Defining and Measuring University Technology Transfer:

Investigating the Feasibility of Using Patent Citations as a Measure of Success

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Abstract

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Keywords: technology transfer, university technology transfer, technology commercialization, federally funded research and development, patents, patent citations

**Introduction**

Technology transfer is the transition of technology or intellectual property from one person or entity to another person or entity. Improving the transfer of technology derived from federally funded research and development (R&D) to the private sector to achieve national objectives regarding economic growth and the nation’s security is a priority area for the public policy of the United States of America (OMB, 2018). In fact, increasing the return on investment from federally funded R&D has been a top priority for the U.S. government going back to the Bush administration (OMB, 2002) and policy goals in this area can be traced as far back as the 1940s (Bush, 1949).

University technology transfer (UTT) is a subcategory of the broader technology transfer field. It focuses on the transfer of technology derived from research conducted at universities to the private sector. Identifying the key drivers of successful UTT is an important topic for study. A significant portion of the federal R&D budget goes to American universities to conduct research of interest to the federal government and achieve other national objectives.

In fiscal year 2018, the U.S. federal budget for total R&D was greater than US$142.9 billion (American Association for the Advancement of Science [AAAS], 2018a). In 2016, American universities received roughly US$32.7 billion from the federal government for research and development support (AAAS, 2018b). This amounts to nearly a quarter of the federal R&D budget. With total federal outlays of over US$3.9 trillion, the amount directed to U.S. universities for research is less than 1 percent of total government spending (Congressional Budget Office [CBO], 2018) but is still a significant amount in absolute terms given that it is greater than the gross domestic product (GDP) of over 112 countries (United Nations [UN], 2017) and there are other important problems of national interest to which the government could direct those dollars.

Important questions in the area of UTT that remain unanswered or underexplored include (1) how should success in UTT be defined, (2) how should UTT performance be measured, and (3) what are the drivers of successful UTT.

**Literature Review**

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**Research Questions**

The purpose of this research study is to investigate the question of how UTT success should be defined and measured. In this study, I consider an alternative conceptualization of UTT and explore an alternative approach measuring it. Specifically, I address the following research questions:

1. Can patent citations data serve as a useful measure of UTT success?
2. Can UTT success as measured by patent citations be significantly explained by variables that capture patent and citation data?

I use patents as a proxy for a unit of technology. I hypothesize that there is a positive linear relationship between the transfer of a technology as measured by the numbers of citations received by a patent and various measures of the patent’s originality, generality, citation lag time, and categorization.

**Data and Methods**

**Data Sources**

This study uses patent data with constructed variables obtained from the National Bureau of Economic Research (NBER) website. The data file included all utility patents granted from January 1, 1963 to December 30, 1999 listed in the Technology Assessment and Forecast (TAF) database of the United States Patent and Trademark Office (USPTO). The data file contained data on 2,923,922 patents across 23 variables. Table 1 and Table 2 provide information about the variables.

Table 1

Original USPTO Patent Data Variables

| Variable | Variable Type | Extended Name | Description |
| --- | --- | --- | --- |
| PATENT | Numeric | Patent Number | The number assigned to the allowed patent by the USPTO. |
| GYEAR | Numeric | Grant Year | The year the USPTO allowed the patent. |
| GDATE | Numeric | Grant Date | The date the USPTO allowed the patent expressed in terms of the number of weeks elapsed since January 1, 1960. |
| APPYEAR | Numeric | Application Year | The year the patent application was submitted to the USPTO. |
| COUNTRY | Character | Country of First Inventor | The country of citizenship for the first inventor listed on the patent application. |
| POSTATE | Character | State of First Inventor (US) | The state of residency for the first inventor listed on the patent application if the country of citizenship is the United States of America. |
| ASSIGNEE | Numeric | Assignee Identifier | Unique identifier for the assignee of the patent. |
| ASSCODE | Numeric | Assignee Code | A one character code categorizing the type of assignee. |
| CLAIMS | Numeric | Number of Claims | Number of independent and dependent claims on the patent. |
| NCLASS | Numeric | Main Patent Class | A code that categorizes the patent into one of several broad classifications. |

