

Research Article

The Socio-Demographic, Economic and Financial Profiles of Municipalities at Risk of Financial Distress in Pennsylvania

John M Trussel^{1*} and Patricia A Patrick²¹Department of Accounting, University of Tennessee at Chattanooga, USA²Department of Accounting, The Pennsylvania State University, USA***Corresponding author:** John M. Trussel, Department of Accounting, University of Tennessee at Chattanooga, College of Business, Chattanooga, Tn 37421, USA**Received:** September 26, 2014; **Accepted:** October 20, 2014; **Published:** November 03, 2014**Abstract**

We determine the socio-demographic, economic and financial profiles of both rural and urban municipalities in Pennsylvania that are at risk of financial distress compared to those that are not at risk. Using univariate tests, we find that the municipalities in urban areas that are at risk of financial distress have significantly higher percentages of poverty, minorities, college degrees, and unemployment, and they have significantly lower tax efforts than their urban counterparts that are not at risk. Municipalities in rural areas that are at risk of financial distress have significantly higher property values, marginally higher tax efforts, and they have significantly lower percentages of college degrees and lower fiscal capacities than their rural counterparts that are not at risk. Using multivariate tests, we find that population, percentage of minorities, and percent with college degrees are positively related to the risk of financial distress, while population growth and fiscal capacity are negatively associated with the risk of financial distress.

Introduction

In most states, municipalities are the key providers of public safety, water, sewer, streets, parks, and recreation. However, a municipality can continue to provide these important public services only if it can avoid significant financial problems, commonly called fiscal or financial distress [1,2]. The purpose of this study is to develop a socio-demographic, economic and financial profile of municipalities that are at risk of financial distress contrasted with those that are not at risk. We use municipalities in Pennsylvania to develop and test our model of financial distress. This study is important because financial distress among municipalities is on the rise surrounding the years of the great recession of 2007-2009. For example, in the last ten years alone, Pennsylvania's Department of Community and Economic Development (DCED) recognized the cities of Harrisburg, Altoona, Nanticoke, New Castle, and Pittsburgh as financially distressed [3]. During this period, the City of Harrisburg was forced into receivership and a recovery plan to restructure \$600 million of debt, when a federal judge denied its October 2011 Chapter 9 bankruptcy filing [4].

Financial distress in municipalities is an intergovernmental problem [5,6]. It can make state governments unstable, threaten the bond-ratings of state governments, and put pressure on state governments to pick up the slack in delivering services, when municipalities can no longer do so [5,7]. Municipal financial distress can also impair the willingness of businesses to move into local areas, since business decisions are often based on local taxes, services, infrastructure, and fees [5]. Intervention by state governments during the early stages of financial distress is important because it is less costly than intervention at the later stages, and anything that affects the health and welfare of the people living within a state is a concern of the state [5].

State governments can play an active role in helping municipalities prevent, detect and mitigate financial distress [5]. In Pennsylvania, the *Municipalities Financial Recovery Act of 1987* (Act 47) charges the DCED with implementing an early intervention program (EIP) to help municipalities avoid or minimize the impact of financial distress [8]. The DCED administers an annual Survey of Financial Condition (SOFC), which asks municipalities if they meet symptoms of financial distress established by Act 47. If a municipality gives an affirmative answer to any of the questions on the SOFC, then it is deemed to be at risk of financial distress.

Financial distress is an imbalance between the needs and resources of the people and the resources of the municipality [7,9]. We use socio-demographic indicators to proxy the needs of the people, economic indicators to proxy the resources of the people, and financial indicators to proxy the resources of the municipalities. Following the DCED definition, we define a municipality at risk of financial distress if it answers affirmative to any question on the SOFC [10]. We use SOFC data from the DCED for 2010 to get our sample of municipalities.

We use univariate statistics to develop the socio-demographic, economic and financial profiles of municipalities at risk of financial distress compared to those that are not at risk. We develop a multivariate model to test the relationships among the various factors and the risk of financial distress. Using logistic regression, we find that two socio-demographic factors (population and percent of minorities), one economic factor (population growth), and one financial factor (fiscal capacity) are related to the risk of financial distress.

Section II provides the background on financial distress in municipalities, with an emphasis on the early intervention programs in Pennsylvania. Section III describes the socio-demographic,

Table 1: The Survey of financial condition questions.

