Factor Investing in the Corporate Bond Market

Patrick Houweling

Jeroen van Zundert, CFA

**Appendix A. Robustness Checks**

## Using Corporate Bond Data for Alternative Factor Definitions

Although we believe that the definitions presented in the article are suitable representations of the factors, they are by no means the only way to define them. This is similar to the choices investors face when applying factor investing in the equity market, where multiple definitions could be used to capture a factor. For instance, the equity value factor can be defined as the book-to-market ratio, the price-to-earnings ratio, or the dividend yield. Likewise, momentum can be calculated over various formation periods. In this section, we provide empirical evidence for alternative factor definitions in the corporate bond market.

Our base case definition of size**,** which we will refer to as S0, is the total market capitalization of all bonds of a company in the index. Our alternative definition, S1, does not look at *company* size but, rather, at *bond* size by selecting the 10% of the bonds with the smallest market capitalization in the index.

For low risk, the base case definition (LR0) selects the 10% shortest-maturity bonds within the highest ratings: AAA/AA/A for investment grade and BB/B for high yield. Our first alternative definition, LR1, is more restrictive in the rating dimension by choosing from AAA rated and AA rated bonds in investment grade and from BB rated bonds in high yield. Otherwise, LR1 uses the same construction method. Our second alternative definition of low risk (LR2) uses spread and maturity as risk measures, instead of rating and maturity as in the base case. LR2 selects the one-third of the bonds with the shortest maturities within the one-third of the bonds with the lowest credit spreads. It thus contains 11% of the bonds, which is very close to the 10% used in the previous definitions. The final alternative definition (LR3) selects the 10% of the bonds with the lowest duration times spread (DTS). Ben Dor, Dynkin, Hyman, Houweling, van Leeuwen, and Penninga (2007) found strong evidence that DTS is a predictor of the volatility of a corporate bond; de Carvalho, Dugnolle, Lu, and Moulin (2014) demonstrated the existence of a low-risk effect across various fixed-income markets using DTS as the risk measure.

The value base case definition (V0) conducts a regression of spread on minor rating (AAA, AA+, AA, … C) dummies, maturity, and three-month spread change and selects the 10% bonds for which the percentage deviation between the market spread and the fitted spread is the largest. The first alternative definition (V1) uses rating and maturity as in the base case, but instead of a regression, it first creates three equally populated maturity buckets within each major rating group (AAA/AA, A, BBB, BB, B, CCC/CC/C) and then selects the 10% highest spreads within each rating-times-maturity peer group. The second alternative value definition (V2) is a direct translation of the book-to-market measure in the equity market by selecting the 10% of the bonds with the highest ratio of notional amount to market value (i.e., the reciprocal of the bond price).

For momentum, we use a formation period of 6 months in the base case definition (M0); for the alternative definitions (M1, M2, and M3), we change the formation period to 3 months, 9 months, and 12 months, respectively.

**Table A1** shows key statistics for both the alternative definitions and the base case definitions to facilitate the comparison. For the size factor (Panel A), we consider bond size as an alternative to company size. The bond size measure yields a significant Sharpe ratio for high yield (0.54) but not for investment grade (0.22). There are two possible explanations. First, the alternative definition measures *bond* size rather than *company* size, so it proxies for bond illiquidity (see Sarig and Warga 1989). Because investment-grade bonds are generally more liquid than high-yield bonds (see Chen, Lesmond, and Wei 2007, Table I), the illiquidity premium is likely to be lower in investment grade. Second, a large percentage of the companies in the high-yield market have only one bond in the index (on average, 65% versus 30% for investment grade), so the difference between selecting small bonds or small companies is smaller.

For the low-risk factor, there is a strong consistency in the results in Panel B, because all three alternative definitions generate significantly positive alphas, varying between 0.42% (1.80%) and 0.65% (2.20%) for investment grade (high yield).

For the value factor, the results in Panel C show that for investment grade, both alphas (1.21% and 1.64%) pass the significance tests whereas for high yield, one alpha (3.70%) is significant and the other alpha (1.53%) is positive but insignificant.