Table 2

Constructed Patent Data Variables

| Variable | Variable Type | Extended Name | Description |
| --- | --- | --- | --- |
| CAT | Numeric | Technological Category | A higher-level classification of the Main Patent Class. |
| SUBCAT | Numeric | Technological Sub-category | The sub-category of the primary technological category to which the patent is assigned. |
| CMADE | Numeric | Number of Citations Made | The number of citations made by the patent. |
| CRECEIVE | Numeric | No. of Citations Received | The number of citations in other patents that reference the patent. |
| RATIOCIT | Numeric | Percent of Citations Made to Patents Granted Since 1963 | The ratio of the number of citations made by all patents granted since 1963 to the total number of citations made by the particular patent. |
| GENERAL | Numeric | Measure of Generality | A measure of how broad the influence of a patent spans across fields as determined by the number of different fields of all patents that cite the patent of interest.  Calculated as the following:  Generalityi = 1 - , where *sij* denotes the percentage of citations received by patent *i* that belong to patent class *j*, out of *ni* patent classes. |
| ORIGINAL | Numeric | Measure of Originality | A measure of the originality of a patent as determined by the number of different fields for all patents cited by the patent of interest.  Calculated as the following:  Originalityi = 1 - , where *sij* denotes the percentage of citations made by patent *i* that belong to patent class *j*, out of *ni* patent classes. |
| FWDAPLAG | Numeric | Mean Forward Citation Lag | The mean time difference between the application or grant date of the patent and that of the other patents citing this patent. |
| BCKGTLAG | Numeric | Mean Backward Citation Lag | The mean time difference between the application or grant date of the patent and that of the patents it cites. |
| SELFCTUB | Numeric | Share of Self-Citations Made – Upper Bound | The number of citations made by the patent to other patents with the same assignee divided by the total number of citations made by all patents with assignee codes. |
| SELFCTLB | Numeric | Share of Self-Citations Made – Lower Bound | The number of citations made by the patent to other patents with the same assignee divided by the total number of citations made by all patents. |
| SECUPBD | Numeric | Share of Self-Citations Received – Upper Bound | The number of citations received by the patent from other patents with the same assignee divided by the total number of citations received by all patents with assignee codes. |
| SECDLWBD | Numeric | Share of Self-Citations Received – Lower Bound | The number of citations received by the patent from other patents with the same assignee divided by the total number of citations received by all patents. |

**Data Selection and Modifications**

I used RStudio to create a subset of the data. After importing the data, I filtered the data for grant years between and including 1995 through 1999. I then filtered that data for patents that had at least 1 claim. I subsequently filtered that data for patents with at least 1 claim received. This generated a subset of 253,328 observations.

I inspected the final data sample using the miss\_var\_summary function to check for missing data by variables to ensure that there was no missing data in the CRECEIVE and CLAIMS variables. I then used the miss\_case\_summary function to check how many observations had missing data in the other variables. I used the get\_dupes function the verify that there were no duplicates in the PATENT variable thus ensuring that it could be used as a unique identifier. I then checked for duplicates across all variables to ensure that each observation was unique.

I used the sample function to select a random sample of 2,000 observations from the subset of 253,328 observations using the seed of 1972 for the function. I then saved this sample data as a CSV file.

**Analysis**

I analyzed the sample data using IBM SPSS Statistics 25. The SPSS 25 analysis output is shown in Exhibit A. I began by verifying that the correct data type and variable type was applied to each variable in the variable view tab. For this study, I assigned CRECEIVE as the dependent variable (DV). I prepared descriptive statistics for the dependent variable using the Analyze > Descriptive Statistics > Frequencies function. The specific statistics calculated for the DV included mean, standard error of mean, median, mode, minimum, maximum, and range, standard deviation, variance, skewness, and kurtosis. I created a histogram with the normal distribution curve superimposed to visually examine the data.

I then used the Graphs > Chart Builder function to create a scatter plot of the DV against the CLAIMS variable, which is one independent variable (IV) of interest. I later used the scatter plot to visually examine whether there was a potential relationship between the two variables.

