Risky (Small) Business:
Small Business Owners' Risk Aversion and its Impact on Decision Making

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Gabrielle Tammaro
Prof. Daniel Tortorice

1. Introduction

The contributions small businesses make to the American economy are arguably negligible at the individual level, but they have an undeniable aggregate impact. Firms that meet the U.S. Small Business Bureau's definition of a small business (meaning they do not exceed industry-specific employment and annual receipt thresholds) not only employ 48% of all American workers, but the goods and services they produce contribute 44% of the nation's GDP (U.S. Small Business Administration, Small Business Profile (2016) U.S. Small Business Administration (2019). Despite their indisputable value, it is impossible to get to intimately know each and every American who owns one of the country's 28.8 million small businesses, or closely evaluate how they manage their firms (Small Business Profile (2016). Each small business owner's journey to and conduct in business ownership is uniquely personal; that is part of the reason why so many people prefer to shop at these types of firms rather than at large chain companies and big-box stores.

However, this does not mean that it is impossible to study what *kinds* of people own small businesses. Economists have conducted several studies on small business owners (SBOs) to see if they possess specific traits that could explain their path to business ownership. While SBOs have been found to be highly innovative and driven by achievement motivation (Stewart et al. 1999), the bulk of research on this subject has focused on SBOs' high propensity for risk-taking.

Werner (2016) defines a risk-averse person as someone who "prefers a deterministic outcome equal to the expectation of a risky outcome over that risky outcome." Economic literature studying the risk-aversion of small business owners primarily falls into two categories. The first details how SBOs have a higher risk-taking propensity than people in other job positions. Ahmed (1985) finds that entrepreneurs are more risk-loving than the general population. Coleman and Cohn (2001) finds that SBOs report themselves to have a greater willingness to accept risk than medium and large business owners (who have ownership in businesses like SBOs, but "delegate" control of business operations). Interestingly, SBOs are also found to hold more "risky assets" which they define as "stocks, stock mutual funds, non-government bonds, foreign bonds, investment real estate, business ownership, and various other types of assets for which returns are less certain" (Coleman and Cohn 2001). Thus, small business owners have actual evidence of being less risk-averse than these counterparts. In somewhat of a contrast, Carland et al. (1995) and Stewert et al. (1999) find that SBOs are more risk-averse than large business

managers (who possess similar control over business operations to SBOs, but do not have ownership in businesses).

The second category of literature in this field details how there are varying levels of risk-loving-ness within small-business owners themselves. The literature on the subject does not use specific or uniform definitions for the different types of SBOs; the taxonomic levels vary greatly between papers (Smith and Miner (1983), Kunkel (2001)). While researchers occasionally evaluate business owners based on traits such as their experience, as in Armstrong and Hird (2009) who find that new business owners are more risk-loving than older business owners, many papers in the field use the widely cited Carland et al. (1984) definitions for entrepreneurs and small business owners to differentiate the types of SBOs. Wagener et al. (2008), Stewart et al. (1999), and Carland et al. (1995) all use this definition and find that entrepreneurs, who are classified as businesses owners who manage firms to achieve profit and firm growth, are more risk-loving than "regular" small business owners, who manage firms to achieve personal goals.

However, labeling business owners by the aims they have for their businesses as Carland et al. (1984) does can get complicated. The lines between "personal" and "business" goals are easily blurred. For example, Ang (1995) and Moskowitz and Vissing-Jørgensen (2002) find that small business owners tend to have a lack of separation between personal and firm finances, meaning that they are subjecting their personal capital to the potential successes and failures of their businesses. Furthermore, as firms are profit maximizers, one might assume that every small business owner wants to achieve higher profits.

Given the dispersion of risk aversion across small business owners, it may be worthwhile to explore risk aversion levels in small business owners using a more comprehensive scope that includes evaluating a SBOs' firm, ownership, and personal characteristics. Consequently, my paper seeks to expand on the previously conducted research on the different levels of risk aversion between small business owners in extended prior analyses. I seek to identify what influences SBOs' levels of risk aversion and to attempt to answer whether or not their level or risk aversion impacts their everyday business decisions.

