

## Arson and Abandonment: A Restatement

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### Abstract

Tobin's  $q$  ratio is identified as an significant variable in a revised version of the arson abandonment model formulated by the author in a 1981 *Journal* article. Empirical tests of the revised model generally validate the results found in the 1981 test with the  $q$  ratio being the most significant explanatory variable identified. It is concluded that arson rates, and hence arson abandonments, are sensitive to considerations of risk and return in a manner not dissimilar to legitimate financial decisions.

Cloninger (1981) presents a model of arson abandonment that reconciles traditional abandonment models developed in the finance literature with criminal offense models developed in the economic literature. The 1981 article attempts to define the conditions under which abandonment by arson in the current period is the wealth maximizing alternative for risk neutral firms. Under those conditions, arson would also be the wealth maximizing alternative for risk averse firms as long as the risk of abandonment by arson is equal to or less than the risk of continued operation or the risk of abandonment by legitimate means.<sup>1</sup> The same conclusions hold even if the risk of arson exceeds the risks of continued operation or legitimate abandonment as long as the expected returns of arson are sufficiently large to offset the increased risks of arson. (See Cloninger, 1985).

Cloninger (1981) implies that the decision to abandon an asset *by arson* is made only after deciding to abandon the asset *per se*. This sequence is not required. Arson will be the wealth maximizing decision even though abandonment by other means is not financially justifiable as long as the risk adjusted present value of arson abandonment is greater than that of continued

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I would like to express my appreciation to Roger Fowler for his tireless efforts in assimilating the data for this project. I also wish to thank the research department of Goldham, Sachs and Company for graciously and expeditiously providing data on Tobin's  $q$  and return on equity. Any errors found in this analysis are the sole responsibility of the author.

<sup>1</sup> Since 1964 the rate of arrest for arson has averaged just under one chance in six with a high of one chance in four and a low of one chance in 20.

operation. That is, abandonment by arson may be justified even when abandonment by legitimate methods is not.

The arson offense rate model specified in the 1981 article is given by:

$$R = K A^{b_1} B^{b_2} E^{b_3} Q^{b_4} \exp(u) \quad (1)$$

where  $R$  = Arson rate;  $K$  = Constant;  $A$  = Objective probability of arrest for arson;  $B$  = Business profit rate;  $E$  = Business failure rate and  $Q$  = Property crime (burglary) rate.

As the 1981 article notes, the insured value of assets is their replacement value which, for most assets, is normally less than their going concern or market value. If the market value of assets exceeds their replacement value, the likelihood that the assets will be abandoned by arson diminishes. That is, if the present value of their future cash flows from operations exceeds the present value of the cash flow that would be generated by their piecemeal liquidation, the assets are less likely to be destroyed and their insured value claimed. On the other hand, if their market value is less than their replacement value, there is greater incentive to abandon them by arson. It would, therefore, be expected that the arson rate would vary inversely with the ratio of market value to replacement value of assets generally. This ratio is the familiar Tobin  $q$ . Because of the potential importance of this ratio in explaining arson offense rates, the earlier model is revised to include the  $q$  ratio ( $T$ ). The model is now given by:

$$R = K A^{b_1} B^{b_2} E^{b_3} Q^{b_4} T^{b_5} \exp(u). \quad (2)$$

The revised model is tested utilizing a sample that is approximately twice the size of the 1981 sample. Data are now available for the years 1964 - 1987 with the exception of 1976 when, for lack of reliable data, the National Fire Protection Association declined to publish or report the incidence of arson. Arson arrests and the burglary rate are obtained from the *Uniform Crime Reports* published by the FBI. The business failure rate is obtained from Dun and Bradstreet while the business profit rate (return on equity for the Standard and Poor 400) and Tobin's  $q$  (the market value of firms divided by the replacement value of their assets) is provided by the research department of Goldman, Sachs and Company.

Empirical tests replicating the same log-linear OLS regression technique used in the 1981 test are employed and the results are given in Table 1 along with the empirical results of the 1981 model.

The empirical results are consistent with the 1981 model and support the inclusion of Tobin's  $q$  as an explanatory variable. The sign of the coefficient for  $T$  is consistent with a priori expectations and is significant beyond the .001 level. The coefficient indicates, *ceteris paribus*, that the percentage change in the arson rate is just over half the change in the  $q$  ratio.