Question 1: Has your municipality maintained a deficit over a three-year period, with a deficit of 1% or more in each of the previous fiscal years?
Question 2: Have your municipality's expenditures exceeded revenues for a period of three years or more?
Question 3: Has your municipality defaulted in payment of principal or interest on any of its bonds or notes or in payment of rentals due any authority?
Question 4: Has your municipality missed a payroll for 30-days?
Question 5: Has your municipality failed to make required payments to judgment creditors for 30-days beyond the date of the recording of the judgment?
Question 6: Has your municipality, for a period of at least 30-days beyond the due date, failed to forward taxes withheld on the income of employees or failed to transfer employer or employee contributions to social security?
Question 7: Has your municipality accumulated and operated for each of two successive years a deficit equal to 5% or more of its revenue?
Question 8: Has your municipality failed to make the budgeted payment of its minimum obligation as required by Section 302 of the Act of December 18, 1984, known as the Municipal Pension Fund Act, during the fiscal year for which the payment was budgeted and failed to take action within that time period to make required payments?
Question 9: Has your municipality sought to negotiate resolution or adjustment of a claim in excess of 30% against a fund or budget and failed to reach an agreement with creditors?
Question 10: Has your municipality filed a municipal debt readjustment plan pursuant to Chapter 9 of the Bankruptcy Code?
Question 11a: Was your municipality at the maximum general purpose real estate tax limit as of the last municipal fiscal year?
Question 11b: If yes, have you reduced police, highway or other services this fiscal year because of your inability to raise general purpose real estate taxes?

economic and financial indicators of financial distress. The results of the empirical testing are included in Section IV, and Section V concludes the paper.

Background on Financial Monitoring in Pennsylvania

State governments can play an active role in helping municipalities prevent, detect and mitigate financial distress [5]. For example, Pennsylvania's role in addressing financial distress is formalized in Act 47 [8]. Act 47 charges the Department of Community and Economic Development (DCED) with the responsibility of assisting municipalities experiencing the symptoms of financial distress and divides that responsibility into two key areas. The first is assisting municipalities with formal designations of distress. The second is administering an early intervention program to help municipalities avoid formal designations of distress by helping them to reduce the symptoms.

Both processes begin with the annual Survey of Financial Condition (SOFC). Act 47 requires each municipality to file an annual SOFC with the DCED. The SOFC contains a series of questions that match the eleven criteria of financial distress established by Act 47 [8]. The SOFC enables the DCED to monitor the financial conditions of the municipalities. If a municipality answers affirmatively to any question on the SOFC, the DCED will review that municipality to determine if the municipality needs assistance to correct a minor fiscal problem or if the municipality is experiencing a financial emergency [8]. The SOFC questions are included in Table 1.

The early intervention program is a preventative program for municipalities wishing to reduce the symptoms of distress [10]. The DCED uses SOFC data to identify the symptoms of distress [10]. Patrick and Trussel [11] analyzed the SOFC data gathered by the DCED between 2007 and 2010 to identify the extent, type, and characteristics of rural and urban municipalities experiencing the symptoms of financial distress. They analyzed the associations of financial distress with selected socio-demographic, economic, and financial indicators using univariate statistics. They controlled for a municipality's status as rural or urban, and its type as a city, borough, first class or second class township. The results provide important insights about the extent, type, and characteristics of

Pennsylvania municipalities experiencing the symptoms of financial distress between 2007 and 2010. We expand the work of Patrick and Trussel [11] to develop a multivariate model of financial distress using the socio-demographic, economic and financial indicators. This important expansion allows us to simultaneously examine the relationships among these indicators and municipalities at risk of financial distress.

Only a few previous studies use socio-demographic, economic and financial indicators to predict municipal financial distress. Patrick and Trussel [11] use one single Act 47 criteria, reductions in public services, to define financial distress in Pennsylvania municipalities, but limit their indicators to financial factors. Trussel and Patrick [2,12,13] define financial distress as a significant and persistent imbalance between revenues and expenditures, and operationalize distress using two Act 47 criteria (three consecutive years of operating deficits and cumulative operating deficits of more than five percent during the same three-year period), but also only use financial indicators of distress. Patrick and Trussel [11,14] define financial distress as any affirmative answer to an Act 47 criteria and use socio-demographic, economic, and financial indicators to identify distress, but do not develop predictive models of distress. Little research combines socio-demographic, economic and financial indicators in a multivariate approach to predict distress in municipalities.

The Indicators of Financial Distress

Financial distress is an imbalance between the needs and resources of the people and the resources of the municipality [7,9]. Following Patrick and Trussel [11], we use socio-demographic indicators to proxy the needs of the people, economic indicators to proxy the resources of the people, and financial indicators to proxy the resources of the municipalities. We expand the work of Patrick and Trussel [11] to include multivariate tests and the relative costs of misclassification (Table 2).