To do this, I collected data on nearly one hundred small businesses by asking them to complete a survey that evaluated their level of risk aversion and demographic information.   I also asked questions that studied their responses to potential scenarios regarding everyday business decisions. Ultimately, I seek to use data that I collected to determine if (1) demographic characteristics can predict a small business owner's level of risk aversion and (2) if a small business owner's level of risk aversion and demographic information can predict their patterns in hiring and investment decisions.

2. Data

2.1 Invitation of Respondents

Nearly four hundred small business owners were invited to take the survey during the fall and winter of 2021. Besides personally asking small business owners in the Greater Boston area to take the survey, I contacted businesses from around the world (with 91.6% of respondents being American SBOs) by identifying them on social media hashtags related to small businesses. These hashtags included large nation/worldwide trends like #smallbusiness and #supportlocalbusinesses as well as state and local hashtags like #alaskasmallbusiness #hartfordsmallbusiness. After asking if they would take the survey, those who affirmed that they were interested were provided the link to the survey, which was sent to them electronically.

2.2 Survey Instrument

Small business owners who expressed a willingness to provide data were asked to complete the Google Forms survey sent to them. Ultimately, ninety-six survey respondents successfully completed the survey, a 24% response rate. The survey included three questionnaires that evaluated their risk aversion, demographics, and hypothetical business scenario responses.

2.2.1 Risk Aversion Questionnaire

In the risk aversion questionnaire, respondents were asked eleven questions that evaluated how they would respond to a hypothetical game in which they would win a sum of money in each of the eleven rounds.

In the first question, respondents were presented with two choices. They could (1) pick the certain option, which is to win ten dollars or (2) pick the uncertain option, which is to put their hand into a bag filled with an equal number of red and black chips. If they pulled a red chip, they would win twenty dollars; however, if they selected a black chip, they would only win ten dollars. In each of the next ten succeeding questions they were asked the same question. However, the value that they would win if they selected the black chip continuously decreased until it hit zero in question eleven.

Rational small business owners should demonstrate certain patterns in their responses. First, they should always select the uncertain option in the first question. The worst they could do in the uncertain scenario is win ten dollars, which is equal to the only outcome in the certain option. Furthermore, the first question might be the only round in which a respondent selects the uncertain option, or they may continue to select it until they reach a particular question. At that point, they would rather "settle" for the certain option's ten dollars (and thus forgo the chance of winning twenty dollars if they were to pull a red chip) because they are 'afraid' of potentially pulling a black chip and winning less than ten dollars (the amount they could have been guaranteed). Thus, this brings us to the second pattern of a rational respondent. The respondent should have a "streak" of selecting the uncertain option, and then at a particular question flip and successively only select the certain option from that point forward. This is because the value of the black chip continues to diminish as the risk aversion questions progresses, and that is the only thing changing between the questions. To be clear, the respondent's answers should not change from uncertain to certain options from question to question. Consider the following example: a rational business owner would not select the uncertain option in question three, when the value of the black chip is six dollars and fifty cents, if he already decided that he would select the certain option in the preceding question, when the value of the black chip was higher at eight dollars.

The twenty-three survey respondents who did not demonstrate both of these elements of rationale decision making in the risk aversion questionnaire were dropped from the analysis.

2.2.2   Demographics Questionnaire

The next portion of the survey asked respondents to answer personal, ownership, and firm specific questions. For privacy and uniformity purposes, most questions were multiple-choice. Multiple-choice answers were transformed from qualitative to quantitative data. For example, respondents were asked how they feel about taking risks in their personal lives by answering a multiple-choice question that had three options: they could identify as risk-averse, risk-neutral, or risk-loving. Respondents who selected that they were risk-averse were assigned a value of zero for this question, respondents who selected that they were risk neutral were assigned an one, and respondents who selected that they were risk-loving were assigned a two. This numeric categorization strategy was used for most multiple-choice questions.

For some multiple-choice questions, response categories were merged, forming new variables. For example, the categorical race variable was simplified into the binary variable *White* that clustered all the non-white, Hispanic/Latino respondents together so that they could be measured against white, not Hispanic/Latino SBOs.

For questions that required more specific and less personal details, respondents provided short numeric answers that were made uniform. For example, respondents who answered the question regarding how much ownership they had in their business with a percent had their response converted to a decimal.