An additional difference between the two models is the sign of the business failure rate which is reversed from the earlier test. This reversal is not unexpected for two reasons: 1) the positive sign found in the 1981 test is not

**Table 1**  
**Results of Empirical Tests of Arson Offense Models**  
 (Student t statistics given in parenthesis.)

| variable            | symbol | 1981 model        | revised model       |
|---------------------|--------|-------------------|---------------------|
| constant            | K      | -15.424<br>n.a.   | -4.130<br>(-3.57)** |
| Arrest              | A      | -.246<br>(-2.53)* | -.312<br>(-2.60)*   |
| Profit              | B      | .602<br>(3.22)**  | .319<br>(2.96)**    |
| Failure             | E      | .276<br>(1.47)    | -.119<br>(-2.55)*   |
| Burglary            | Q      | 3.079<br>(6.08)** | 1.004<br>(5.70)**   |
| Tobin q             | T      | —<br>—            | -.551<br>(6.34)**   |
| N                   |        | 12                | 23                  |
| R <sup>2</sup>      |        | .999              | .984                |
| R <sup>2</sup> adj. |        | n.a.              | .979                |
| DW                  |        | 1.99              | 2.02                |
| F                   |        | 166**             | 208**               |

\* Significance level  $\leq .05$ .

\*\* Significance level  $\leq .01$ .

significant at any conventional level and, 2) the negative sign is consistent with results found by Hershbarger and Miller (HM) (1978) in a time series test and by Brotman and Fox (BF) (1988) in a cross sectional test.<sup>2</sup> (The latter results are weak, however, and differ from BF's time series results.) Both tests use measures of the incidence as opposed to the rate of arson as dependent variables. Hershbarger and Miller dismiss the business failure rate as a possible explanatory variable because its negative coefficient appears to be inconsistent with their *a priori* expectations. They hypothesize that during periods of high business failure rates a greater number of assets are likely to be abandoned. Therefore, arson rates, reflecting one illegitimate method of abandonment, would also be expected to be high. This hypothesis is the basis

<sup>2</sup> Brotman and Fox criticize the time series technique used by HM for yielding correlations that may be misleading. They demonstrate that similar results cannot be produced using cross sectional state data. In their reply, HM cite the interdependencies among state variables for the reduced correlations produced by the cross sectional test. The present study differs from HM and BF in that the variables included in the model are determined *a priori* based on behavioral implications of the abandonment and criminal offense models. Empirical testing (employing time series analysis) proceeds only after the model is specified. Additionally, the error term, in the present study, is not correlated with any of the variables including time. A subject for future research is to test for similar results using data drawn from individual incidents in a cross sectional test.

for including the business failure rate in my 1981 model. While this hypothesis may possess face validity, it addresses only one possible interpretation of the business failure rate series.

An alternative interpretation is that the business failure rate serves as a surrogate for rates of return on assets in general and, hence, the opportunity costs of not abandoning unproductive or marginally productive assets. It could be theorized that during periods when the rate of business failures increases, rates of return on assets in general fall making the opportunity cost of holding an existing marginally productive asset decrease. That is, a high rate of business failures may reflect low rates of return on assets generally making the differential return between any given asset and the return on alternative assets small. Under these circumstances there is less incentive for asset holders to abandon one asset in favor of another. That is, the differential returns may be insufficient to justify the risk and/or the moral reluctance to abandon the asset by arson. Thus, arson rates may be negatively correlated with the business failure rate because the latter is an inverse proxy for rates of return on assets in general and, hence, a measure of the opportunity costs of holding unproductive or marginally productive assets. If so, then the negative correlation between the arson rate and business failure rate is not unexpected. The empirical results on the revised and updated model (as well as those found by HM and BF) are clearly consistent with the latter interpretation.

In conclusion, the current empirical test results of the revised and updated model add a measure of reliability and robustness to the empirical findings of the 1981 test. The evidence supports the hypothesis that arson rates are sensitive to risk-return considerations in a manner consistent with economic models of criminal behavior and financial models of abandonment. That is, arson rates appear to respond to risk and return measures in a manner that is consistent with attempts to maximize shareholder wealth.