The Socio-Demographic indicators

We use socio-demographic indicators to proxy the needs of citizens in the municipality.

Population: The population of a municipality is highly correlated with its revenues and often used to proxy a municipality's size [2].

Table 2: The Indicators of Financial Distress.

<u>Factor</u>	<u>Measurement</u>
<i>Socio-Demographic Factors</i> Population (POPULATION)	Population
Pct. Elderly Population (ELDERLY)	$\frac{\text{Population over 64-years Old}}{\text{Total Population}}$
Pct. Poverty (POVERTY)	$\frac{\text{Population Living in Poverty}}{\text{Total Population}}$
Pct. Minorities (MINORITIES)	$\left[\frac{1 - \text{White Alone Population}}{\text{Total Population}} \right]$
Pct. With Degree (COLLEGE)	$\frac{\text{4-Year College Degree or More}}{\text{Total Population}}$
<i>Economic Factors</i> Median Household Income (HHINCOME)	Median Household Income
Median Property Value (PROPVAL)	Median Property Value
Market Value per Capita (MKTVAL)	$\frac{\text{Assessed Property Value}}{\text{Population}}$
Pct. Unemployed (UNEMPLOYED)	$\frac{\text{Unemployed Adults}}{\text{Total Population}}$
Population Growth (GROWTH)	$\frac{(\text{Population}_t - \text{Population}_{t-1})}{\text{Population}_{t-1}}$
<i>Financial Factors</i> Fiscal Capacity (FISCAP)	$\frac{\text{Assessed Value Property}}{\text{Total Population}}$
Revenue per Capita (REVCAP)	$\frac{\text{Total Revenue}}{\text{Total Population}}$
Debt per Capita (DEBTCAP)	$\frac{\text{Total Municipal Debt}}{\text{Total Population}}$
Taxes per Capita (TAXCAP)	$\frac{\text{Total Tax Revenues}}{\text{Total Population}}$
Tax Effort (TAXEFF)	$\left[\frac{1 - \text{Intergovernmental Revenue}}{\text{Total Revenue}} \right]$

Note: We also control for type (city, borough, first-class township and second-class township) and status (rural or urban).

Damanpour [15] finds larger organizations have better access to resources, information and innovations while the Pennsylvania Economy League [16] and ACIR [17] find larger, older, industrialized municipalities more likely to be distressed. We use the 2010 U.S. census measure of population (POPULATION).

Percentage of Elderly: Elderly adults tend to have a high demand for public services [18]. They depend more on public health and human services, public transportation, and public safety. They are often unable to pay for the services, so the services are subsidized by municipal governments. Municipalities serving populations with higher proportions of elderly people have higher rates of financial distress [19]. We measure elderly populations (ELDERLY) as the percentage of people 65-years of age and older in the municipalities.

Percentage of Poverty: People living in poverty typically need more public services [19]. Impoverished people tend to live in communities with higher rates of crime, substandard housing, juvenile delinquency, lower-skilled workers, and joblessness [9]. These

populations rely heavily on public transportation, law enforcement, emergency medical services, and judicial systems [20]. Municipalities are often the key providers of these services and municipalities serving impoverished communities have higher rates of distress [19]. We measure poverty (POVERTY) as the percentage of people in the municipalities at or below the poverty-level.

Percentage of Minorities: Wood [19] finds that race is highly correlated with financial distress [19]. Minority populations tend to have limited employment opportunities, limited educational opportunities, and higher needs for public services [21]. The U.S. Department of Labor [22] reported that minorities have had consistently higher rates of unemployment than their Caucasian counterparts since 1975. We measure minorities (MINORITIES) as the percentage of people that claim to be other than “white only” on the US Census.

Percentage with College Degrees: People with at least a bachelor’s degree tend to have more employment opportunities, higher

incomes, and lower demands for public services [19]. People with college degrees usually work in service industries, and municipalities serving communities with higher proportions of people with college degrees have lower rates of financial distress [19]. We measure college degrees as the percentage of people with at least a bachelor's degree (COLLEGE).

The Economic indicators

We use economic indicators to proxy the resources of the citizens in the municipality.

Household income: Household income is a key source of municipal revenue and a measure of economic prosperity [16]. Municipalities serving people with higher household incomes are less likely to be financially distressed [16,20]. We measure household income (HHINCOME) as median household income.

Property values: Property tax revenue is the foundation of a municipal tax base [16]. Higher property values mean higher taxes and more revenue [23]. Property values have declined in many cities and many of these cities are in distress [16]. We measure property values two ways. We use median property value (PROPVAL) and market value per capita (MKTVAL) as the market value of all the real property divided by the population.