Finally, in Panel D, we see that for both investment grade and high yield, the shorter formation period of three months generates significantly positive alphas of 0.50% and 2.35%, respectively. The alphas decrease as the formation period increases. For high yield, 9-month momentum and 12-month momentum still deliver positive alphas of 1.52% and 0.78%; for investment grade, both alphas are around 0. As noted earlier, the absence of a momentum effect in investment grade is a common finding in the literature.

It is evident from Table A1 that the results are robust to alternative definitions of the factors.

**Table A1. Performance Statistics of Long-Only Factor Portfolios for Various Factor Definitions, January 1994–June 2015**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Investment Grade | | | |  | High Yield | | | |
| Mean | Volatility | Sharpe Ratio | CAPM Alpha |  | Mean | Volatility | Sharpe Ratio | CAPM Alpha |
| *A. Size* |  |  |  |  |  |  |  |  |  |
| S0: Company size | 1.61% | 3.82% | 0.42\* | 1.12%\* |  | 7.83% | 12.20% | 0.64\*\* | 5.68%\* |
| S1: Bond size | 1.17 | 5.43 | 0.22 | 0.65 |  | 8.31 | 15.47 | 0.54\* | 5.34\* |
|  |  |  |  |  |  |  |  |  |  |
| *B. Low risk* |  |  |  |  |  |  |  |  |  |
| LR0: AAA/AA/A, BB/B; short maturity | 0.91% | 2.24% | 0.41\* | 0.70%\*\* |  | 3.78% | 6.69% | 0.56\*\* | 2.39%\*\* |
| LR1: AAA/AA, BB; short maturity | 0.71 | 2.71 | 0.26 | 0.42\* |  | 3.52 | 6.11 | 0.58\*\* | 2.20\*\* |
| LR2: Spread × Maturity | 0.96 | 2.76 | 0.35\*\* | 0.65\*\* |  | 3.60 | 8.09 | 0.45\*\* | 1.81\*\* |
| LR3: DTS | 0.71 | 1.04 | 0.68\*\* | 0.60\*\* |  | 2.59 | 3.89 | 0.67\*\* | 1.80\*\* |
|  |  |  |  |  |  |  |  |  |  |
| *C. Value* |  |  |  |  |  |  |  |  |  |
| V0: Spread regression maturity + Rating + Delta spread | 1.79% | 6.76% | 0.27\* | 1.06% |  | 6.58% | 13.37% | 0.49\*\* | 3.72%\* |
| V1: Rating × Maturity × Spread | 2.49 | 7.88 | 0.32\* | 1.64\*\* |  | 5.13 | 17.01 | 0.30 | 1.53 |
| V2: Bond book-to-market | 2.09 | 8.13 | 0.26 | 1.21\* |  | 7.99 | 21.45 | 0.37 | 3.70\* |
|  |  |  |  |  |  |  |  |  |  |
| *D. Momentum* |  |  |  |  |  |  |  |  |  |
| M0: 6 Months | 0.80% | 4.32% | 0.19 | 0.35% |  | 4.37% | 10.29% | 0.42\* | 2.15%\* |
| M1: 3 Months | 1.04 | 4.99 | 0.21 | 0.50\* |  | 4.78 | 11.16 | 0.43\*\* | 2.35\* |
| M2: 9 Months | 0.53 | 3.92 | 0.13 | 0.14 |  | 3.54 | 9.60 | 0.37 | 1.52 |
| M3: 12 Months | 0.34 | 3.84 | 0.09 | –0.04 |  | 2.75 | 9.40 | 0.29 | 0.78 |
|  |  |  |  |  |  |  |  |  |  |
| *E. Equity definitions* |  |  |  |  |  |  |  |  |  |
| Size: Equity market cap | 1.33% | 4.73% | 0.28 | 0.85% |  | 5.11% | 14.24% | 0.36 | 2.42% |
| Low risk: Equity volatility | 0.66 | 3.64 | 0.18 | 0.28 |  | 2.79 | 7.74 | 0.36 | 1.18 |
| Value: Equity book-to-market | 0.97 | 7.18 | 0.13 | 0.22 |  | 3.66 | 15.98 | 0.23 | 0.58 |
| Momentum: 12-Month equity return | 1.03 | 3.94 | 0.26 | 0.60\* |  | 2.98 | 8.59 | 0.35 | 1.13 |