Finally, I used the Analyze > Regression > Linear function to conduct a multiple regression analysis. The CRECEIVE variable remained the DV. The IVs included CAT, SUBCAT, NCLASS, CLAIMS, GENERAL, ORIGINAL, CMADE, RATIOCIT, BCKGTLAG, FWDAPLAG, SELFCTUB, SELFCTLB, SECDLWBD, and SECDUPBD. The options I selected for the linear regression statistics included model fit, R squared change, and part and partial correlations; estimates, confidence level 95 percent, and covariance matrix for the regression coefficients; and Durbin-Watson and casewise diagnotics for outliers beyond 3 standard deviations for the residuals.

**Discussion**

**Findings and Results**

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**Policy Implications**

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**Limitations of the Analysis**

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**Possible Extensions**

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**Conclusion**

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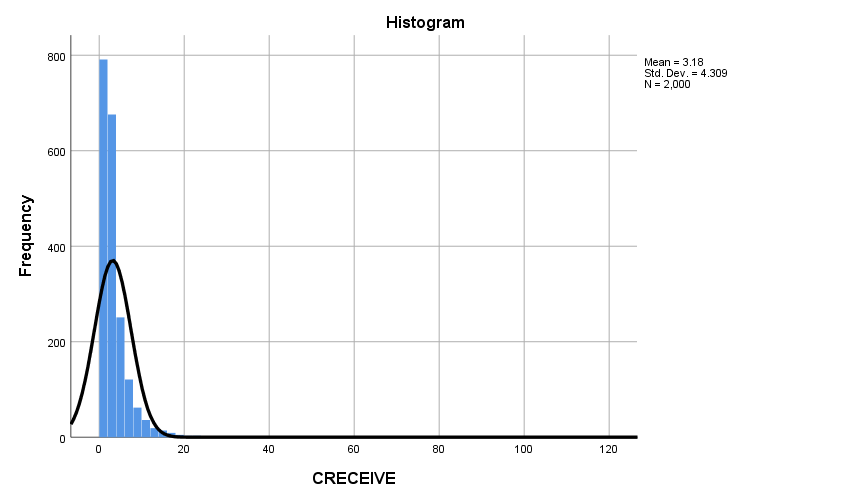
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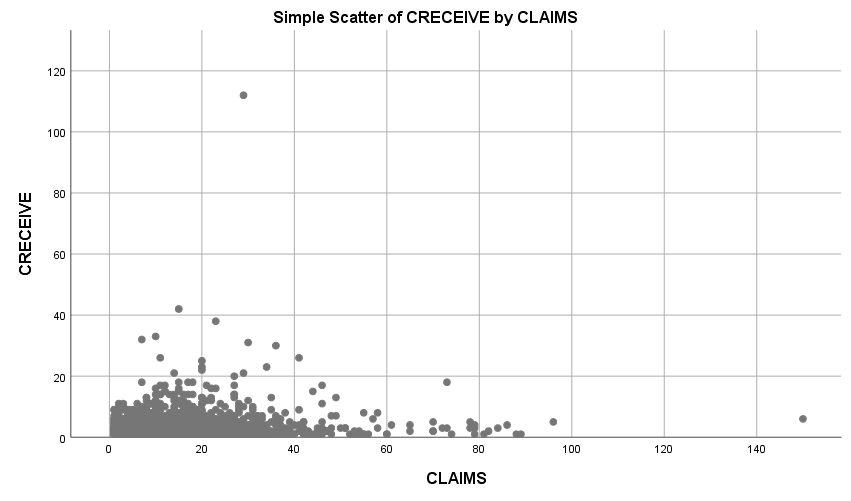
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Appendix A. SPSS 25 Analysis Output

|  |  |  |
| --- | --- | --- |
| **Statistics** | | |
| CRECEIVE | | |
| N | Valid | 2000 |
| Missing | 0 |
| Mean | | 3.18 |
| Std. Error of Mean | | .096 |
| Median | | 2.00 |
| Mode | | 1 |
| Std. Deviation | | 4.309 |
| Variance | | 18.567 |
| Skewness | | 10.292 |
| Std. Error of Skewness | | .055 |
| Kurtosis | | 214.022 |
| Std. Error of Kurtosis | | .109 |
| Range | | 111 |
| Minimum | | 1 |
| Maximum | | 112 |