Unemployment rates: Unemployment rates (UNEMPLOYED) are directly associated with distress [19]. Unemployment rates are also tied to low-income industries and plant closings [19]. Unemployed people often become temporarily delinquent in their tax payments and may even have to leave the area to find work [19]. Unemployed people may be also more likely than others to temporarily rely on public goods and services [19].

Population growth: Municipalities compete with other municipalities for taxpayers and attract high-income tax payers with high quality public goods and services, low tax and crime rates, and attractive parks and recreation [7]. Across the nation urban populations are declining while rural populations are growing [16,24]. Declining populations are more problematic than growing populations because municipalities experiencing out-migration must provide the same level of services with less revenue [7]. We measure population growth (GROWTH) as the percentage change in populations between 2000 and 2010.

The financial indicators

We use financial indicators to proxy the financial position of the municipalities.

Fiscal capacity: Fiscal capacity is the ability of a municipality to generate revenue to meet operating expenditures, pay for planned capital projects, and deal with economic changes [25]. Fiscal capacity is also a municipality's ability to operate without intergovernmental revenue and a key factor in assessing the ability of the municipality to finance services [26]. The DCED [27] measures fiscal capacity as the assessed value of real property per capita. We measure assessed value (FISCAP) as the assessed value of real property divided by population. Assessed value is a different measure of property values than market value. Assessed values are primarily used as a basis for property tax determinations by municipalities.

Revenue per capita: The DCED [27] measures revenue per capita

as total operating revenue divided by population and suggests that revenue per capita measures the strength of a municipality's tax base. The DCED holds that revenue per capita reflects changes in tax rates, fee structures, and shifts in revenue sources. The DCED [27] warns that municipalities with decreasing revenue per capita need to find alternative sources of revenue, if they wish to avoid distress or cuts in services. We measure revenue per capita (REVCAP) as total operating revenues divided by population.

Debt per capita: Debt is arguably the single most important determinant of financial distress [2]. The excessive use of debt can cause municipalities to divert revenues from public services to debt service [2]. Debt is a fixed cost that can result in cash flow problems and insolvency, if used in excess [27]. We measure debt per capita (DEBTCAP) as total liabilities divided by population.

Taxes per capita: Municipalities rely on taxes to finance their operations [27]. Taxes tend to be the single largest source of revenues for many municipalities [27]. When populations or property values decline, tax revenues usually also decline and this could result in distress [27]. We measure taxes per capita (TAXCAP) as total tax revenues divided by population.

Tax effort: Tax effort is the ability of a municipality to raise the funds needed to provide services [16]. Tax effort is a measure of self-reliance and independence from intergovernmental revenue [16]. ACIR [28] measures tax effort as the percentage of a municipality's own-source revenues to total revenues. We measure tax effort (TAXEFF) as the complement of the revenues received from other governments to total revenues.

Empirical Results

This section discusses the empirical results, including the data sources, univariate tests, and multivariate tests.

The data sources

We obtain SOFC data from the DCED for 2010 and use it to identify the municipalities at risk of financial distress. We obtain socio-demographic and economic data from the American Community Survey (ACS) for 2009. We obtain population data from the U.S. Census Bureau and unemployment rates from the U.S. Department of Labor for 2009. We obtain annual financial data for each municipality from the DCED for 2009. We use 2009 data for the indicators since the surveys for the 2010 SOFC are completed during the 2010 fiscal year.

In Pennsylvania, there are 56 cities, 959 boroughs, 92 first class townships and 1,455 second class townships for a total of 2,562 municipalities. We control for differences in municipal type (TYPE). A municipality's type as a city, borough, or township reflects its population density, the historical circumstances surrounding its designation, and the type of services it provides [16]. We control for a municipality's status as rural or urban and classify any municipality with a population density of less than 284 people per mile as rural. The distinction between rural and urban is important because historically distress was an urban problem [9]; however, the evidence is mixed more recently [19]. To be included in the sample, the municipality must have all of the data available in the database to compute the independent variables. We excluded outliers, which are

Table 3: Municipalities in the Study.

Panel A: Sample.

	Municipalities	
	Number	Percent
Total municipalities in Pennsylvania	2,562	100.00%
Less: Municipalities with missing data	123	4.8%
Less: Outliers ^c	130	5.1%
Final sample	2,309	90.1%

Panel B: Municipalities Partitioned by Financial Distress (FD), Type and Rural/Urban Status.