### References

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**APPENDIX 1**

| <b>obs</b> | <b>Arson</b> | <b>Arrest</b> | <b>Burglary</b> | <b>Busfail</b> | <b>Replace</b> | <b>Roe</b> |
|------------|--------------|---------------|-----------------|----------------|----------------|------------|
| 1964       | 16.1700      | 0.2440        | 635.8000        | 53.0000        | 1.8100         | 10.9000    |
| 1965       | 17.5200      | 0.2630        | 663.2000        | 53.0000        | 1.8600         | 11.5000    |
| 1966       | 19.1200      | 0.2630        | 722.1000        | 52.0000        | 1.4900         | 11.2000    |
| 1967       | 22.3300      | 0.1830        | 826.6000        | 49.0000        | 1.6900         | 10.1000    |
| 1968       | 25.0300      | 0.1830        | 932.3000        | 39.0000        | 1.6800         | 9.5000     |
| 1969       | 27.9500      | 0.1540        | 984.1000        | 37.0000        | 1.3900         | 8.4000     |
| 1970       | 32.0400      | 0.1440        | 1084.9000       | 44.0000        | 1.2700         | 6.5000     |
| 1971       | 34.9700      | 0.1540        | 1163.5000       | 42.0000        | 1.3100         | 6.9000     |
| 1972       | 40.4400      | 0.1260        | 1140.8000       | 38.0000        | 1.3900         | 7.0000     |
| 1973       | 40.9300      | 0.1170        | 1222.5000       | 36.0000        | 1.0500         | 6.3000     |
| 1974       | 54.1200      | 0.0930        | 1437.7000       | 38.0000        | 0.6800         | 3.6000     |
| 1975       | 67.6200      | 0.1000        | 1525.9000       | 43.0000        | 0.8100         | 5.1000     |
| 1976       | N.A.         | N.A.          | 1439.4000       | 35.0000        | 0.8100         | 5.1000     |
| 1977       | 76.2200      | 0.0990        | 1410.9000       | 28.0000        | 0.6500         | 5.3000     |
| 1978       | 72.0400      | 0.1180        | 1434.6000       | 24.0000        | 0.6000         | 5.0000     |
| 1979       | 66.1200      | 0.1330        | 1511.9000       | 28.0000        | 0.6100         | 4.5000     |
| 1980       | 62.2500      | 0.1360        | 1684.1000       | 42.0000        | 0.7000         | 3.6000     |
| 1981       | 67.2800      | 0.1330        | 1649.5000       | 61.0000        | 0.5500         | 4.6000     |
| 1982       | 55.6800      | 0.1630        | 1488.8000       | 88.0000        | 0.5700         | 3.8000     |
| 1983       | 52.0700      | 0.1620        | 1337.7000       | 110.0000       | 0.6200         | 5.2000     |
| 1984       | 46.7300      | 0.1720        | 1263.7000       | 107.0000       | 0.6100         | 6.8000     |
| 1985       | 49.0100      | 0.1670        | 1287.3000       | 115.0000       | 0.7400         | 7.4000     |
| 1986       | 46.0400      | 0.1680        | 1344.6000       | 120.0000       | 0.8200         | 7.4000     |
| 1987       | 43.1700      | 0.1710        | 1329.6000       | 102.0000       | 0.9600         | 7.8000     |

## APPENDIX 2

| Series   | Mean         | S.D.        | Maximum     | Minimum    |
|----------|--------------|-------------|-------------|------------|
| Arson    | 45.1639130   | 18.4327050  | 76.220000   | 16.170000  |
| Arrest   | 0.1585217    | 0.0470076   | 0.263000    | 0.093000   |
| Burglary | 1220.9609000 | 305.1614800 | 1684.100000 | 635.900000 |
| Busfail  | 58.6521740   | 31.0243430  | 120.100000  | 24.000000  |
| Replace  | 1.0373913    | 0.4505776   | 1.860000    | 0.550000   |
| ROE      | 6.8869565    | 2.4447168   | 11.500000   | 3.600000   |

|                    | Corvariance   | Correlation |
|--------------------|---------------|-------------|
| Arson, Arson       | 324.9922500   | 1.0000000   |
| Arson, Arrest      | -0.6467929    | -0.7803926  |
| Arson, Burglary    | 4989.2686000  | 0.9273064   |
| Arson, Busfail     | -18.5625710   | -0.0339353  |
| Arson, Replace     | -7.1974766    | -0.9059970  |
| Arson, ROE         | -37.9741226   | -0.8809987  |
| Arrest, Arrest     | 0.0021136     | 1.0000000   |
| Arrest, Burglary   | -10.7309890   | -0.7820724  |
| Arrest, Busfail    | 0.3769206     | 0.2701993   |
| Arrest, Replace    | 0.0133209     | 0.6575092   |
| Arrest, ROE        | 0.0922416     | 0.8391415   |
| Burglary, Burglary | 89074.6810000 | 1.0000000   |
| Burglary, Busfail  | 991.8514700   | 0.1095266   |
| Burglary, Replace  | -121.2667100  | -0.9220351  |
| Burglary, ROE      | -669.5735500  | -0.9383075  |
| Busfail, Busfail   | 920.6616300   | 1.0000000   |
| Busfail, Replace   | -3.8182985    | -0.2855636  |
| Busfail, ROE       | 3.2519857     | 0.0448252   |
| Replace, Replace   | 0.1941932     | 1.0000000   |
| Replace, ROE       | 0.9224877     | 0.8755231   |
| ROE, ROE           | 5.7167864     | 1.0000000   |

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