series of $\hat{\gamma}_{0t}$.

Table 1

Portfolio estimators for γ_0, γ_1 and γ_2 based on the 'market index' with generalized least squares estimation.[a]

$$R_{it} = \hat{\gamma}_{0t} + \hat{\gamma}_{1t}\hat{\beta}_{it} + \hat{\gamma}_{2t}[(\phi_{it} - \phi_{mt})/\phi_{mt}]$$

Period	$\hat{\gamma}_0 - R_F$	$t(\hat{\gamma}_0 - R_F)$	$\hat{\beta}_0$	$\hat{\gamma}_1 - (R_M - R_F)$	$t(\hat{\gamma}_1 - (R_M - R_F))$	$\hat{\beta}_1$	$\hat{\gamma}_2$	$t(\hat{\gamma}_2)$	$\hat{\beta}_2$
1936–1975	0.00450	2.76	0.45	−0.00092	−1.00	0.75	−0.00052	−2.92	0.01
1936–1955	0.00377	1.66	0.43	−0.00060	−0.80	0.80	−0.00043	−2.12	0.01
1956–1975	0.00531	2.22	0.46	−0.00138	−0.82	0.73	−0.00062	−2.09	0.01
1936–1945	0.00121	0.30	0.63	−0.00098	−0.77	0.82	−0.00075	−2.32	−0.01
1946–1955	0.00650	2.89	0.03	−0.00021	−0.26	0.75	−0.00015	−0.65	0.06
1956–1965	0.00494	2.02	0.34	−0.00098	−0.56	0.96	−0.00039	−1.27	−0.01
1966–1975	0.00596	1.43	0.49	−0.00232	−0.80	0.69	−0.00080	−1.55	0.01

[a] $\hat{\gamma}_0 - R_F$ = mean difference between return on zero beta portfolio and risk-free rate. $\hat{\gamma}_1 - (R_M - R_F)$ = mean difference between actual risk premium ($\hat{\gamma}_1$) and risk premium stipulated by Sharpe–Lintner model ($R_M - R_F$). $\hat{\gamma}_2$ = size premium. $\hat{\beta}_i$ = actual estimated market risk of $\hat{\gamma}_i$ (theoretical values: $\hat{\beta}_0 = 0$, $\beta_1 = 1$, $\beta_2 = 0$); all $\hat{\beta}_0$, $\hat{\beta}_1$ are significantly different from the theoretical values. $t(\cdot)$ = t-statistic.

The deviations from the theoretical betas are largest for the 'market index', smaller for the CRSP value-weighted index, and smallest for the CRSP equally-weighted index. This is due to two factors: first, even if the true covariance structure is stationary, betas with respect to a value-weighted index change whenever the weights change, since the weighted average of the betas is constrained to be equal to one. Second, the betas and their standard errors with respect to the 'market index' are much larger than for the stock indices (a typical stock beta is between two and three), which leads to larger deviations — a kind of 'leverage' effect. Thus, the results in table 1 show that the final correction for the deviation of $\hat{\beta}_0$ and $\hat{\beta}_1$ from their theoretical values is of crucial importance for maket proxies with changing weights.

Estimated portfolio betas and portfolio market proportions are (negatively) correlated. It is therefore possible that the errors in beta induce an error in the coefficient of the market proportion. According to Levi (1973), the probability limit of $\hat{\gamma}_1$ in the standard errors-in-the-variables model is

$$\operatorname{plim} \hat{\gamma}_1 = \gamma_1/(1+(\sigma_u^2 \cdot \sigma_2^2)/D) < \gamma_1,$$

with

$$D = (\sigma_1^2 + \sigma_u^2) \cdot \sigma_2^2 - \sigma_{12}^2 > 0,$$

where σ_1^2, σ_2^2 are the variances of the true factors β and ϕ, respectively, σ_u^2 is the variance of the error in beta and σ_{12} is the covariance of β and ϕ. Thus, the bias in $\hat{\gamma}_1$ is unambiguously towards zero for positive γ_1. The probability limit of $\hat{\gamma}_2 - \gamma_2$ is [Levi (1973)]

$$\operatorname{plim} (\hat{\gamma}_2 - \gamma_2) = (\sigma_u^2 \cdot \sigma_{12} \cdot \gamma_1)/D.$$

We find that the bias in $\hat{\gamma}_2$ depends on the covariance between β and ϕ and the sign of γ_1. If σ_{12} has the same sign as the covariance between $\hat{\beta}$ and ϕ, i.e., $\sigma_{12} < 0$, and if $\gamma_1 > 0$, then $\operatorname{plim}(\hat{\gamma}_2 - \gamma_2) < 0$, i.e., $\operatorname{plim} \hat{\gamma}_2 < \gamma_2$. If the grouping procedure is not successful in removing the error in beta, then it is likely that the reported $\hat{\gamma}_2$ overstates the true magnitude of the size effect. If this was a serious problem in this study, the results for the different market indices should reflect the problem. In particular, using the equally-weighted stock index should then lead to the smallest size effect since, as was pointed out earlier, the error in beta problem is apparently less serious for that kind of index. In fact, we find that there is little difference between the estimates.[10]

[10]For the overall time period, $\hat{\gamma}_2$ with the equally-weighted CRSP index is -0.00044, with the value weighted CRSP index -0.00044 as well as opposed to the -0.00052 for the 'market index' reported in table 1. The estimated betas of $\hat{\gamma}_0$ and $\hat{\gamma}_1$ which reflect the degree of the error in beta problems are 0.07 and 0.91, respectively, for the equally-weighted CRSP index and 0.13 and 0.87 for the value-weighted CRSP index.

Thus, it does not appear that the size effect is just a proxy for the unobservable true beta even though the market proportion and the beta of securities are negatively correlated.

The correlation coefficient between the mean market values of the twenty-five portfolios and their betas is significantly negative, which might have introduced a multicollinearity problem. One of its possible consequences is coefficients that are very sensitive to addition or deletion of data. This effect does not appear to occur in this case: the results do not change significantly when five portfolios are dropped from the sample. Revising the grouping procedure — ranking on the basis of beta first, then ranking on the basis of market proportion — also does not lead to substantially different results.

4.2. A closer look at the results

An additional factor relevant for asset pricing — the market value of the equity of a firm — has been found. The results are based on a linear model. Linearity was assumed only for convenience and there is no theoretical reason (since there is no model) why the relationship should be linear. If it is nonlinear, the particular form of the relationship might give us a starting point for the discussion of possible causes of the size effect in the next section. An analysis of the residuals of the twenty-five portfolios is the easiest way to look at the linearity question. For each month t, the estimated residual return

$$\hat{\varepsilon}_{it} = R_{it} - \hat{\gamma}_{0t} - \hat{\gamma}_{1t}\hat{\beta}_{it} - \hat{\gamma}_{2t}[(\phi_{it} - \phi_{mt})/\phi_{mt}], \qquad i = 1, \ldots, 25, \tag{5}$$

is calculated for all portfolios. The mean residuals over the forty-five year sample period are plotted as a function of the mean market proportion in fig. 1. Since the distribution of the market proportions is very skewed, a logarithmic scale is used. The solid line connects the mean residual returns of each size group. The numbers identify the individual portfolios within each group according to beta, '1' being the one with the largest beta, '5' being the one with the smallest beta.