Type	Rural Municipalities			Urban Municipalities			Total Municipalities			
	NFD	FD	Total	NFD	FD	Total	NFD	FD	Total	Pct. FD
City	2	0	2	29	15	44	31	15	46	32.6%
Borough	361	22	383	404	29	433	765	51	816	6.3%
1st Class Twp	0	0	0	77	4	81	77	4	81	4.9%
2nd Class Twp	1,070	61	1,131	206	29	235	1,276	90	1,366	6.6%
Total	1,433	83	1,516	716	77	793	2,149	160	2,309	6.9%
Pct. by Status	94.5%	5.5%	100.0%	90.3%	9.7%	100.0%	93.1%	6.9%	100.0%	

^a Municipalities at risk of financial distress (FD) are those answering "Yes" to any question on the Survey of Financial Condition.

^b Percentage at risk financial distress (Pct. FD) is the portion of municipalities at risk of financial distress by type.

^c Outliers are defined as those municipalities that have indicators in the extreme 0.5 percentiles.

municipalities with independent variables (except population) in the extreme one-half percentile (less than 0.05 percentile and more than 99.5 percentile). The final sample consists of 2,309 municipalities. The sample criteria are summarized in Panel A of Table 3.

We deem a municipality at risk of financial distress for any affirmative answer on the 2010 SOFC. Panel 3 or Table 3 shows that 6.9 percent of the municipalities are at risk of distress. Cities have the highest number at risk of distress at 48.2 percent. There are almost twice as many urban municipalities than rural municipalities at risk.

Univariate profiles of municipalities at risk of financial distress

In this subsection we follow [11] and discuss the socio-demographic, economic and financial profiles of municipalities at risk of financial distress compared to those that are not at risk by type and rural or urban status.

The Socio-demographic profile

Panel A of Table 4 shows the socio-demographic profile of financial distress. The urban municipalities at risk of financial distress have larger populations, higher percentages of poverty and minorities, and lower percentages of the elderly and college degrees than the urban municipalities not at risk of financial distress. However, the differences in the percentage of elderly and college educated are not statistically significant between the two groups of urban municipalities. The rural municipalities at risk of financial distress have larger populations and higher percentages of college degrees and elderly, but lower percentages of poverty and minorities than the rural municipalities that are not at risk. Only the differences for college degrees are statistically significant. In summary, the distressed urban municipalities have significantly higher percentages

of poverty, minorities, and college degrees while the distressed rural municipalities also have significantly lower percentages of college degrees, statistically speaking.

The economic profile of distress

Panel B of Table 4 shows the economic profile of financial distress. The urban municipalities at risk of financial distress have lower household incomes, lower property values, lower market values, and lower population growth rates, but higher unemployment rates than the urban municipalities not experiencing distress. However, none of these factors, except the unemployment rates have statistically significant differences between the two groups of urban municipalities. The rural municipalities experiencing distress have higher household incomes, higher property values, higher market values, similar unemployment rates, and lower population growth rates than the rural municipalities not at risk. Only the differences for property values are statistically significant between the two groups. In summary, the distressed urban municipalities have significantly higher unemployment rates while the distressed rural municipalities have significantly higher property values.

The financial profile of distress

Panel C of Table 4 shows the financial profile of distress. The urban municipalities at risk of financial distress have lower fiscal capacity, lower revenues per capita, higher debt per capita, lower taxes per capita, and lower tax effort than the urban municipalities not at risk. However, only tax effort is statistically different between the two groups of urban municipalities. The rural municipalities at risk of financial distress have lower assessed values and debt per capita but higher revenues per capita, taxes per capita and tax effort than the rural municipalities not at risk; however, only fiscal capacity is statistically significant and tax effort is marginally significant. In summary, the distressed urban municipalities have significantly lower tax efforts, while distressed rural municipalities have marginally higher tax efforts and lower fiscal capacity.

Multivariate profiles of municipalities at risk of financial distress

The univariate profiles do not control for the other indicators. In this section, we simultaneously consider all of the indicators. The

Table 4: The Profile of Financial Distress (FD) in Rural and Urban Municipalities.

Panel A: Socio-Demographic Profile.

Urban	Population***	Elderly	Poverty***	Minorities**	College
Not FD	8,175	16.5%	9.7%	7.7%	16.4%
FD	12,762	16.2%	12.5%	11.2%	15.4%
Rural	Population	Elderly	Poverty	Minorities	College***
Not FD	1,880	16.2%	10.5%	2.5%	9.7%
FD	1,969	16.8%	10.0%	2.3%	11.3%

Panel B: Economic Profile.