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| --- | --- | --- | --- | --- | --- |
| **CRECEIVE** | | | | | |
|  | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | 1 | 791 | 39.6 | 39.6 | 39.6 |
| 2 | 433 | 21.7 | 21.7 | 61.2 |
| 3 | 243 | 12.2 | 12.2 | 73.4 |
| 4 | 146 | 7.3 | 7.3 | 80.7 |
| 5 | 105 | 5.3 | 5.3 | 85.9 |
| 6 | 75 | 3.8 | 3.8 | 89.6 |
| 7 | 46 | 2.3 | 2.3 | 92.0 |
| 8 | 36 | 1.8 | 1.8 | 93.8 |
| 9 | 26 | 1.3 | 1.3 | 95.1 |
| 10 | 22 | 1.1 | 1.1 | 96.2 |
| 11 | 14 | .7 | .7 | 96.9 |
| 12 | 10 | .5 | .5 | 97.4 |
| 13 | 9 | .4 | .4 | 97.8 |
| 14 | 10 | .5 | .5 | 98.3 |
| 15 | 4 | .2 | .2 | 98.5 |
| 16 | 4 | .2 | .2 | 98.7 |
| 17 | 5 | .3 | .3 | 99.0 |
| 18 | 5 | .3 | .3 | 99.2 |
| 20 | 1 | .1 | .1 | 99.3 |
| 21 | 2 | .1 | .1 | 99.4 |
| 22 | 1 | .1 | .1 | 99.4 |
| 23 | 2 | .1 | .1 | 99.5 |
| 25 | 1 | .1 | .1 | 99.6 |
| 26 | 2 | .1 | .1 | 99.7 |
| 30 | 1 | .1 | .1 | 99.7 |
| 31 | 1 | .1 | .1 | 99.8 |
| 32 | 1 | .1 | .1 | 99.8 |
| 33 | 1 | .1 | .1 | 99.9 |
| 38 | 1 | .1 | .1 | 99.9 |
| 42 | 1 | .1 | .1 | 100.0 |
| 112 | 1 | .1 | .1 | 100.0 |
| Total | 2000 | 100.0 | 100.0 |  |





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| **Model Summaryb** | | | | | | | | | | |
| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | |  |
| R Square Change | F Change | df1 | df2 | Sig. F Change | Durbin-Watson |
| 1 | .425a | .181 | .174 | 4.140 | .181 | 26.029 | 14 | 1652 | .000 | 1.969 |
| a. Predictors: (Constant), SUBCAT, CMADE, SECDUPBD, FWDAPLAG, CLAIMS, GENERAL, SELFCTUB, RATIOCIT, ORIGINAL, NCLASS, BCKGTLAG, SELFCTLB, CAT, SECDLWBD | | | | | | | | | | |
| b. Dependent Variable: CRECEIVE | | | | | | | | | | |

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| --- | --- | --- | --- | --- | --- | --- |
| **ANOVAa** | | | | | | |
| Model | | Sum of Squares | df | Mean Square | F | Sig. |
| 1 | Regression | 6245.660 | 14 | 446.119 | 26.029 | .000b |
| Residual | 28314.370 | 1652 | 17.139 |  |  |
| Total | 34560.030 | 1666 |  |  |  |
| a. Dependent Variable: CRECEIVE | | | | | | |
| b. Predictors: (Constant), SUBCAT, CMADE, SECDUPBD, FWDAPLAG, CLAIMS, GENERAL, SELFCTUB, RATIOCIT, ORIGINAL, NCLASS, BCKGTLAG, SELFCTLB, CAT, SECDLWBD | | | | | | |