*Notes:* This table reports performance statistics for the base case and alternative definitions of the size, low-risk, value, and momentum factors for US investment-grade and US high-yield corporate bonds. See Table 3 in the article for details on the construction of the factor portfolios and the text of this appendix for the definitions of the factors. The left-hand side of the table shows the mean, volatility, Sharpe ratio, and CAPM alpha for investment grade; the right-hand side shows the same for high yield. Mean, volatility, and alpha are annualized. Corporate bond returns are measured as excess returns versus duration-matched Treasuries. Statistical significance is determined through two-sided tests of whether the Sharpe ratio is different from the Sharpe ratio of the corporate bond market (test in Jobson and Korkie 1981) and whether the CAPM alpha is different from zero (*t*-test with Newey–West standard errors).

\*Significant at the 5% level.

**\*\***Significant at the 1% level.

## Using Equity Data for Alternative Factor Definitions

In the previous section, we analyzed alternative definitions using bond market information. In this section, we test whether equity factor definitions also generate premiums in the corporate bond market. For this analysis, we link all corporate bonds in our sample to the parent company. This reduces the sample size from 1.3 million to 1.1 million bond-month observations, because not all companies have publicly listed equity. For size, we construct decile portfolios of corporate bonds by ranking on the company’s equity market capitalization; for low risk, we use the one-year volatility of daily equity returns; for value, we use the book-to-market ratio; for momentum, we use 12 – 1 month equity returns. We might call these definitions “stock-bond factor spillovers,” in the spirit of “stock-bond momentum spillover” (see Gebhardt, Hvidkjaer, and Swaminathan 2005; Bektic, Wenzler, Wegener, Schiereck, and Spielmann 2016).

Panel E of Table A1 shows the results. All equity spillover definitions generate positive alphas as well as Sharpe ratios that are higher than the Sharpe ratio of the corporate bond market. However, only for momentum spillover in investment grade is the alpha statistically significant; in fact, the alpha is even higher than that of corporate bond momentum itself, consistent with Gebhardt et al. (2005) and Haesen, Houweling, and van Zundert (2015).

This analysis shows that although the equity spillover definitions generate a premium in the corporate bond market, they do not work as well as the bond-based definitions (with the exception of momentum spillover). So, factor investing in corporate bonds requires the explicit use of bond market information—investors cannot merely copy the equity definitions.

## Controlling for Rating, Maturity, or Sector Effects

Factor portfolios could, either structurally or temporarily, exhibit preferences for particular market segments, such as credit ratings, maturity buckets, or sectors. To determine to what extent our results are affected by such preferences, we construct rating-neutral, maturity-neutral, and sector-neutral factor portfolios. First, we divide the sample into groups (e.g., using credit ratings). Then, we select the top 10% based on a particular factor in each group. Finally, we merge the decile portfolios of all groups to construct the group-neutral factor portfolio. We conduct this analysis for all factors with respect to credit ratings (AAA/AA, A, BBB, BB, B, and CCC/CC/C), maturities (five equal-sized groups), and sectors (Consumer Cyclical, Consumer Non-Cyclical, Energy + Utilities, Industrials, Financials, Others). The exception is the low-risk factor, for which we do not control for rating and maturity because they are an integral part of the definition of low risk.

The results are shown in **Table A2**. In general, we find that the performance of the factor portfolios is robust to controlling for rating, maturity, or sector effects. For both investment grade and high yield, all Sharpe ratios remain statistically significant and most are very similar to those in the base case. The same is true for the alphas, with a few exceptions. An interesting improvement can be observed for momentum in investment grade: The maturity-neutral portfolio construction results in a significantly higher Sharpe ratio than that of the corporate bond market and in a significant alpha as well (see Panel D).