Urban	Household Income	Property Values	Market Value	Unemployed**	Growth
Not FD	54,719	161,838	69,457	5.9%	2.6%
FD	50,825	152,192	64,251	7.0%	2.1%
Rural	Household Income	Property Values*	Market Value	Unemployed	Growth
Not FD	46,668	121,488	56,858	6.1%	1.2%
FD	47,235	134,561	55,984	6.1%	-0.4%

Panel C: Financial Profile.

Urban	Assessed Value	Revenues per Capita	Debt Per Capita	Taxes per Capita	Tax Effort**
Not FD	37,995	784	478	311	0.871
FD	34,091	773	548	302	0.846
Rural	Assessed Value**	Revenues per Capita	Debt Per Capita	Taxes per Capita	Tax Effort*
Not FD	27,523	394	169	156	0.700
FD	21,995	402	158	170	0.729

Note: This table presents the means for each indicator.
 //** The differences in the means of the financially distressed and not financially distressed municipalities (within rural and urban) are statistically significant at the 0.10/0.05/0.01 level using t-tests.

significance of the multivariate model of financial distress is addressed using logistic regression analysis, since the dependent variable is categorical. Using this method, the underlying latent dependent variable is the probability of financial distress for municipality i , which is related to the observed variable, $Status_i$, through the relation:

- $Status_i = 0$ if the organization is not at risk of financial distress,
- $Status_i = 1$ if the organization is at risk of financial distress.

The model includes all of the independent variables from Table 1. We also control for the type of municipality and the urban or rural status. The predicted probability of the k^{th} status for local government i , $P(Status_{ik})$ is calculated as:

$$P(Status_{ik}) = \frac{1}{1 + e^{-Z}} \tag{1}$$

where

$$Z_i = \alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_i x_i$$

And x_i represents the indicators listed in Table 1.

Pearson correlations (not shown) find that the highest correlation among the independent variables to be 0.864 between PROP and MKTVAl; thus, multicollinearity may present a problem with the regressions. We eliminated PROP to reduce this problem. We use a random sample of approximately one-half of the municipalities to develop the model (the estimation sample) and the other half to test the model (the holdout sample). Since we do not want to overestimate the model, we use stepwise regression with a backward elimination approach. The results of the regression model are included in Table 5. Overall, the chi-square statistic (39.524) indicates that model is significant at less than the 0.01 level, and the Nagelkerke R² is 0.086. The multivariate model also indicates that municipalities at risk of financial distress have higher populations, percentage of minorities, and percentage of college degrees, and they have lower population growth and fiscal capacity than those that are not at risk of financial distress. We did not anticipate that the percentage of those with college degrees would be directly related to financial distress. Like the univariate tests, higher percentages of college degrees are related to a higher likelihood of financial distress when controlling for the other variables.

Predicting Financial Distress

We use the logistic regression model to test the predictive ability. The observed logistic regression equation (from Table 5) for entity i at time t is:

Table 5: The Logistic Regression Results of the Relation among the Risk Factors and Financial Distress.

Variable	Coefficient	S.E.	Wald	p-value	Exp(B)
Constant	-5.660	0.833	46.137	0.000	0.003
POPULATION	0.350	0.114	9.425	0.002	1.419
MINORITIES	3.067	1.284	5.706	0.017	21.470
COLLEGE	4.062	1.903	4.556	0.033	58.102
GROWTH	-2.477	1.111	4.967	0.026	0.084
FISCAP	0.001	0.000	5.280	0.022	1.000

$$P(Status_{it}) = \frac{1}{1 + e^{-Z}}$$

$$Z_i = -5.660 + 0.350 POPULATION + 3.067 MINORITIES + 4.062 COLLEGE - 2.477 GROWTH - 0.001 FISCAP$$

Model Chi-Square (p-value) 39.524 (p < 0.01)
 -2 Log Likelihood 537.609
 Nagelkerke R² 0.086

Note: See Table 2 for a description of the independent variables. Since a stepwise approach was utilized, only the statistically significant variables (at the 0.05 level) are displayed. The latent dependent variable equals 0 if the municipality is not financially distressed and 1 if the municipality is financially distressed.

$$P(i, t) = 1/(1 + e^{-Z_i})$$

where:

$$Z_i = -5.660 + 0.350 POPULATION + 3.067 MINORITIES + 4.062 COLLEGE - 2.477 GROWTH - 0.001 FISCAP$$

The predicted dependent variable, the probability of financial distress for local government i , is computed using the actual risk factors for each municipality in the estimation sample. The resulting probabilities are used to classify municipalities as at risk of financial distress or not. Jones [29] suggests two ways of adjusting the cutoff probability for classifying as at risk or not at risk of financial distress. First, we incorporate the prior probability of financial distress, and second, we include the expected cost of misclassification.