The figure shows clearly that the linear model is misspecified.[11] The residuals are not randomly distributed around zero. The residuals of the portfolios containing the smallest firms are all positive; the remaining ones are close to zero. As a consequence, it is impossible to use $\hat{\gamma}_2$ as a simple size premium in the cross-section. The plot also shows, however, that the misspecification is not responsible for the significance of $\hat{\gamma}_2$ since the linear model underestimates the true size effect present for very small firms. To illustrate this point, the five portfolios containing the smaller firms are

[11] The nonlinearity cannot be eliminated by defining ϕ_i as the log of the market proportion.

deleted from the sample and the parameters reestimated. The results, summarized in table 2, show that the $\hat{\gamma}_2$ remain essentially the same. The relationship is still not linear; the new $\hat{\gamma}_2$ still cannot be used as a size premium.

Fig. 1 suggests that the main effect occurs for very small firms. Further support for this conclusion can be obtained from a simple test. We can regress the returns of the twenty-five portfolios in each result on beta alone and examine the residuals. The regression is misspecified and the residuals contain information about the size effect. Fig. 2 shows the plot of those residuals in the same format as fig. 1. The smallest firms have, on average, very large unexplained mean returns. There is no significant difference between the residuals of the remaining portfolios.

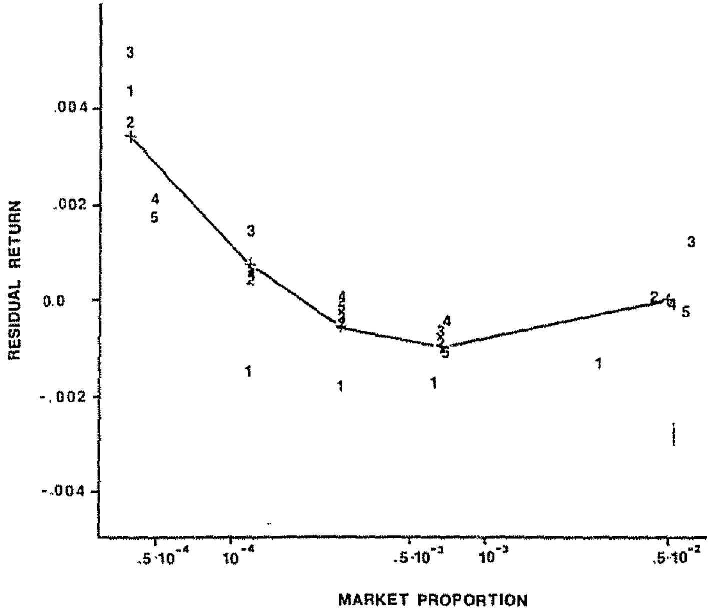

Fig. 1. Mean residual returns of portfolios (1936–1975) with equally-weighted CRSP index as market proxy. The residual is calculated with the three-factor model [eq. (3)]. The numbers 1,...,5 represent the mean residual return for the five portfolios within each size group (1: portfolio with largest beta,...,5: portfolio with smallest beta). + represents the mean of the mean residuals of the five portfolios with similar market values.

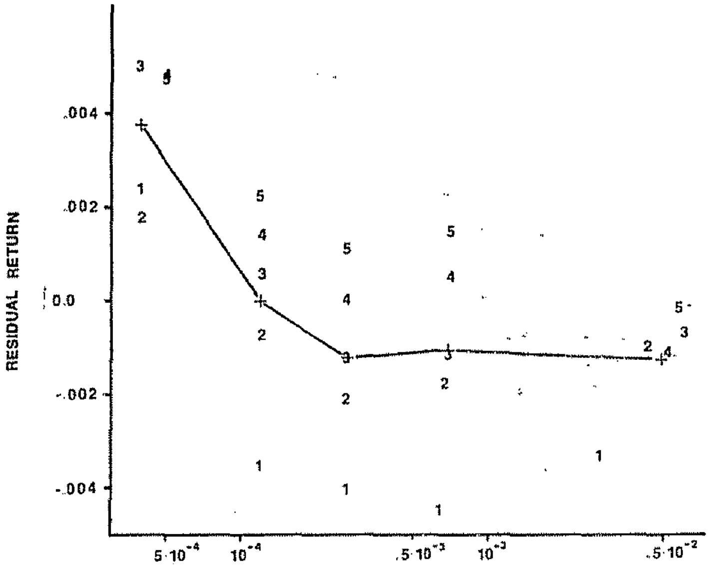

Fig. 2. Mean residual returns of portfolios (1936–1975) with equally-weighted CRSP index as market proxy. The residual is calculated with the two-factor model ($\hat{\varepsilon}_{it} = R_{it} - \hat{\gamma}_{0t} - \hat{\gamma}_{1t}\hat{\beta}_{it}$). The symbols are as defined for fig. 1.

4.3. 'Arbitrage' portfolio returns

One important empirical question still remains: How important is the size effect from a practical point of view? Fig. 2 suggests that the difference in returns between the smallest firms and the remaining ones is, on average, about 0.4 percent per month. A more dramatic result can be obtained when the securities are chosen solely on the basis of their market value.

As an illustration, consider putting equal dollar amounts into portfolios containing the smallest, largest and median-sized firms at the beginning of a year. These portfolios are to be equally weighted and contain, say, ten, twenty or fifty securities. They are to be held for five years and are rebalanced every month. They are levered or unlevered to have the same beta. We are then interested in the differences in their returns,

$$R_{1t} = R_{st} - R_{lt}, \qquad R_{2t} = R_{st} - R_{at}, \qquad R_{3t} = R_{at} - R_{lt}, \tag{6}$$

Table 2
Portfolio estimators for γ_2 for all 25 portfolios and for 20 portfolios (portfolios containing smallest firms deleted) based on CRSP equally weighted index with generalized least-squares estimation.*

	Size premium $\hat{\gamma}_2$ with	
Period	25 portfolios	20 portfolios
1936–1975	−0.00044 (−2.42)	−0.00043 (−2.54)
1936–1955	−0.00037 (−1.72)	−0.00041 (−1.88)
1956–1975	−0.00056 (−1.91)	−0.00050 (−1.91)
1936–1945	−0.00085 (−2.81)	−0.00083 (−2.48)
1946–1955	0.00003 (0.12)	−0.00003 (−0.13)
1956–1965	−0.00023) (−0.81)	−0.00017 (−0.65)
1966–1975	−0.00091 (−1.78)	−0.00085 (−1.84)

*t-statistic in parentheses.

where R_{st}, R_{at} and R_{lt} are the returns on the portfolios containing the smallest, median-sized and largest firms at portfolio formation time (and $R_{1t} = R_{2t} + R_{3t}$). The procedure involves (a) the calculation of the three differences in raw returns in each month and (b) running time series regressions of the differences on the excess returns of the market proxy. The intercept terms of these regressions are then interpreted as the $\bar{R}_i$, $i = 1, \ldots, 3$. Thus, the differences can be interpreted as 'arbitrage' returns, since, e.g., R_{1t} is the return obtained from holding the smallest firms long and the largest firms short, representing zero net investment in a zero-beta portfolio.[12] Simple equally weighted portfolios are used rather than more sophisticated minimum variance portfolios to demonstrate that the size effect is not due to some quirk in the covariance matrix.