**Table A2. Performance Statistics of Long-Only Factor Portfolios Controlled for Rating, Maturity, or Sector Effects, January 1994–June 2015**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Investment Grade | | | |  | High Yield | | | |
|  | Mean | Volatility | Sharpe Ratio | CAPM Alpha |  | Mean | Volatility | Sharpe Ratio | CAPM Alpha |
| *A. Size* |  |  |  |  |  |  |  |  |  |
| Base case | 1.61% | 3.82% | 0.42\* | 1.12%\* |  | 7.83% | 12.20% | 0.64\*\* | 5.68%\* |
| Rating neutral | 1.43 | 3.68 | 0.39\* | 1.07 |  | 5.52 | 9.72 | 0.57\*\* | 3.64\* |
| Maturity neutral | 1.59 | 4.06 | 0.39\* | 1.20 |  | 7.44 | 12.55 | 0.59\* | 5.18\* |
| Sector neutral | 1.53 | 3.66 | 0.42\* | 1.17\* |  | 7.02 | 12.23 | 0.57\* | 4.85\* |
|  |  |  |  |  |  |  |  |  |  |
| *B. Low risk* |  |  |  |  |  |  |  |  |  |
| Base case | 0.91% | 2.24% | 0.41\* | 0.70%\*\* |  | 3.78% | 6.69% | 0.56\*\* | 2.39%\*\* |
| Sector neutral | 0.89 | 1.59 | 0.56\*\* | 0.73\*\* |  | 3.22 | 6.42 | 0.50\*\* | 1.86\*\* |
|  |  |  |  |  |  |  |  |  |  |
| *C. Value* |  |  |  |  |  |  |  |  |  |
| Base case | 1.79% | 6.76% | 0.27\* | 1.06% |  | 6.58% | 13.37% | 0.49\*\* | 3.72%\* |
| Rating neutral | 1.87 | 6.65 | 0.28\* | 1.14\* |  | 6.36 | 13.36 | 0.48\*\* | 3.49\* |
| Maturity neutral | 1.85 | 6.70 | 0.28\* | 1.12\* |  | 6.27 | 13.75 | 0.46\*\* | 3.33\* |
| Sector neutral | 1.79 | 5.97 | 0.30\*\* | 1.14\* |  | 5.15 | 12.75 | 0.40\* | 2.43 |
|  |  |  |  |  |  |  |  |  |  |
| *D. Momentum* |  |  |  |  |  |  |  |  |  |
| Base case | 0.80% | 4.32% | 0.19 | 0.35% |  | 4.37% | 10.29% | 0.42\* | 2.15%\* |
| Rating neutral | 0.73 | 4.32 | 0.17 | 0.27 |  | 3.64 | 9.40 | 0.39 | 1.59 |
| Maturity neutral | 1.09 | 4.25 | 0.26 | 0.63\* |  | 4.32 | 10.53 | 0.41\* | 2.05\* |
| Sector neutral | 0.73 | 4.28 | 0.17 | 0.28 |  | 3.87 | 10.25 | 0.38 | 1.65 |

*Notes:* This table reports performance statistics for the base case and rating-, maturity-, and sector-neutral alternatives of the size, low-risk, value, and momentum factors for US investment-grade and US high-yield corporate bonds. See Table 3 in the article for details on the construction of the factor portfolios. The rating-, maturity-, and sector-neutral portfolios are formed by first creating factor portfolios per rating group (AAA/AA, A, BBB, BB, B, CCC/CC/C), maturity group (five equal-sized groups), or sector (Consumer Cyclical, Consumer Non-Cyclical, Energy + Utilities, Industrials, Financials, Others) and then combining all groups to form the final factor portfolio. The left-hand side of the table shows the mean, volatility, Sharpe ratio, and CAPM alpha for investment grade; the right-hand side shows the same for high yield. Mean, volatility, and alpha are annualized. Corporate bond returns are measured as excess returns versus duration-matched Treasuries. Statistical significance is determined through two-sided tests of whether the Sharpe ratio is different from the Sharpe ratio of the corporate bond market (test in Jobson and Korkie 1981) and whether the CAPM alpha is different from zero (*t*-test with Newey–West standard errors).

\*Significant at the 5% level.

**\*\***Significant at the 1% level.

## Constructing Portfolios on a Liquid Subsample

A concern when investing in corporate bonds is that they are less liquid than stocks. To examine the effect of liquidity on the performance of factor portfolios, we restrict our bond sample to a liquid subset by choosing the most liquid bond of each company. We use the age (time since issuance) and size (amount outstanding) of each bond as liquidity criteria, because previous studies have shown that these are effective liquidity proxies (see, e.g., Sarig and Warga 1989; Crabbe and Turner 1995). In each month and for each company, we use the following procedure:

1. We limit the set of bonds of the company to bonds with an age of at most two years. If no bonds are younger than two years, we limit the set to bonds with an age of at most four years. If no such bonds are found, we select all bonds of the company.
2. Within the age-restricted set of bonds, we select the largest bond.