Using logit, the proportion of at risk municipalities in the sample must be the same as the proportion in the population to account for the prior probability of financial distress. If the proportion is not the same, then the constant must be adjusted [30]. This is more of a problem when a paired sample method is used, which is not the case here. Since we do not know the proportion of at risk municipalities in the population of all municipalities, we assume that the proportion of municipalities in Pennsylvania is an unbiased estimator of the proportion in the population of all municipalities. Since 6.9 percent of the municipalities in the sample are at-risk of financially distress, we assume that the prior probability of financial distress is 0.069.

The ratios of the cost of type I errors (incorrectly classifying financially distressed municipalities as not financially distressed – a false negative) to type II errors (incorrectly classifying municipalities that are not financially distressed as financially distressed – a false positive) also must be determined. The particular cost function is difficult to ascertain and will depend on the user of the information. For example, a creditor may want to minimize loan losses (and thus type I errors); however, he or she will suffer an opportunity cost (type II error) if credit is granted to another borrower at a lower rate. In most cases, the cost of a type II error is likely to be much smaller than a Type I error. Thus, we incorporate several relative cost ratios

Table 6: The predictive ability of the financial distress model including the expected costs of misclassification and the relative costs of type I Error to Type II Error.

Panel A: Estimation Sample.

	Ratio of the Cost of Type I to Type II Errors						
	1:1	10:1	20:1	30:1	40:1	60:1	100:1
Cutoff	0.380	0.080	0.052	0.052	0.025	0.025	0.025
Type I Error	0.975	0.388	0.188	0.188	0.013	0.013	0.013
Type II Error	0.001	0.264	0.542	0.542	0.900	0.900	0.900
Overall Error	0.070	0.273	0.516	0.516	0.836	0.836	0.836
ECM Model	0.068	0.513	0.763	0.892	0.872	0.889	0.924
ECM Naive	0.069	0.690	0.931	0.931	0.931	0.931	0.931
Relative Costs	0.988	0.744	0.820	0.959	0.937	0.955	0.992
Overall Correct	0.930	0.727	0.484	0.484	0.164	0.164	0.164

Panel B: Holdout Sample.

	Ratio of the Cost of Type I to Type II Errors						
	1:1	10:1	20:1	30:1	40:1	60:1	100:1
Cutoff	0.380	0.080	0.052	0.052	0.025	0.025	0.025
Type I Error	0.988	0.675	0.388	0.388	0.038	0.038	0.038
Type II Error	0.004	0.263	0.543	0.543	0.912	0.912	0.912
Overall Error	0.070	0.291	0.532	0.532	0.853	0.853	0.853
ECM Model	0.072	0.710	1.040	1.307	0.953	1.004	1.108
ECM Naive	0.069	0.690	0.931	0.931	0.931	0.931	0.931
Relative Costs	1.036	1.029	1.117	1.404	1.023	1.079	1.190
Overall Correct	0.930	0.709	0.468	0.468	0.147	0.147	0.147

Note: The cutoff is the probability of financial distress that minimizes the expected cost of misclassification, ECM. ECM is computed as $ECM = P(FD)P_{CI} + [1 - P(FD)]P_{CII}$, where $P(FD)$ is the prior probability of financial distress (0.069), P_I and P_{II} are the conditional probabilities of Type I and Type II errors, respectively. C_I and C_{II} are the costs of Type I and type II errors, respectively. The relative costs are the ECM Model divided by the ECM Naive.

(and cutoff probabilities) into our analysis. Specifically, we include the relative costs of type I to type II errors of 1:1, 10:1, 20:1, 30:1, 40:1, 60:1, and 100:1 [31,32].

The results of using the logit model to classify municipalities as financially distressed or not are included in Panel A of Table 6 for the estimation sample. The cutoff probabilities presented are those that minimize the expected costs of misclassification. Following [31], the Expected Costs of Misclassification (ECM) are computed as:

$$ECM = P(FD)P_{I}C_{I} + [1 - P(FD)]P_{II}C_{II},$$

where

$P(FD)$ is the prior probability of financial distress, P_I and P_{II} are the conditional probabilities of Type I and Type II errors, respectively, and C_I and C_{II} are the costs of Type I and type II errors, respectively.