Table 3 shows that the results of the earlier tests are fully confirmed. $\bar{R}_2$, the difference in returns between very small firms and median-size firms, is typically considerably larger than $\bar{R}_3$, the difference in returns between median-sized and very large firms. The average excess return from holding very small firms long and very large firms short is, on average, 1.52 percent

[12]No *ex post* sample bias is introduced, since monthly rebalancing includes stocks delisted during the five years. Thus, the portfolio size is generally accurate only for the first month of each period.

Table 3
Mean monthly returns on 'arbitrage' portfolios.[a]
$R_j - R_k = \hat{\alpha}_i + \hat{\beta}_i(R_m - R_F)$

	$\bar{\alpha}_1$[b]			$\bar{\alpha}_2$[c]			$\bar{\alpha}_3$[d]		
	$n=10$	$n=20$	$n=50$	$n=10$	$n=20$	$n=50$	$n=10$	$n=20$	$n=50$
Overall period									
1931–1975	0.0152	0.0148	0.0101	0.0130	0.0124	0.0089	0.0021	0.0024	0.0012
	(2.99)	(3.53)	(3.07)	(2.90)	(3.56)	(3.64)	(1.06)	(1.41)	(0.85)
Five-year subperiods									
1931–1935	0.0589	0.0597	0.0427	0.0462	0.0462	0.0326	0.0127	0.0134	0.0101
	(2.25)	(2.81)	(2.35)	(1.92)	(2.55)	(2.46)	(1.09)	(1.49)	(1.42)
1936–1940	0.0201	0.0182	0.0089	0.0118	0.0145	0.0064	0.0084	0.0037	0.0025
	(0.82)	(0.97)	(0.67)	(0.55)	(0.90)	(0.65)	(1.20)	(0.62)	(0.49)
1941–1945	0.0430	0.0408	0.0269	0.0381	0.0367	0.0228	0.0049	0.0038	0.0041
	(2.29)	(2.46)	(2.17)	(2.29)	(2.54)	(2.02)	(1.25)	(1.09)	(1.68)
1946–1950	−0.0060	−0.0046	−0.0036	−0.0058	−0.0059	−0.0029	−0.0002	−0.0104	−0.0007
	(−1.17)	(−0.97)	(−0.97)	(−1.03)	(−1.29)	(−0.83)	(−0.07)	(−0.50)	(−0.38)
1951–1955	−0.0067	−0.0011	0.0013	−0.0004	0.0026	0.0010	−0.0062	−0.0037	0.0003
	(−0.89)	(−0.21)	(0.32)	(−0.07)	(0.72)	(0.39)	(−1.29)	(−0.99)	(0.11)
1956–1960	0.0039	0.0008	0.0037	0.0007	−0.0027	0.0011	0.0031	0.0035	0.0026
	(0.67)	(0.15)	(0.89)	(0.14)	(−0.64)	(0.45)	(0.88)	(1.16)	(0.97)
1961–1965	0.0131	0.0060	0.0024	0.0096	0.0046	0.0036	0.0035	0.0014	−0.0012
	(1.38)	(0.67)	(0.31)	(1.11)	(0.72)	(0.77)	(0.59)	(0.24)	(−0.24)
1966–1970	0.0121	0.0117	0.0077	0.0129	0.0110	0.0071	0.0008	0.0007	0.0006
	(1.64)	(2.26)	(1.91)	(1.93)	(2.71)	(2.43)	(0.23)	(0.22)	(0.27)
1971–1975	0.0063	0.0108	0.0098	0.0033	0.0077	0.0083	0.0030	0.0031	0.0015
	(0.60)	(1.23)	(1.45)	(0.39)	(1.18)	(1.79)	(0.64)	(0.72)	(0.43)

[a]Equally-weighted portfolios with n securities, adjusted for differences in market risk with respect to CRSP value-weighted index, t-statistics in parentheses.
[b]Small firms held long, large firms held short.
[c]Small firms held long, median-size firms held short.
[d]Median-size firms held long, large firms held short.

per month or 19.8 percent on an annualized basis. This strategy, which suggests very large 'profit opportunities', leaves the investor with a poorly diversified portfolio. A portfolio of small firms has typically much larger residual risk with respect to a value-weighted index than a portfolio of very large firms with the same number of securities [Banz (1978, ch. 3)]. Since the fifty largest firms make up more than 25 percent of the total market value of NYSE stocks, it is not surprising that a larger part of the variation of the return of a portfolio of those large firms can be explained by its relation with the value-weighted market index. Table 3 also shows that the strategy would not have been successful in every five year subperiod. Nevertheless, the magnitude of the size effect during the past forty-five years is such that it is of more than just academic interest.

5. Conclusions

The evidence presented in this study suggests that the CAPM is misspecified. On average, small NYSE firms have had significantly larger risk adjusted returns than large NYSE firms over a forty year period. This size effect is not linear in the market proportion (or the log of the market proportion) but is most pronounced for the smallest firms in the sample. The effect is also not very stable through time. An analysis of the ten year subperiods show substantial differences in the magnitude of the coefficient of the size factor (table 1).

There is no theoretical foundation for such an effect. We do not even know whether the factor is size itself or whether size is just a proxy for one or more true but unknown factors correlated with size. It is possible, however, to offer some conjectures and even discuss some factors for which size is suspected to proxy. Recent work by Reinganum (1980) has eliminated one obvious candidate: the price–earnings (*P*/*E*) ratio.[13] He finds that the *P*/*E*-effect, as reported by Basu (1977), disappears for both NYSE and AMEX stocks when he controls for size but that there is a significant size effect even when he controls for the *P*/*E*-ratio, i.e., the *P*/*E*-ratio effect is a proxy for the size effect and not vice versa. Stattman (1980), who found a significant negative relationship between the ratio of book value and market value of equity and its return, also reports that this relationship is just a proxy for the size effect. Naturally, a large number of possible factors remain to be tested.[14] But the Reinganum results point out a potential problem with some of the existing negative evidence of the efficient market hypothesis. Basu believed to have identified a market inefficiency but his *P*/*E*-effect is

[13]The average correlation coefficient between *P*/*E*-ratio and market value is only 0.16 for individual stocks for thirty-eight quarters ending in 1978. But for the portfolios formed on the basis of *P*/*E*-ratio, it rises to 0.82. Recall that Basu (1977) used ten portfolios in his study.

[14]E.g., debt–equity ratios, skewness of the return distribution [Kraus and Litzenberger (1976)].

just a proxy for the size effect. Given its longevity, it is not likely that it is due to a market inefficiency but it is rather evidence of a pricing model misspecification. To the extent that tests of market efficiency use data of firms of different sizes and are based on the CAPM, their results might be at least contaminated by the size effect.