**Table A3** shows performance statistics of the factor portfolios constructed on both the liquid subset and the full dataset for ease of comparison. For investment grade, almost all Sharpe ratios and alphas remain statistically significant and are very similar to those in the base case; the same is true for *all* the high-yield statistics. We thus conclude that the performance of the factor portfolios is robust to liquidity effects.

**Table A3. Performance Statistics of Long-Only Factor Portfolios on Liquid Subsample, January 1994–June 2015**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Investment Grade | | | |  | High Yield | | | |
|  | Mean | Volatility | Sharpe Ratio | CAPM Alpha |  | Mean | Volatility | Sharpe Ratio | CAPM Alpha |
| *A. Size* |  |  |  |  |  |  |  |  |  |
| All bonds | 1.25% | 4.02% | 0.31\* | 1.25%\* |  | 7.89% | 12.40% | 0.64\*\* | 5.71%\* |
| Liquid subsample | 1.49 | 3.85 | 0.39\* | 1.11 |  | 8.04 | 12.42 | 0.65\*\* | 5.85\* |
|  |  |  |  |  |  |  |  |  |  |
| *B. Low risk* |  |  |  |  |  |  |  |  |  |
| All bonds | 0.91% | 2.24% | 0.41\* | 0.70%\*\* |  | 3.78% | 6.69% | 0.56\*\* | 2.39%\*\* |
| Liquid subsample | 0.95 | 2.23 | 0.43\*\* | 0.72\*\* |  | 3.60 | 6.95 | 0.52\*\* | 2.14\*\* |
|  |  |  |  |  |  |  |  |  |  |
| *C. Value* |  |  |  |  |  |  |  |  |  |
| All bonds | 1.79% | 6.76% | 0.27\* | 1.06% |  | 6.58% | 13.37% | 0.49\*\* | 3.72%\* |
| Liquid subsample | 2.11 | 6.92 | 0.31 | 1.43 |  | 7.15 | 13.09 | 0.55\*\* | 4.47\* |
|  |  |  |  |  |  |  |  |  |  |
| *D. Momentum* |  |  |  |  |  |  |  |  |  |
| All bonds | 0.80% | 4.32% | 0.19 | 0.35% |  | 4.37% | 10.29% | 0.42\* | 2.15%\* |
| Liquid subsample | 1.17 | 4.06 | 0.29 | 0.75 |  | 4.55 | 9.95 | 0.46\*\* | 2.44\* |
|  |  |  |  |  |  |  |  |  |  |
| *E. Multi-factor* |  |  |  |  |  |  |  |  |  |
| All bonds | 1.28% | 3.98% | 0.32\*\* | 0.84%\*\* |  | 5.64% | 10.04% | 0.56\*\* | 3.49%\*\* |
| Liquid subsample | 1.43 | 4.11 | 0.35\*\* | 1.00\* |  | 5.83 | 10.18 | 0.57\*\* | 3.72\*\* |

*Notes:* This table reports performance statistics of the size, low-risk, value, and momentum factors for US investment-grade and US high-yield corporate bonds limited to the most liquid bond of each company. The most liquid bond is determined in two steps: (1) Limit the set of bonds to bonds with an age of at most two years, and if no such bonds are found, restrict to an age of at most four years—if still no bonds are found, select all bonds; (2) within the age-restricted set of bonds, select the bond with the largest amount outstanding. See Table 3 in the article for details on the construction of the factor portfolios. The left-hand side of the table shows the mean, volatility, Sharpe ratio, and CAPM alpha for investment grade; the right-hand side shows the same for high yield. Mean, volatility, and alpha are annualized. Corporate bond returns are measured as excess returns versus duration-matched Treasuries. Statistical significance is determined through two-sided tests of whether the Sharpe ratio is different from the Sharpe ratio of the corporate bond market (test in Jobson and Korkie 1981) and whether the CAPM alpha is different from zero (*t*-test with Newey–West standard errors).

\*Significant at the 5% level.