2.2.3 Business Scenarios Questionnaire

In the business scenarios portion of the survey, respondents were asked how they would respond to two hypothetical situations. The first regarded an investment decision:

There is a piece of equipment available for you to immediately rent/lease for your business. If you purchase this piece of equipment, there are ONLY two ways it could affect your business's profits:

Possibility 1: Renting/leasing the piece of equipment leads you to have LOWER annual profits than you currently have without the equipment because revenue only increased by 50% of the equipment's price.

> *Possibility 2: Renting/leasing the piece of equipment leads you to have HIGHER*
> *annual profits than you currently have without the equipment because revenue*
> *increased by 150% of the equipment's price.*

The second regarded a hiring decision:

> *A potential employee has come to your place of business and asked for a job. If you hire this*
> *worker, there are ONLY two ways the worker could affect your business's profits:*
>
> > *Possibility 1: Hiring the worker leads you to have LOWER annual profits than you*
> > *currently have without the worker because revenue only increased by 50% of the worker's*
> > *salary.*
> >
> > *Possibility 2: Hiring the worker leads you to have MORE in annual profits than you*
> > *currently have without the worker because revenue increased by 150% of the worker's*
> > *salary.*

Respondents were then asked five questions for each business decision scenario. The first question
for each scenario stated that there was a one-hundred percent chance that accepting the decision
would increase their profits. Thus, there would be a zero percent chance that their profits would fall.
Respondents were then asked if they would buy the equipment/hire the worker. As the questions for
each scenario progressed, the probability that buying the equipment/hiring the worker would increase
profits decreased. Thus, the likelihood that the profits would fall increased. The last question for
both scenarios stated that there was a zero percent chance that the decision would not yield higher
profits (meaning that there was a one-hundred percent change that the profits would decrease).

Again, rational respondents would invest in the equipment/hire the worker in the first questions as
they would surely have higher profits by doing so. Furthermore, they would never invest in the
equipment/hire the worker in the last questions as they would for sure see a decrease in profits.
Additionally, they would have a "streak" of deciding to invest in the equipment/hire the worker, and
then at a particular question, flip and successively only select that they would not purchase the
equipment/hire the worker from that point forward. This is because the probability of profits increasing
from buying the equipment/hiring the worker continuously falls as the questions progress.

2.3 Key Variables

2.3.1 *GammaRisk*

Each question in the risk aversion questionnaire has a unique *GammaRisk* value. Respondents were assigned the *GammaRisk* value of the last question they selected the uncertain option for in the risk aversion survey. This indicates their level of risk aversion. Again, only respondents who (1) responded that they would take the uncertain option in the first question and (2) only flipped from selecting the uncertain option to the certain option one-time OR always selected the uncertain option had a risk aversion score assigned to them.

GammaRisk for each question was calculated by using the *constant relative risk aversion utility model* which demonstrates that as a business owner's risk-aversion (R) increases, their utility of a certain outcome, relative to an uncertain outcome, increases.

$$U(\pi) = \frac{\pi^{(1-R)}}{(1-R)}$$

The *constant relative risk aversion model* was employed in the expected utility of the uncertain option, which is calculated as:

$$EU = P_1(U(Red)) + (1-P_1)((U)Black)$$

$$EU = .5(U(20)) + .5((U)Black)$$

where P_1 is the probability that respondent would pull a red chip, *Red* is the amount won when a red chip is pulled, *U(Red)* is the constant relative risk aversion utility level for when a respondent pulls a red chip, *1- P_1* is the probability that respondent would pull a black chip, *Black* is the amount won when a black chip is pulled, *U(Black)* is the constant relative risk aversion calculated utility level for when a respondent pulls a black chip.

Using the same definitions as above, the expected utility of the certain option can be calculated as:

$$EU = P_1(U(Certain(\pi)))$$

$$EU = 1(U(Certain(\pi)))$$

$$EU = (U(10))$$

To calculate *GammaRisk* for each question, I set the utility of the certain option and the utility of

the uncertain option equal to each other. Then I solved for what level of risk (R) a SBO would need to exhibit for them to be indifferent between the uncertain and certain outcomes.

$$EU(Certain) = EU(Uncertain)$$

$$(U(10))= .5(U(20)) + .5((U)Black)$$

As the value of the black chip decreases, *GammaRisk* falls as there is less explanation for why a respondent would pick the certain option. Furthermore, *GammaRisk* has a direct relationship with risk aversion. Someone who only selected the uncertain option in the first two questions would be risk averse and have a higher *GammaRisk* score than someone who selected the uncertain option for all eleven questions. A respondent who answered in that fashion would be would be risk loving.