The validity of the model is tested on the holdout sample using the same cutoff probabilities from the estimation sample. Panel B of Table 6 includes the results for the holdout sample. The results indicate that the model can identify financially distressed municipalities, with 16.4 percent (at a cost ratio of 100:1) to 93 percent (at a cost ratio of 1:1) of the municipalities in the estimation sample correctly classified. In the holdout sample, 14.7 percent to 93 percent of the municipalities

are correctly classified.

To test the usefulness of the model, we compare these results to a naïve strategy. This strategy classifies all municipalities as financially distressed (not financially distressed) when the ratio of relative costs is greater than (less than or equal to) the prior probability of financial distress. If all municipalities are classified as financially distressed (not financially distressed), then the naïve strategy makes no type I (type II) errors. In this case, P_I (P_{II}) is zero, and P_{II} (P_I) is one. The expected cost of misclassification for the naïve strategy of classifying all municipalities as not financially distressed (financially distressed) reduces to $0.931C_{II}$ ($0.0069C_I$).

We also report the relative costs or the ratio of the ECM for our model to the ECM for the naïve strategy in Table 6. Relative costs below one are an indication of a cost-effective model. For the estimation sample, our model consistently has a lower ECM than the naïve strategy across all ranges of costs of type I and type II errors. For the holdout sample, however, the model is not cost-effective. These results provide mixed evidence that our financial distress model is cost-effective in relation to a naïve strategy for the ranges of the costs of type I and type II errors.

Applying the prediction model

We use one of the municipalities from the sample to illustrate the model. The model allows one to predict the status of the municipality as at risk of financial distress or not at risk. From the results of the logistic regression, the probability of the financial distress for municipality i at time t , $P(i,t)$ is:

$$P(i,t) = \frac{1}{1 + e^{-z_i}} \tag{1}$$

where

$$Z_i = -5.660 + 0.350 \text{ POPULATION} + 3.067 \text{ MINORITIES} + 4.062 \text{ COLLEGE} - 2.477 \text{ GROWTH} - 0.001 \text{ FISCAP}$$

Substituting the actual variables from the example entity (in parentheses), we obtain:

$$Z_i = -5.660 + 0.350 (5.236) + 3.067 (0.000) + 4.062 (0.179) - 2.477 (0.679) - 0.001 (64,468)$$

$$Z_i = -5.578$$

$$P = 1 / (1 + e^{5.578})$$

$$P = 0.004$$

From Panel A of Table 5, the municipality is predicted not to be financially distressed, since the actual probability (0.004) is less than the cutoff at all levels of the ratio of Type I to Type II errors. The entity’s actual status is not financially distressed. In this case, the model correctly predicted the financial status of this municipality.

Robustness tests

We test the assumptions made while developing and testing our model for robustness. We test the robustness of our definition of financial distress. We assumed the prior probability of financial distress in developing our prediction model was 6.9 percent, since 6.9 percent of the municipalities in the initial sample were financially distressed. We evaluated the sensitivity of the model to other

specifications of the prior probability of financial distress by using prior probabilities of 0.05 and 0.10. The changes do not alter the results significantly.

Conclusion

Determining whether a municipality is experiencing distress is a complex matter. Symptoms of distress exist on a continuum and symptoms are not a permanent condition [7]. Municipalities move in and out of distress, and some municipalities are more distressed than others [7]. The very nature of financial distress makes it difficult to identify and measure. We classify a municipality as at risk of financial distress if it answered yes to any SOFC question; however, a single answer to the Act 47 criteria may not indicate distress.

Using univariate tests, we develop socio-demographic, economic and financial profiles of municipalities at risk of financial distress compared to those not at risk. We find that the at risk urban municipalities have significantly higher percentages of poverty, minorities, college degrees, unemployment rates, and significantly lower tax efforts than their urban counterparts. The at risk rural municipalities have significantly higher property values, marginally higher tax efforts, and significantly lower percentages of college degrees and fiscal capacities than their rural counterparts.

Using multivariate tests, we find that population, percentage of minorities, and percent with college degrees are positively related to financial distress, while population growth and fiscal capacity are negatively associated with financial distress. All the indicators are statistically significant. We find mixed results when we use our model to predict municipalities as at risk or not at risk.

Financial distress is an intergovernmental problem [5]. It can make state governments unstable, threaten the bond-ratings of state governments, and put pressure on state governments to deliver public services [5]. Municipal distress can impair the willingness of businesses to move into areas [5]. Intervention by state governments during the early stages is less costly than intervention at later stages [5]. Anything that affects the welfare of the people living within a state is a concern of the state [5]. For these reasons, state governments should help prevent, detect and mitigate financial distress at the municipal level [5,6]. Our model may help in identifying municipalities that are at risk of financial distress.

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