One possible explanation involving the size of the firm directly is based on a model by Klein and Bawa (1977). They find that if insufficient information is available about a subset of securities, investors will not hold these securities because of estimation risk, i.e., uncertainty about the true parameters of the return distribution. If investors differ in the amount of information available, they will limit their diversification to different subsets of all securities in the market.[15] It is likely that the amount of information generated is related to the size of the firm. Therefore, many investors would not desire to hold the common stock of very small firms. I have shown elsewhere [Banz (1978, ch. 2)] that securities sought by only a subset of the investors have higher risk-adjusted returns than those considered by all investors. Thus, lack of information about small firms leads to limited diversification and therefore to higher returns for the 'undesirable' stocks of small firms.[16] While this informal model is consistent with the empirical results, it is, nevertheless, just conjecture.

To summarize, the size effect exists but it is not at all clear why it exists. Until we find an answer, it should be interpreted with caution. It might be tempting to use the size effect, e.g., as the basis for a theory of mergers — large firms are able to pay a premium for the stock of small firms since they will be able to discount the same cash flows at a smaller discount rate. Naturally, this might turn out to be complete nonsense if size were to be shown to be just a proxy.

The preceding discussion suggests that the results of this study leave many questions unanswered. Further research should consider the relationship between size and other factors such as the dividend yield effect, and the tests should be expanded to include OTC stocks as well.

[15] Klein and Bawa (1977, p. 102).
[16] A similar result can be obtained with the introduction of fixed holding costs which lead to limited diversification as well. See Brennan (1975), Banz (1978, ch. 2) and Mayshar (1979).

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Chapter 8

Fama-French Three Factor Model

In 1992 Eugene Fama and Kenneth French published a landmark paper in the Journal of Finance titled "The Cross-Section of Expected Stock Returns." In this paper, Fama and French criticized the traditional capital asset pricing model (CAPM) for not adequately measuring asset returns. They found that the relationship between beta and average return disappears over the 1963–1990 period and is weak for the 1941–1990 period. This conclusion does not support the CAPM's key assumption: that returns on stocks are positively related to market betas.[1]

After critiquing CAPM, Fama and French went on to identify two other characteristics that they claim better describe security returns than beta does—market value and the book-value-to-market-value ratio. While Fama and French at the time offered no explicit replacement for CAPM, their 1992 paper was the start of a series of critiques and arguments among academics that persists today.

The 1992 paper was followed that same year by an academic study conducted by Kothari, Shanken, and Sloan that seemed to contradict the findings of Fama and French Kothari, Shanken, and Sloan concluded in their paper that returns do reflect significant compensation for beta risk, both statistically and economically, when beta is measured on an annual basis. (Fama and French used monthly data in their study.) However, they went on to say that the variation in expected returns may not be accounted for by beta alone.[2]

There were two more papers of importance published in 1993 in The Journal of Portfolio Management. "Are Reports of Beta's Death Premature?" was written by Chan and Lakonishok who detailed the influence of sample period selection on the conclusion of prior studies. They found a strong relationship between beta and return for the years of their study up to 1982. Though Chan and Lakonishok are not ardent supporters of beta, they "do not feel that the evidence for discarding beta is clear-cut and overwhelming."[3]

The second noteworthy article, written by Fischer Black, was titled "Beta and Return." In this article, Black refuted the conclusions of Fama and French and stated that "beta is alive and well."[4] Black's main point was that Fama and French did not prove what they claimed to have proven—that beta has no explanatory power. Like Chan and Lakonishok, Black pointed to the selection of time period. Black also demonstrated that Fama and French's own results still showed a relationship, albeit weak, between beta and return for the selected period.

Finally, Fama and French revisited the issue in 1994.[5] Building on their prior work, they proposed a three factor model for security expected returns:

1. Covariance with the market
2. Size
3. Financial risk as determined by the book-to-market ratio

As a result of this academic debate, Fama and French created a model that can be viewed as an extension of the CAPM. While the traditional CAPM only focuses on the covariance of security returns with the market as a whole, Fama and French add two additional elements: size and book-to-market value. They found that the returns on stocks are better explained as a function of size and book-to-market value in addition to the single market factor of the CAPM, with the company's size capturing the size effect and its book-to-market ratio capturing the financial distress of a firm.

Within the context of the Fama-French model, size is measured by market capitalization. Many studies, including one by Ibbotson Associates, have looked at firm size as a determinant of expected returns. The underlying notion is that small companies are viewed as riskier than large companies and therefore investors should be rewarded for taking on the additional risk. Firms with a higher book-to-market ratio (the more "financially distressed" companies) also demonstrate more risk than firms with a low book-to-market ratio. Again, investors should be rewarded with a higher cost of equity for taking on additional risk.

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Short communication

Utility stocks and the size effect—revisited

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Abstract

Wong concluded there is weak empirical support that firm size is a missing factor from the capital asset pricing model for industrial stocks but not for utility stocks. Her weak results, however, do not rule out the possibility of a small firm effect for utilities. The issue she addressed has important financial implications in regulated proceedings that set rates of return for utilities. New studies based on different size water utilities are presented that do support a small firm effect in the utility industry.

Keywords: Utility stocks; Beta risk; Firm size

Annie Wong concludes there is some weak evidence that firm size is a missing factor from the capital asset pricing model ("CAPM") for industrial stocks but not for utility stocks (Wong, 1993, p. 98). This "firm size effect" is an observation that small firms tend to earn higher returns than larger firms after controlling for differences in estimates of beta risk in the CAPM. Wong notes that if the size effect exists, it has important implications and should be considered by regulators when they determine fair rates of return for public utilities. This paper re-examines the basis for her conclusions and presents new information that indicates there is a small firm effect in the utility sector.

1. Reconsideration of the evidence provided by Wong

Wong relies on Barry and Brown (1984) and Brauer (1986) to suggest the small firm effect may be explained by differences in information available to investors of small and large firms.

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She states that requirements to file reports and information generated during regulatory proceedings indicate the same amount of information is available for large and small utilities and thus, if the differential information hypothesis explains the small firm effect, then the uniformity of information available among utility firms would suggest the size effect should not be observed in the utility industry. But contrary to the facts she assumes, there are differences in information available for large and small utilities. More parties participate in proceedings for large utilities and thus generate more information. Also, in some jurisdictions smaller utilities are not required to file all of the information that is required of larger firms. Thus, if the small firm effect is explained by differential information, contrary to Wong's hypothesis, differences in available information suggests there is a small firm effect in the utility industry. Wong did not discuss other potential explanations of the small firm effect for utilities.[2]

Wong's empirical results are not strong enough to conclude that beta risks of utilities are unrelated to size. In the period 1963–1967, when monthly data were used to estimate betas, her estimates of utility betas as well as industrial betas increased as the size of the firms decreased, but she did not find the same inverse relationship between size and beta risk for utilities in other periods. Being unable to demonstrate a relationship between size and beta in other periods may be the result of Wong using monthly, weekly and daily data to make those beta estimates. Roll (1980) concluded trading infrequency seems to be a powerful cause of bias in beta risk estimates when time intervals of a month or less are used to estimate betas for small stocks. When a small stock is thinly traded, its stock price does not reflect the movement of the market, which drives down the apparent covariance with the market and creates an artificially low beta estimate.