The *GammaRisk* of the last question a respondent selected that they would take the uncertain option for was assigned as the SBO's *GammaRisk*. However, as the denominator of the certain/uncertain utility ratio approaches zero when using the numeric values from the first question, respondents who only selected the uncertain option for the first question were assigned a missing value for their risk aversion score. For these respondents, only an infinite level of risk aversion could explain why they would prefer the uncertain option; they would at worst win the same amount of money they would get if they chose the certain option.

Figure 1: GammaRisk Calculations

GammaRisk	
Value	Criteria
3.763529	Respondent selected "uncertain" option for RAQs 1&2
1.000005	Respondent selected "uncertain" option for RAQs 1-3
1	Respondent selected "uncertain" option for RAQs 1-4
0.650925	Respondent selected "uncertain" option for RAQs 1-5
0.516729	Respondent selected "uncertain" option for RAQs 1-6
0.402827	Respondent selected "uncertain" option for RAQs 1-7
0.305759	Respondent selected "uncertain" option for RAQs 1-8
0.222885	Respondent selected "uncertain" option for RAQs 1-9
0.092037	Respondent selected "uncertain" option for RAQs 1-10
0	Respondent selected "uncertain" option for RAQs 1-11
.	Respondent selected "uncertain" option only for RAQ 1

The mean *GammaRisk* was .864. This suggests that the average respondent was slightly risk-averse. However, this estimate is slightly skewed in the direction of more risk-aversion as respondents who selected the "uncertain" option only for the first risk aversion question were not assigned a *GammaRisk* score, thus they are unaccounted for.

2.2.2 *GammaProftsH* and *GammaProftsE*

To calculate investment and hiring decision scores (*GammaProfitsE* and *GammaProfitsH*) for each respondent, a similar application of the expected utility model used for the *GammaRisk* calculations was employed.

Each question in the hiring business scenario set of questions has a unique *GammaProfitsH* value. Respondents were assigned the *GammaProfitsH* value of the last question they selected the "hire" option for in the hiring business scenario set of questions. Each question in the equipment business scenario set of questions has a unique *GammaProfitsE* value. Respondents were assigned the *GammaProfitsE* value of the last question they selected the "purchase" option for in the equipment business scenario set of questions.

When calculating *GammaProfitsE* and *GammaProfitsH*, profits are now being expressed as the price of the equipment/salary of the worker. Thus, the *constant relative risk aversion utility model* now has two versions to reflect modifications. One demonstrates how profits would increase by 50% of the price of the equipment/salary of the worker, while the other shows how profits would decrease by 50% of the price of the equipment/salary of the worker.

$$UProfitsIncrease = \frac{(1.05(Cost\ of\ Decision))^{1-R}}{(1-R)}$$

$$UProfitsDecrease = \frac{(.95(Cost\ of\ Decision))^{1-R}}{(1-R)}$$

Setting the ratio of the utility of the certain outcome (which was when the SBO made no changes to their hiring/investments, and profits remained the same) and the uncertain option (when the SBO purchased the equipment/hired the worker and profits changed) equal to each other allowed for the solving of what level of risk aversion (R) an SBO would need to have for them to be indifferent towards the certain and uncertain outcomes.

To be more explicit: to calculate *GammaProfitsH/GammaProfitsE* for each question, I set the utility of the certain option and the utility of the uncertain option (which is the sum of the utility of profits increasing and the utility of profits decreasing) equal to each other. Then, I solved for what level of risk (R) a SBO would need to exhibit for them to be indifferent between the uncertain and certain outcomes.

$$U(Certain) = U(Uncertain)$$
$$U(\pi) = P_1(U(1.05\pi)) + (1 - P_1)(.95\pi)$$

Again, SBOs were assigned the corresponding *GammaProfitsH/GammaProfitsE* of the last question they answered they would purchase the equipment/hire the worker for. These scores move directly with risk aversion. However, only respondents who 'flipped' from purchasing the equipment/hiring the worker to not purchasing the equipment/hiring the worker at one of the three middle questions were assigned a score. This is because the zero-percent chance that the profits would decrease in the first question and the zero-percent change that profits would increase in the last question renders the ratios as unsolvable.