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| --- | --- | --- | --- | --- | --- | --- |
| **Coefficientsa** | | | | | | |
| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
| B | Std. Error | Beta |
| 1 | (Constant) | 4.829 | 1.773 |  | 2.724 | .007 |
| BCKGTLAG | -.094 | .024 | -.166 | -3.931 | .000 |
| CAT | .031 | .366 | .011 | .084 | .933 |
| CLAIMS | .024 | .008 | .065 | 2.846 | .004 |
| CMADE | .003 | .008 | .009 | .360 | .719 |
| FWDAPLAG | .392 | .093 | .096 | 4.195 | .000 |
| GENERAL | 6.315 | .404 | .364 | 15.625 | .000 |
| NCLASS | .001 | .001 | .034 | 1.330 | .184 |
| ORIGINAL | -1.094 | .395 | -.067 | -2.767 | .006 |
| RATIOCIT | -3.001 | 1.557 | -.078 | -1.927 | .054 |
| SECDLWBD | -4.098 | 2.353 | -.301 | -1.741 | .082 |
| SECDUPBD | 3.950 | 2.298 | .296 | 1.719 | .086 |
| SELFCTLB | -1.145 | 2.178 | -.054 | -.526 | .599 |
| SELFCTUB | .763 | 2.006 | .039 | .380 | .704 |
| SUBCAT | -.004 | .036 | -.016 | -.117 | .907 |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Coefficientsa** | | | | | | | |
| Model | | 95.0% Confidence Interval for B | | Correlations | | | Collinearity Statistics |
| Lower Bound | Upper Bound | Zero-order | Partial | Part | Tolerance |
| 1 | (Constant) | 1.352 | 8.307 |  |  |  |  |
| BCKGTLAG | -.140 | -.047 | -.124 | -.096 | -.088 | .279 |
| CAT | -.687 | .749 | -.065 | .002 | .002 | .028 |
| CLAIMS | .007 | .040 | .090 | .070 | .063 | .961 |
| CMADE | -.013 | .018 | .010 | .009 | .008 | .867 |
| FWDAPLAG | .209 | .576 | .143 | .103 | .093 | .949 |
| GENERAL | 5.522 | 7.108 | .385 | .359 | .348 | .914 |
| NCLASS | .000 | .002 | .086 | .033 | .030 | .745 |
| ORIGINAL | -1.869 | -.318 | .007 | -.068 | -.062 | .858 |
| RATIOCIT | -6.056 | .054 | .058 | -.047 | -.043 | .305 |
| SECDLWBD | -8.714 | .518 | -.039 | -.043 | -.039 | .017 |
| SECDUPBD | -.556 | 8.457 | -.033 | .042 | .038 | .017 |
| SELFCTLB | -5.417 | 3.127 | -.007 | -.013 | -.012 | .047 |
| SELFCTUB | -3.172 | 4.698 | -.010 | .009 | .008 | .048 |
| SUBCAT | -.075 | .066 | -.065 | -.003 | -.003 | .027 |

|  |  |  |
| --- | --- | --- |
| **Coefficientsa** | | |
| Model | | Collinearity Statistics |
| VIF |
| 1 | (Constant) |  |
| BCKGTLAG | 3.586 |
| CAT | 36.299 |
| CLAIMS | 1.040 |
| CMADE | 1.153 |
| FWDAPLAG | 1.053 |
| GENERAL | 1.094 |
| NCLASS | 1.343 |
| ORIGINAL | 1.165 |
| RATIOCIT | 3.284 |
| SECDLWBD | 60.130 |
| SECDUPBD | 59.879 |
| SELFCTLB | 21.367 |
| SELFCTUB | 20.929 |
| SUBCAT | 37.540 |
| a. Dependent Variable: CRECEIVE | | |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Coefficient Correlationsa** | | | | | | | |
| Model | | | SUBCAT | CMADE | SECDUPBD | FWDAPLAG | CLAIMS |
| 1 | Correlations | SUBCAT | 1.000 | -.006 | -.049 | -.034 | .025 |
| CMADE | -.006 | 1.000 | -.005 | .016 | -.144 |
| SECDUPBD | -.049 | -.005 | 1.000 | -.069 | -.028 |
| FWDAPLAG | -.034 | .016 | -.069 | 1.000 | -.049 |
| CLAIMS | .025 | -.144 | -.028 | -.049 | 1.000 |
| GENERAL | -.059 | -.025 | -.035 | -.139 | -.031 |
| SELFCTUB | .058 | -.013 | -.037 | .008 | .011 |
| RATIOCIT | -.032 | -.032 | -.001 | .004 | -.004 |
| ORIGINAL | -.001 | -.248 | .030 | -.002 | -.051 |
| NCLASS | .227 | -.071 | .007 | .004 | -.017 |
| BCKGTLAG | -.071 | -.121 | -.051 | -.054 | .008 |
| SELFCTLB | -.068 | .019 | .040 | -.008 | -.012 |
| CAT | -.983 | .004 | .043 | .033 | -.023 |
| SECDLWBD | .044 | .001 | -.991 | .080 | .027 |
| Covariances | SUBCAT | .001 | -1.778E-6 | -.004 | .000 | 7.404E-6 |
| CMADE | -1.778E-6 | 6.250E-5 | -8.650E-5 | 1.218E-5 | -9.425E-6 |
| SECDUPBD | -.004 | -8.650E-5 | 5.279 | -.015 | -.001 |
| FWDAPLAG | .000 | 1.218E-5 | -.015 | .009 | -3.820E-5 |
| CLAIMS | 7.404E-6 | -9.425E-6 | -.001 | -3.820E-5 | 6.873E-5 |
| GENERAL | -.001 | -8.057E-5 | -.033 | -.005 | .000 |
| SELFCTUB | .004 | .000 | -.170 | .001 | .000 |
| RATIOCIT | -.002 | .000 | -.004 | .001 | -4.893E-5 |
| ORIGINAL | -1.483E-5 | -.001 | .028 | -8.528E-5 | .000 |
| NCLASS | 5.572E-6 | -3.804E-7 | 1.108E-5 | 2.252E-7 | -9.876E-8 |
| BCKGTLAG | -6.066E-5 | -2.273E-5 | -.003 | .000 | 1.672E-6 |
| SELFCTLB | -.005 | .000 | .199 | -.002 | .000 |
| CAT | -.013 | 1.265E-5 | .036 | .001 | -6.838E-5 |
| SECDLWBD | .004 | 1.873E-5 | -5.359 | .018 | .001 |