Ibbotson Associates (2002) found that when annual data are used to estimate betas, beta estimates for the smaller firms increase more than beta estimates for larger firms. Table 1 compares Value Line (2000) beta estimates for three relatively small water utilities that are made with weekly data and an adjusted beta estimated with pooled annual data for the utilities for the 5-year period ending in December 2000. In making the latter estimate, it is assumed that the underlying beta for each of water utilities is the same. The *t*-statistics for the unadjusted beta

Table 1
Beta estimates reported by Value Line and estimated with pooled annual returns for relatively small water utilities

	Value Line[a]	Estimated with annual data[b]
Connecticut Water Service	0.45	
Middlesex Water	0.45	
SJW Corporation	0.50	
Average	0.47	0.78
t-statistic		2.72[c,d]

[a] As reported in Value Line (2000). Betas estimated with 5 years of weekly data.

[b] Estimated with pooled annual return premiums for the 5-year period ending December 2000. Proxy market returns are total returns for the S&P 500 index. Dummy variable in 1999 to reflect the proposed acquisition of SJW Corporation included in analysis.

[c] Significant at the 95% level.

[d] The *t*-statistic for the null hypothesis that the true beta is 0.18 (the derived unadjusted Value Line beta) when the estimated betas is 0.65 (the unadjusted estimated beta) is 1.97. It is significant at the 95% level.

estimate is reported in parentheses. As was found by Ibbotson Associates (2002) for stocks in general, when annual data are used to estimate betas for small utility stocks, the beta estimate increases.

Wong used the Fama and MacBeth (1973) approach to estimate how well firm size and beta explain future returns in four periods. She reports weak empirical results for both the industrial and utility sectors. In every one of the statistical results reported for utilities, the coefficient for the size effect has a negative sign as would be expected if there is a size effect in the utility industry but only one of the results was found to be statistically significant at the 5% level. With the industrial sector, though she found two cases to have a significant size effect, a negative sign for the size coefficient occurred only 75% of the time. What is puzzling is that with these weak results, Wong concludes the analysis provides support for the small firm effect for the industrial industry but no support for a small firm effect for the utility industry.

2. New evidence on risk premiums required by small utilities

Two other studies support a conclusion that small utilities are more risky than larger ones. A study made by Staff of the Water Utilities Branch of the California Public Utilities Commission Advisory and Compliance Division (CPUC Staff, 1991) used proxies for beta risk and determined small water utilities were more risky than larger water utilities. Part of the difficulty with examining the question of relative risk of utilities is that the very small utilities are not publicly-traded. This CPUC Staff study addressed that concern by computing proxies for beta risk estimated with accounting data for the period 1981–1991 for 58 water utilities. Based on that analysis, CPUC Staff concluded that smaller water utilities were more risky and required higher equity returns than larger water utilities. Following 8 days of hearings and testimony by 21 witnesses regarding this study, it was adopted by the California Public Utilities Commission in CPUC Decision 92-03-093, dated March 31, 1992.

Table 2 provides the results of another study of differences in required returns estimated from discounted cash flow ("DCF") model estimates of the costs of equity for water utilities of different sizes. The study compares average estimates of equity costs for two smaller water utilities, Dominguez Water Company and SJW Corporation, with equity cost estimates for two larger companies, California Water Service and American States Water, for the period 1987–1997. All four utilities operated primarily in the same regulatory jurisdiction during that period. Estimates of future growth are required to make DCF estimates. Gordon, Gordon, and Gould (1989) found that a consensus of analysts' forecasts of earnings per share for the next 5 years provides a more accurate estimate of growth required in the DCF model than three different historical measures of growth. Unfortunately, such analysts' forecasts are not generally available for small utilities and thus this study assumes, as was assumed by staff at the regulatory commission, that investors relied upon past measures of growth to forecast the future. The results in Table 2 show that the smaller water utilities had a cost of equity that, on average, was 99 basis points higher than the average cost of equity for the larger water utilities. This result is statistically significant at the 90% level. In terms of the issues being addressed by Wong, the 99 basis points could be the result of differences in beta risk, the small firm effect or some combination of the two.

	D_0/P_0 (%)	Estimated growth (%)[c]	Equity cost estimate (%)[d]	D_0/P_0 (%)	Estimated growth (%)[c]	Equity cost estimate (%)[d]	larger utilities
1987	6.60	7.17	14.24	5.38	10.06	15.98	1.74
1988	6.75	6.30	13.48	5.81	9.08	15.42	1.94
1989	7.10	6.30	13.84	6.47	7.00	13.93	0.09
1990	7.24	6.19	13.87	6.96	7.51	14.99	1.11
1991	6.94	6.29	13.67	6.64	6.24	13.30	−0.36
1992	6.18	5.96	12.50	6.50	6.71	13.65	1.14
1993	5.32	5.68	11.30	5.49	6.31	12.15	0.85
1994	6.03	4.40	10.70	5.80	4.86	10.94	0.25
1995	6.44	3.86	10.55	6.44	4.88	11.64	1.09
1996	5.60	4.06	9.88	5.77	5.58	11.67	1.79
1997	4.93	3.31	8.40	4.52	4.89	9.64	1.23
Averarage difference							0.99
t-statistic							1.405[e]

Limited to period for which Dominguez Water Company data were available. 1998 excluded due to pending buyout.

[a] American States Water and California Water Service.

[b] Dominguez Water Company and SJW Corporation.

[c] Average of 5- and 10-year dividends per share growth, 10-year earnings per share growth and estimates of sustainable growth from internal and external sources for the most recent 10-year period when data are available (1991–1997), otherwise most recent 5-year period (1987–1990).

[d] DCF equity cost as computed by California PUC staff: $k = (D_0/P_0) \times (1 + g) + g$.

[e] Significant at the 90% level.

3. Concluding remarks

Wong's concluding remarks should be re-examined and placed in perspective. She noted that industrial betas tend to decrease with increases in firm size but the same relationship is not found in every period for utilities. Had longer time intervals been used to estimated betas, as was done in Table 1, she may have found the same inverse relationship between size and beta risk for utilities in other periods. She also concludes "there is some weak evidence that firm size is a missing factor from the CAPM for the industrial but not the utility stocks" (Wong, 1993, p. 98), but the weak evidence provides little support for a small firm effect existing or not existing in either the industrial or utility sector. Two other studies discussed here support a conclusion that smaller water utility stocks are more risky than larger ones. To the extent that water utilities are representative of all utilities, there is support for smaller utilities being more risky than larger ones.

Notes

1. Vice President.
2. The small firm effect could also be a proxy for numerous other omitted risk differences between large and small utilities. An obvious candidate is differentials in access to financial markets created by size. Some very small utilities are unable to borrow money without backing of the owner. Other small utilities are limited to private placements of debt and have no access to the more liquid financial markets available to larger utilities.