**\*\***Significant at the 1% level.

## Other Robustness Checks

We conduct three additional robustness checks (tables are available upon request). First, we evaluate market value-weighted portfolios instead of equally weighted portfolios. This means that the portfolios do not benefit from the size premium, leading to lower returns. The returns of the multi-factor portfolios decrease from 1.28% (5.64%) to 1.09% (5.03%) for investment grade (high yield). The Sharpe ratios also drop, to 0.27 and 0.49 from 0.32 and 0.56, respectively, but are still highly significant, with *t*-statistics larger than 3.0. A similar picture emerges for the CAPM alphas. The alphas drop from 0.84% (3.49%) to 0.64% (2.78%) for investment grade (high yield); the *t*-statistics remain high at 2.49 (3.21).

Second, we evaluate the factors using quintile portfolios instead of decile portfolios. In general, the results become a bit weaker, because the portfolios are less tilted toward the factors. The returns of the multi-factor portfolios decrease from 1.28% (5.64%) to 1.18% (4.63%) for investment grade (high yield). The Sharpe ratios drop to 0.31 and 0.48, respectively. However, the *t*-statistics remain large (3.49 and 3.52), indicating that the multi-factor portfolios still perform significantly better than the corporate bond market. Also, the alphas remain large and highly significant at 0.75% and 2.50% for investment grade and high yield.

Finally, we check the robustness of our results in subsamples. For example, it could be that our results are driven by the higher market volatility since 2007. We split our sample into two subsamples: for the first 10 years (January 1994–December 2003) and the remaining period (January 2004–June 2015). The Sharpe ratio of the investment-grade long-only multi-factor portfolio over 1994–2003 (2004–2015) is 0.56 (0.27) versus 0.32 for the full sample; the alpha is 0.90% (0.80%), with a *t*-statistic of 3.05 (1.56). For high yield, the Sharpe ratios of the multi-factor portfolio are 0.44 and 0.65 for 1994–2003 and 2004–2015, respectively; the alphas are 3.41% (with a *t*-statistic of 2.21) and 3.37% (*t*-statistic of 2.28).

## References

Bektic, Demir, Josef-Stefan Wenzler, Michael Wegener, Dirk Schiereck, and Timo Spielmann. 2016. “Extending Fama-French Factors to Corporate Bond Markets.” Working paper (ssrn.com/abstract=2715727).

Ben Dor, Arik, Lev Dynkin, Jay Hyman, Patrick Houweling, Erik van Leeuwen, and Olaf Penninga. 2007. “DTS (Duration Times Spread): A New Measure of Spread Exposure in Credit Portfolios.” *Journal of Portfolio Management*, vol. 33, no. 2: 77–100.

Chen, Long, David A. Lesmond, and Jason Wei. 2007. “Corporate Yield Spreads and Bond Liquidity.” *Journal of Finance*, vol. 62, no.1 (February): 119–149.

Crabbe, Leland E., and Christopher M. Turner. 1995. “Does the Liquidity of a Debt Issue Increase with Its Size? Evidence from the Corporate Bond and Medium-Term Note Markets.” *Journal of Finance*, vol. 50, no. 5: 1719–1734.

de Carvalho, Raul Leote, Patrick Dugnolle, Xiao Lu, and Pierre Moulin. 2014. “Low-Risk Anomalies in Global Fixed Income: Evidence from Major Broad Markets.” *Journal of Fixed Income*, vol. 23, no. 4: 51–70.

Gebhardt, William R., Soeren Hvidkjaer, and Bhaskaran Swaminathan. 2005. “Stock and Bond Market Interaction: Does Momentum Spill Over?” *Journal of Financial Economics*, vol. 75, no. 3 (March): 651–690.

Haesen, Daniel, Patrick Houweling, and Jeroen van Zundert. 2015. “Momentum Spillover from Stocks to Corporate Bonds.” Working paper (ssrn.com/abstract=2131032).

Jobson, J. Dave, and Bob M. Korkie. 1981. “Performance Hypothesis Testing with the Sharpe and Treynor Measures.” *Journal of Finance*, vol. 36, no. 4 (September): 889–908.

Sarig, Oded, and Arthur D. Warga. 1989. “Bond Price Data and Bond Market Liquidity.” *Journal of Financial and Quantitative Analysis*, vol. 24, no. 3 (September): 367–378.