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| --- | --- | --- | --- | --- | --- | --- | --- |
| **Coefficient Correlationsa** | | | | | | | |
| Model | | | GENERAL | SELFCTUB | RATIOCIT | ORIGINAL | NCLASS |
| 1 | Correlations | SUBCAT | -.059 | .058 | -.032 | -.001 | .227 |
| CMADE | -.025 | -.013 | -.032 | -.248 | -.071 |
| SECDUPBD | -.035 | -.037 | -.001 | .030 | .007 |
| FWDAPLAG | -.139 | .008 | .004 | -.002 | .004 |
| CLAIMS | -.031 | .011 | -.004 | -.051 | -.017 |
| GENERAL | 1.000 | -.014 | .090 | -.181 | -.023 |
| SELFCTUB | -.014 | 1.000 | .100 | -.010 | .058 |
| RATIOCIT | .090 | .100 | 1.000 | -.143 | .071 |
| ORIGINAL | -.181 | -.010 | -.143 | 1.000 | -.039 |
| NCLASS | -.023 | .058 | .071 | -.039 | 1.000 |
| BCKGTLAG | .132 | -.054 | .799 | -.145 | .157 |
| SELFCTLB | .018 | -.974 | -.087 | .015 | -.058 |
| CAT | .066 | -.064 | .038 | .011 | -.159 |
| SECDLWBD | .041 | .036 | -.004 | -.028 | -.004 |
| Covariances | SUBCAT | -.001 | .004 | -.002 | -1.483E-5 | 5.572E-6 |
| CMADE | -8.057E-5 | .000 | .000 | -.001 | -3.804E-7 |
| SECDUPBD | -.033 | -.170 | -.004 | .028 | 1.108E-5 |
| FWDAPLAG | -.005 | .001 | .001 | -8.528E-5 | 2.252E-7 |
| CLAIMS | .000 | .000 | -4.893E-5 | .000 | -9.876E-8 |
| GENERAL | .163 | -.011 | .057 | -.029 | -6.298E-6 |
| SELFCTUB | -.011 | 4.025 | .311 | -.008 | 7.910E-5 |
| RATIOCIT | .057 | .311 | 2.425 | -.088 | 7.549E-5 |
| ORIGINAL | -.029 | -.008 | -.088 | .156 | -1.046E-5 |
| NCLASS | -6.298E-6 | 7.910E-5 | 7.549E-5 | -1.046E-5 | 4.645E-7 |
| BCKGTLAG | .001 | -.003 | .030 | -.001 | 2.539E-6 |
| SELFCTLB | .016 | -4.257 | -.294 | .013 | -8.605E-5 |
| CAT | .010 | -.047 | .022 | .002 | -3.975E-5 |
| SECDLWBD | .039 | .171 | -.013 | -.026 | -6.814E-6 |