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COST OF EQUITY FOR ENERGY UTILITIES: BEYOND THE CAPM

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ABSTRACT

The Capital Asset Pricing Model (CAPM) is applied in regulatory cases to estimate the required rate of return, or cost of equity, for low-beta, value-style energy utilities, despite the model's well documented mispricing of investments with similar characteristics. This paper examines CAPM-based estimates for a sample of American and Canadian energy utilities to assess the risk premium error. We find that the CAPM significantly underestimates the risk premium for energy utilities compared to its historical value by an annualized average of more than 4%. Two CAPM extensions, the Fama-French model and an adjusted CAPM, provide econometric estimates of the risk premium that do not present a significant misevaluation.

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1. INTRODUCTION

An important aspect of the regulatory process for energy utilities is the determination of their equity rate of return. This return, also known as the cost of equity capital, represents the expected remuneration of the shareholders of the utilities. It is a crucial component of their total cost of capital, which is central to their investment policy and serves as a basis for setting up the rates to their customers. The purpose of this paper is to highlight the problems of the most commonly used model to determine the equity rate of return for energy utilities and to propose two alternative models that empirically improve on the estimation. By providing new direct and focused evidence for energy utilities, our analysis contributes to the knowledge of energy, regulatory and financial economists, as well as regulators, who are concerned with rate determination.

Regulatory bodies, like the National Energy Board in Canada or the Federal Energy Regulatory Commission in the United States, have the mandate to set the equity rate of return so that it is fair and reasonable. Specifically, according to Bonbright, Danielsen and Kamerschen (1988, Chap. 10), the return should provide the ability to attract and retain capital (the capital-attraction criterion), encourage efficient managerial practice (the management-efficiency criterion), promote consumer rationing (the consumer-rationing criterion), give a reasonably stable and predictable rate level to ratepayers (the rate-level stability and predictability criterion) and ensure fairness to investors (the fairness to investors criterion). While the first four criteria are designed primarily in the interest of the consuming public, the last criterion acts as an equally-important protection for private owners against confiscatory regulation. Its requirement involves determining the return available from the application of the capital to other enterprises of like risk, which demands an understanding of the risk-return relationship in the equity market.

Traditionally, the regulated return has been set through hearings, where arguments on the issue of fairness could be debated. But since the 1990s, numerous boards have adopted an annual mechanism known as a "rate of return formula" or a "rate adjustment formula". This mechanism determines automatically the allowed rate of return through a calculation that explicitly accounts for the risk-return relationship in the equity market. The use of rate adjustment formulas is particularly prevalent in Canada since the landmark March 1995 decision by the National Energy Board (Decision RH-2-94), which sets the stage for the widespread adoption of closely related formulas by provincial regulators.

Most rate adjustment formulas use a method known as the Equity Risk Premium method.[1] This method can be summarized as calculating a utility's equity rate of return as the risk-free rate of return plus a premium that reflects its risk. The risk-free rate is usually related to the yield on a long-term government bond. The risk premium is obtained from the Capital Asset Pricing Model (CAPM) of Sharpe (1964) and Lintner (1965), a classic model of capital market equilibrium. It is equal to the utility's beta, a measure of its systematic risk, multiplied by the market portfolio risk premium. The Equity Risk Premium method has a number of

[1] There exist other methods for estimating the rate of return, most notably the Comparable Earnings method and the Discounted Cash Flows method. See Morin (2006) for a description. These methods are generally not directly incorporated in the rate adjustment formulas.

advantages. First, it is supported by a solid theoretical foundation in the academic literature, thus providing a sound basis for understanding the risk-return relationship. Second, it can be estimated based on stock returns, thereby making it more objective than other methods, and relating it to current market conditions. Third, it is relatively simple to apply and requires data that can be obtained easily.

The Equity Risk Premium method is not, however, without shortcomings. Arguably its most criticized feature is the use of the CAPM as the basis to determine the risk premium. While the CAPM is one of the most important developments in finance, research over the last forty years has produced a large body of work critical of the model. On the theoretical side, Cochrane (1999) summarizes the current most prevalent academic view: "In retrospect, it is surprising that the CAPM worked so well for so long. The assumptions on which it is built are very stylized and simplified."[2] For example, at least since Merton (1973), it is recognized that factors, state variables or sources of priced risk beyond the movements in the market portfolio (the only risk factor in the CAPM) might be needed to explain why some risk premiums are higher than others. On the empirical side, the finance literature abounds with CAPM deficiencies (so-called "anomalies"). Fama and French (2004) review this literature to highlight that the CAPM is problematic in the estimation of the risk premium of low-beta firms, small-capitalisation firms and value (or low-growth) firms. While these problems have been well documented in the finance literature, their effects have not yet been fully explored for energy utilities, which may be part of the reasons why the CAPM is still widely used in rate adjustment formulas. In particular, as the CAPM does not empirically provide a valid risk-return relationship for the equity market, it might fall short of the requirement associated with the fairness to investors' criterion.

Considering the importance of the CAPM in determining the regulated equity rate of return, the objectives of this paper are two-folds. First, we re-examine the use of the model in the context of energy utilities to determine if it is problematic. As utilities are typically low-beta, value-oriented investments, the finance literature suggests that the model will have difficulties in estimating their risk premiums. We analyze the issue empirically by estimating the model and its resulting risk premiums for a sample of Canadian and American energy utilities mostly related to the gas distribution sector, and by testing for the presence of significant differences between the model's risk premium estimates and the historical ones.

Second, we implement two alternative models that are designed to circumvent some of the empirical problems of the CAPM. The first alternative is a three-factor model proposed by Fama and French (1993) (the Fama-French model hereafter). This model has been used to estimate the cost of equity by Fama and French (1997) for general industrial sectors and by Schink and Bower (1994) for the utilities sector in particular. The second alternative is a modified CAPM that includes the adjustments proposed by Blume (1975) and Litzenberger, Ramaswamy and Sosin (1980) (the Adjusted CAPM hereafter). The Fama-French model and the Adjusted CAPM provide useful comparisons with the CAPM on the estimation of the risk premiums of energy utilities.

Our empirical results can be summarized as follows. First, the CAPM significantly underestimates the risk premiums of energy utilities compared to their

[2] Cochrane (1999), p. 39.

historical values. The underestimations are economically important, with annualized averages of respectively 4.5% and 6.2% for the Canadian and American gas utilities we consider, and are consistent with the finance literature on the mispricing of low-beta, value-oriented stocks. Second, the Fama-French model and the Adjusted CAPM are both able to provide costs of equity that are not significantly different from the historical ones. Our results show that the value premium, in the case of the Fama-French model, and a bias correction, in the case of the Adjusted CAPM, are important in eliminating the CAPM underestimations. Both models suggest average risk premiums between 4% and 8% for gas utilities portfolios, and are relevant at the individual utility level as well as at the utilities sector level.

Overall, we conclude that the CAPM is problematic in estimating econometrically the cost of equity of energy utilities. The Fama-French model and the Adjusted CAPM are well specified for this purpose as they reduce considerably the estimation errors. These models could thus be considered as alternatives to the CAPM in the Equity Risk Premium method employed by regulatory bodies to obtain the risk-return relationship for the fairness to investors' criterion.

The CAPM dates back to the mid-1960s. While the model is tremendously important, there has been a lot of progress over the last 45 years in the understanding of the cross-section of equity returns. It should be clear that the goals of this paper are not to implement full tests of asset pricing models or examine comprehensively the numerous models in the equity literature. Focusing on energy utilities, this paper is an application of the CAPM and two reasonable and relevant alternatives to the problem of cost of equity estimation, using a standard methodology. Our findings show that it is potentially important to go beyond the CAPM for energy utilities. They represent an invitation to further use the advances in the literature on the cross-section of returns to better understand their equity rate of return.

The rest of the paper is divided as follows. The next section presents our sample of energy utilities and reference portfolios. The third, fourth and fifth sections examine the risk premium estimates with the CAPM, the Fama-French model and the Adjusted CAPM, respectively. Each section provides an overview of the model, presents its empirical estimation and results, and discusses the implications of our findings. The last section concludes.

2. Sample Selection and Descriptive Statistics

This section examines the sample of firms and portfolios for our estimation of the cost of equity of energy utilities. We focus on the gas distribution sector to present complete sector-level and firm-level results, but we also consider utilities indexes to ensure the robustness to other utilities. We provide Canadian and American results for comparison, as both energy markets are relatively integrated and investors might expect similar returns. We first discuss sample selection issues and then present descriptive statistics.

2.1. Sample Selection

Two important choices guide our sample selection process. First, we use monthly historical data in order to have sufficient data for estimating the parameters and test statistics, while avoiding the microstructure problems of the stock markets (low liquidity for numerous securities, non-synchronization of transactions, etc.) in higher frequency data.[3] We then annualized our results for convenience. Second, we emphasize reference portfolios (such as sector indexes) over individual firms. Reference portfolios reduce the potentially large noise (or diversifiable risk) in the stock market returns of individual firms. They allow for an increased statistical accuracy of the estimates, an advantage recognized since (at least) Fama and MacBeth (1973), and alleviate the problem that we do not observe the returns on utilities directly and must rely on utility holding companies.

To represent the gas distribution sector in Canada and the U.S., we use a published index and a constructed portfolio for each market. The independently-calculated published indexes are widely available and consider the entire history of firms having belonged to the gas distribution sector. The constructed portfolios use the most relevant firms at present in the gas distribution or energy utility sector. The data collection also allows an examination of the robustness of our results at the firm level. The resulting four gas distribution reference portfolios are described below:

- *DJ_GasDi*: A Canadian gas distribution index published by Dow Jones, i.e. the "Dow Jones Canada Gas Distribution Index." The firms in the index are weighted by their market value. Monthly returns (180) are available from January 1992 to December 2006;
- *CAindex*: An equally-weighted constructed portfolio formed of 13 Canadian energy utilities, most with activities that are related to the gas distribution sector, i.e. ATCO Ltd., Algonquin Power Income Fund, Canadian Utilities Limited, EPCOR Power, Emera Incorporated, Enbridge Inc., Fort Chicago Energy Partners, Fortis Inc., Gaz Métro Limited Partnership, Northland Power Income Fund, Pacific Northern Gas, TransAlta Corporation and TransCanada Pipelines.[4] Monthly returns (263) are available from February 1985 to December 2006;
- *DJ_GasUS*: A U.S. gas distribution index published by Dow Jones, i.e. the "Dow Jones US Gas Distribution Index." The firms in the index are weighted by their market value. Monthly returns (180) are available from January 1992 to December 2006;
- *USindex*: An equally-weighted constructed portfolio formed of nine U.S. firms whose activities are heavily concentrated in local gas distribution, i.e. AGL Resources Inc., Atmos Energy Corp., Laclede Group, New Jersey Resources Corp., Northwest Natural Gas Co., Piedmont Natural Gas Co., South Jersey Industries, Southwest Gas Corp. and WGL Holdings Inc. Monthly returns (407) are available from February 1973 to December 2006.

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[3] See Fowler, Rorke and Jog (1979, 1980) for an analysis of these problems in the Canadian stock markets.

[4] We also considered AltaGas Utility Group, Enbridge Income Fund, Westcoast Energy, Nova Scotia Power and Energy Savings Income Fund. We did not retain the first four because they had a returns history of less than 60 months. We eliminated the last one because it is a gas broker and its average monthly return of more than 3% was a statistical outlier. Our results are robust to variations in the formation of the CAindex portfolio, like the inclusion of these five firms or the exclusion of income funds and limited partnerships.

To confirm the validity of our analysis to other energy utilities, we also consider four utilities reference portfolios, which consist of the utilities sector indexes described below:

- *DJ_Util*: A Canadian utilities index published by Dow Jones, i.e. the "Dow Jones Canada Utilities Index." The firms in the index are weighted by their market value. Monthly returns (180) are available from January 1992 to December 2006;
- *TSX_Util*: A Canadian utilities index published by S&P/TSX, i.e. the "S&P/TSX Utilities Index." The firms in the index are weighted by their market value. Monthly returns (228) are available from January 1988 to December 2006;
- *DJ_UtiUS*: A U.S. utilities index published by Dow Jones, i.e. the "Dow Jones US Utilities Index." The firms in the index are weighted by their market value. Monthly returns (180) are available from January 1992 to December 2006;
- *FF_Util*: A U.S. utilities index formed by Profs. Fama and French, or the University of Chicago and Dartmouth College, respectively. The firms in the index are weighted by their market value. Monthly returns (407) are available from February 1973 to December 2006.

Depending on their availability, the reference portfolio series have different starting dates. In our econometric estimation, we keep the maximum number of observations for each series. Fama and French (1997) find that such a choice results in costs of equity more precisely estimated and with more predictive ability than costs of equity obtained from rolling five-year estimation windows, a common choice in practice. The data are collected from the Canadian Financial Markets Research Center (CFMRC), Datastream and the web sites of Prof. French[5] and Dow Jones Indexes[6].

2.2. Descriptive Statistics

Descriptive statistics for the monthly returns are presented in Table 1. Panel A shows the results for the 13 Canadian energy utilities and their equally-weighted portfolio (CAindex). Panel B shows the results for nine U.S. gas distribution utilities and their equally-weighted portfolio (USindex). Panel C shows the statistics for Canadian and U.S. indexes for the utilities sector (DJ_Util, DJ_UtilUS, TSX_Util and FF_Util) and the gas distribution sub-sector (DJ_GasDi and DJ_GasUS).[7]

[5] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

[6] http://www.djindexes.com/mdsidx/index.cfm?event=showtotalMarketIndexData&perf=Historical%20Values

[7] The returns from August to November 2001 of the Dow Jones U.S. indexes are strongly influenced by the Enron debacle, which started with the resignation of its CEO, Jeffrey Skilling, on August 14, 2001 and ended with the bankruptcy of the company on December 2, 2001. During those four months, the DJ_GasUS and DJ_UtiUS indices lost 68.9% and 16.2% of their value, respectively. By comparison, the equally-weighted portfolio of U.S. gas distributors (USindex) gained 1.2% and the Fama-French utilities index (FF_Util) lost 6.2 %. In order to soften the impact of that statistical aberration (caused by an unprecedented fraud) on the estimation of the risk premium, the returns from August to November 2001 of DJ_GasUS and DJ_UtilUS are replaced by those of USindex and FF_Util, respectively.