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| --- | --- | --- | --- | --- | --- | --- |
| **Coefficient Correlationsa** | | | | | | |
| Model | | | BCKGTLAG | SELFCTLB | CAT | SECDLWBD |
| 1 | Correlations | SUBCAT | -.071 | -.068 | -.983 | .044 |
| CMADE | -.121 | .019 | .004 | .001 |
| SECDUPBD | -.051 | .040 | .043 | -.991 |
| FWDAPLAG | -.054 | -.008 | .033 | .080 |
| CLAIMS | .008 | -.012 | -.023 | .027 |
| GENERAL | .132 | .018 | .066 | .041 |
| SELFCTUB | -.054 | -.974 | -.064 | .036 |
| RATIOCIT | .799 | -.087 | .038 | -.004 |
| ORIGINAL | -.145 | .015 | .011 | -.028 |
| NCLASS | .157 | -.058 | -.159 | -.004 |
| BCKGTLAG | 1.000 | .081 | .059 | .047 |
| SELFCTLB | .081 | 1.000 | .074 | -.045 |
| CAT | .059 | .074 | 1.000 | -.037 |
| SECDLWBD | .047 | -.045 | -.037 | 1.000 |
| Covariances | SUBCAT | -6.066E-5 | -.005 | -.013 | .004 |
| CMADE | -2.273E-5 | .000 | 1.265E-5 | 1.873E-5 |
| SECDUPBD | -.003 | .199 | .036 | -5.359 |
| FWDAPLAG | .000 | -.002 | .001 | .018 |
| CLAIMS | 1.672E-6 | .000 | -6.838E-5 | .001 |
| GENERAL | .001 | .016 | .010 | .039 |
| SELFCTUB | -.003 | -4.257 | -.047 | .171 |
| RATIOCIT | .030 | -.294 | .022 | -.013 |
| ORIGINAL | -.001 | .013 | .002 | -.026 |
| NCLASS | 2.539E-6 | -8.605E-5 | -3.975E-5 | -6.814E-6 |
| BCKGTLAG | .001 | .004 | .001 | .003 |
| SELFCTLB | .004 | 4.744 | .059 | -.231 |
| CAT | .001 | .059 | .134 | -.032 |
| SECDLWBD | .003 | -.231 | -.032 | 5.538 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Collinearity Diagnosticsa** | | | | | | | |
| Model | Dimension | Eigenvalue | Condition Index | Variance Proportions | | | |
| (Constant) | BCKGTLAG | CAT | CLAIMS |
| 1 | 1 | 9.314 | 1.000 | .00 | .00 | .00 | .00 |
| 2 | 1.681 | 2.354 | .00 | .00 | .00 | .00 |
| 3 | 1.194 | 2.793 | .00 | .00 | .00 | .00 |
| 4 | .668 | 3.733 | .00 | .02 | .00 | .00 |
| 5 | .592 | 3.965 | .00 | .00 | .00 | .01 |
| 6 | .430 | 4.654 | .00 | .04 | .00 | .25 |
| 7 | .327 | 5.340 | .00 | .01 | .00 | .68 |
| 8 | .276 | 5.811 | .00 | .17 | .00 | .01 |
| 9 | .247 | 6.144 | .00 | .02 | .00 | .02 |
| 10 | .182 | 7.152 | .00 | .05 | .00 | .00 |
| 11 | .060 | 12.417 | .01 | .00 | .01 | .02 |
| 12 | .018 | 22.678 | .00 | .02 | .00 | .00 |
| 13 | .006 | 38.484 | .00 | .00 | .00 | .00 |
| 14 | .002 | 61.293 | .00 | .02 | .98 | .00 |
| 15 | .002 | 69.600 | .98 | .65 | .01 | .00 |