TABLE 1
Descriptive Statistics of Monthly Returns

Variable	N	Mean	St Dev	Min	Max	Brief Description
Panel A: Canadian Energy Utilities						
ATCO	263	0.013	0.067	-0.301	0.279	ATCO Ltd.
Algonqui	108	0.009	0.054	-0.163	0.166	Algonquin Power Income Fund
CanUtili	263	0.012	0.043	-0.107	0.159	Canadian Utilities Limited
EPCOR	114	0.008	0.046	-0.201	0.108	EPCOR Power
Emera	143	0.009	0.043	-0.137	0.115	Emera Incorporated
Enbridge	263	0.011	0.054	-0.365	0.205	Enbridge Inc.
FortChic	107	0.009	0.054	-0.119	0.210	Fort Chicago Energy Partners
Fortis	228	0.013	0.041	-0.134	0.146	Fortis Inc.
GazMetro	166	0.010	0.037	-0.134	0.084	Gaz Métro Limited Partnerships
NorthPow	104	0.011	0.063	-0.202	0.205	Northland Power Income Fund
PacNorth	263	0.010	0.070	-0.400	0.507	Pacific Northern Gas
TransAlt	263	0.009	0.048	-0.217	0.188	TransAlta Corporation
TransCan	258	0.008	0.054	-0.214	0.254	TransCanada Pipelines
CAindex	263	0.010	0.031	-0.130	0.087	Equally-weighted portfolio
Panel B: U.S. Gas Distribution Utilities						
AGL_Res	407	0.013	0.052	-0.138	0.253	AGL Resources Inc.
Atmos	277	0.013	0.063	-0.302	0.269	Atmos Energy Corp.
Laclede	407	0.012	0.056	-0.148	0.374	Laclede Group
NJ_Res	407	0.013	0.063	-0.171	0.577	New Jersey Resources Corp.
Northwes	407	0.012	0.060	-0.236	0.274	Northwest Natural Gas Co.
Piedmont	407	0.013	0.059	-0.188	0.315	Piedmont Natural Gas Co.
SouthJer	407	0.012	0.058	-0.194	0.486	South Jersey Industries
Southwes	407	0.011	0.070	-0.304	0.234	Southwest Gas Corp.
WGL_Hold	407	0.012	0.071	-0.232	0.807	WGL Holdings Inc.
USindex	407	0.012	0.041	-0.121	0.338	Equally-weighted portfolio
Panel C: Sector Indexes						
TSX_Util	228	0.010	0.037	-0.101	0.114	S&P/TSX Utilities Index
DJ_GasDi	180	0.012	0.043	-0.139	0.137	Dow Jones Canada Gas Distribution Index
DJ_Util	180	0.007	0.036	-0.139	0.101	Dow Jones Canada Utilities Index
DJ_GasUS	180	0.012	0.039	-0.120	0.143	Dow Jones US Gas Distribution Index
DJ_UtiUS	180	0.009	0.042	-0.127	0.136	Dow Jones US Utilities Index
FF_Util	407	0.010	0.041	-0.123	0.188	Fama-French US Utilities Index

NOTES: This table presents descriptive statistics on the monthly returns of 13 Canadian utilities and their equally-weighted portfolio (CAindex) in Panel A, of nine U.S. gas distribution utilities and their equally-weighted portfolio (USindex) in Panel B, and on selected utilities sector indexes in Panel C. The columns labelled N, Mean, St Dev, Min and Max correspond respectively to the number of observations, the mean, the standard deviation, the minimum value and the maximum value. The column labelled Brief Description gives the full name of the utility holding companies or the utilities sector indexes.

For the Canadian energy utilities, the monthly average return of all 13 firms is 1.0% with a standard deviation of 3.1%. The Dow Jones Canada Gas Distribution Index, the Dow Jones Canada Utilities Index and the S&P/TSX Utilities Index have mean returns of 1.2%, 0.7% and 1.0%, respectively. The monthly average return of the nine U.S. gas distribution utilities is 1.2% with a standard deviation of 4.1%. The Dow Jones US Gas Distribution Index, the Dow Jones US Utilities Index and the Fama-French U.S. Utilities Index show mean returns of 1.2%, 0.9% and 1.0%, respectively. Correlations between the four gas distribution reference portfolios (not tabulated) are between 0.29 and 0.80. These correlations indicate that the portfolios show some commonality, but are not perfect substitutes. We next start our analysis of the equity risk premium models.

3. EQUITY RISK PREMIUM WITH THE CAPM

This section examines the use of the Capital Asset Pricing Model (CAPM) for estimating the rate of return for energy utilities. The CAPM is the model the most often associated with the Equity Risk Premium method that is the basis of the rate adjustment formulas of regulatory bodies. We first present the model and its relevant literature. Then we estimate the model for our sample of energy utilities. Finally, we discuss the implications of our findings.

3.1. Model and Literature

The CAPM is a model proposed by Sharpe (1964) and Lintner (1965) in which the expected equity return or cost of equity for a gas utility is given by

$$E(R_{GAS}) = R_f + \beta \times \lambda_m ,$$

where R_f is the risk-free rate, β is the firm's beta or sensitivity to the market returns and λ_m is the market risk premium. In this model, a higher beta results in a higher risk premium.

The CAPM is the best known model of expected return. In spite of its undeniable importance in the field of finance, it has long been rejected by numerous empirical tests in the academic literature. The empirical rejections start with the first tests (Black, Jensen and Scholes, 1972, Fama and MacBeth, 1973, and Blume and Friend, 1973) that find that the relation between beta and average return is flatter than predicted by the model. They continue with the discovery of numerous "anomalies" (like the price-to-earnings effect of Basu, 1977, the size effect of Banz, 1981, etc.). Finally, in the 1990s, based on high-impact articles, including Fama and French (1992, 1993, 1996a and 1996b), Jegadeesh and Titman (1993) and Jagannathan and Wang (1996), the academic profession reaches a relative consensus that the CAPM is not valid empirically. In Canada, like elsewhere in the world, the literature reaches similar conclusions (see Morin, 1980, Bartholdy, 1993, Bourgeois and Lussier, 1994, Elfakhani, Lockwood and Zaher, 1998, L'Her, Masmoudi and Suret, 2002, 2004.).

A complete review of the literature on the problems of the CAPM is beyond the scope of this paper. It is nevertheless important to point out the two characteristics of energy utilities that suggest the CAPM might be problematic in estimating their equity return. First, energy utilities have typically low betas, significantly below one. Second, they are known as value investments, in the sense that they have high earnings-to-price, book-to-market, cash flows-to-price or dividend-to-price ratios. In a summary article requested for a symposium on the 40th anniversary of the CAPM, Fama and French (2004) highlight the result of using the model to estimate the cost of equity capital for firms with these two characteristics:

> "As a result, CAPM estimates of the cost of equity for high beta stocks are too high (relative to historical average returns) and estimates for low beta stocks are too low (Friend and Blume, 1970). Similarly, if the high average returns on value stocks (with