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| **Collinearity Diagnosticsa** | | | | | | | |
| Model | Dimension | Variance Proportions | | | | | |
| CMADE | FWDAPLAG | GENERAL | NCLASS | ORIGINAL | RATIOCIT |
| 1 | 1 | .00 | .00 | .00 | .00 | .00 | .00 |
| 2 | .01 | .00 | .01 | .00 | .00 | .00 |
| 3 | .00 | .00 | .00 | .00 | .00 | .00 |
| 4 | .03 | .00 | .48 | .00 | .01 | .00 |
| 5 | .66 | .01 | .12 | .00 | .01 | .00 |
| 6 | .05 | .00 | .26 | .05 | .00 | .00 |
| 7 | .00 | .01 | .07 | .06 | .11 | .00 |
| 8 | .17 | .01 | .01 | .00 | .15 | .00 |
| 9 | .07 | .15 | .00 | .06 | .61 | .00 |
| 10 | .00 | .72 | .03 | .17 | .05 | .00 |
| 11 | .00 | .09 | .00 | .57 | .04 | .03 |
| 12 | .00 | .00 | .00 | .00 | .00 | .00 |
| 13 | .00 | .01 | .00 | .00 | .00 | .00 |
| 14 | .00 | .00 | .00 | .04 | .00 | .01 |
| 15 | .00 | .00 | .01 | .04 | .01 | .96 |

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| --- | --- | --- | --- | --- | --- | --- |
| **Collinearity Diagnosticsa** | | | | | | |
| Model | Dimension | Variance Proportions | | | | |
| SECDLWBD | SECDUPBD | SELFCTLB | SELFCTUB | SUBCAT |
| 1 | 1 | .00 | .00 | .00 | .00 | .00 |
| 2 | .00 | .00 | .00 | .00 | .00 |
| 3 | .00 | .00 | .01 | .01 | .00 |
| 4 | .00 | .00 | .00 | .00 | .00 |
| 5 | .00 | .00 | .00 | .00 | .00 |
| 6 | .00 | .00 | .00 | .00 | .00 |
| 7 | .00 | .00 | .00 | .00 | .00 |
| 8 | .00 | .00 | .00 | .00 | .00 |
| 9 | .00 | .00 | .00 | .00 | .00 |
| 10 | .00 | .00 | .00 | .00 | .00 |
| 11 | .00 | .00 | .00 | .00 | .00 |
| 12 | .00 | .00 | .97 | .97 | .00 |
| 13 | .99 | .99 | .00 | .00 | .00 |
| 14 | .00 | .01 | .01 | .00 | .98 |
| 15 | .00 | .00 | .01 | .01 | .01 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Casewise Diagnosticsa** | | | | |
| Case Number | Std. Residual | CRECEIVE | Predicted Value | Residual |
| 30 | 3.969 | 23 | 6.57 | 16.431 |
| 153 | 6.012 | 32 | 7.11 | 24.890 |
| 202 | 8.752 | 42 | 5.77 | 36.234 |
| 230 | 24.993 | 112 | 8.53 | 103.472 |
| 243 | 4.464 | 23 | 4.52 | 18.482 |
| 405 | 3.015 | 18 | 5.52 | 12.483 |
| 446 | 5.000 | 25 | 4.30 | 20.700 |
| 457 | 6.050 | 31 | 5.95 | 25.047 |
| 585 | 3.176 | 20 | 6.85 | 13.147 |
| 759 | 3.171 | 21 | 7.87 | 13.129 |
| 879 | 4.847 | 26 | 5.94 | 20.065 |
| 1063 | 7.988 | 38 | 4.93 | 33.072 |
| 1116 | 4.865 | 22 | 1.86 | 20.141 |
| 1173 | 3.055 | 18 | 5.35 | 12.647 |
| 1220 | 6.425 | 33 | 6.40 | 26.598 |
| 1347 | 3.151 | 17 | 3.96 | 13.044 |
| 1474 | 3.049 | 17 | 4.38 | 12.621 |
| 1680 | 5.220 | 26 | 4.39 | 21.610 |
| 1744 | 3.035 | 16 | 3.44 | 12.564 |
| 1786 | 3.514 | 21 | 6.45 | 14.550 |

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| --- | --- | --- | --- | --- | --- |
| **Residuals Statisticsa** | | | | | |
|  | Minimum | Maximum | Mean | Std. Deviation | N |
| Predicted Value | -1.29 | 8.81 | 3.30 | 1.936 | 1667 |
| Residual | -4.706 | 103.472 | .000 | 4.123 | 1667 |
| Std. Predicted Value | -2.372 | 2.844 | .000 | 1.000 | 1667 |
| Std. Residual | -1.137 | 24.993 | .000 | .996 | 1667 |
| a. Dependent Variable: CRECEIVE | | | | | |