Figure 2: GammaProfitsE Calculations

GammaProfitsE	
Value	Criteria
.	Respondent selected "purchase" option only for Equipment Question 1
21.889	Respondent selected "purchase" option only for Equipment Questions 1&2
0	Respondent selected "purchase" option only for Equipment Questions 1-3
-21.889	Respondent selected "purchase" option only for Equipment Questions 1-4
.	Respondent selected "purchase" option only for Equipment Questions 1-5

Figure 3: GammaProfitsH Calculations

GammaProfitsH	
Value	Criteria
.	Respondent selected "hire" option only for Hiring Question 1
21.889	Respondent selected "hire" option only for Hiring Questions 1&2
0	Respondent selected "hire" option only for Hiring Questions 1-3
-21.889	Respondent selected "hire" option only for Hiring Questions 1-4
.	Respondent selected "hire" option only for Hiring Questions 1-5

The average *GammaProfitsE* value of 10.671 was slightly higher the average *GammaProfitsH* value of 8.439, thus suggesting that respondents are more risk averse when making equipment purchasing decisions than they are when making hiring decisions.

2.2.3 Demographic Variables:

Some questions in the demographic portion of the survey collected information regarding personal, non-business-related information about the respondent. *Gender* is a binary variable that takes the value of one if the respondent is a female and a value of zero if they are a male. Men and women were nearly equally represented in the survey with women making up 52% of the pool.

Age is a categorical variable that takes an integer value of zero to six. Respondents under the age of fifteen were assigned a zero, respondents between the ages of sixteen and nineteen were assigned a one, respondents between the ages of twenty and twenty-four were assigned a two, respondents between the ages of twenty-five and thirty-four were assigned a three, respondents between the ages of thirty-five and forty-four were assigned a four, respondents between the ages of forty-five and fifty-four were assigned a five, respondents between the ages of fifty-five and sixty-five were assigned a six. This breakdown is consistent with the Bureau of Labor Statistics' division of ages for employment figures. Furthermore, assuming that the average American starts working full time around the age of twenty-one and works until they retire at the age of 65, the average respondent age of 41.51 years is appropriate.

White is a binary variable that takes a value of one if the respondent is white (and not Hispanic/Latino) and a value of zero if they are not. Nearly 72% of respondents were white. *Married* is a binary variable that takes a value of one if the respondent is currently married and a zero if they are not. Nearly 63% of respondents were married. *Children* is a binary variable that takes a value of one if the respondent has children that qualify as legal dependents and a zero if they do not. While nearly 48% of respondents had children who qualified as dependents, I would assume that this value would be higher if the question did not specify that the children had to be legal dependents.

HighSchoolDegree is a binary variable in which respondents received a zero if they had not completed high school and a one if they did. Nearly 97% of survey respondents were high school graduates, suggesting that they are literate in at least foundation areas of business such as reading, writing, and basic math. *EducationYears* is a categorical variable that takes a value of twelve if the

respondent's highest level of completed education was a high school diploma, a value of fourteen if the respondent's highest level of education was an associate's degree, a value of sixteen if the respondent's highest level of education was a bachelor's degree, and a value of seventeen if the respondent's highest level of education was an advanced degree. As the average number of years in school was slightly over fifteen, respondents as a whole were a well-educated group.

RiskPersonal is a categorical variable that takes a value of zero if the respondent reported themselves to be risk averse in their personal life, a value of one if they reported themselves to be risk neutral in their personal life, and a value of two if they reported themselves to be risk loving in their personal life.

Some questions in the demographic questionnaire asked questions specific to the respondent's role as a business owner. *RiskBusiness* is a categorical variable that takes a value of zero if the respondent reported themselves to be risk averse when making business decisions, a value of one if they reported themselves to be risk neutral when making business decisions, and a value of two if they reported themselves to be risk loving when making business decisions. When comparing personal versus business risk aversion, the average respondent indicated they were risk-neutral in both aspects of risk aversion. However, the average level of personal risk aversion (1.115) was slightly less risk-averse than the average level of business risk aversion (1.042).

IncSource is a binary variable that takes a value of one if the respondent identified their business as one of their primary sources of income and zero if they did not. More than 70% of survey respondents indicated that their business was their primary source of income.

OwnedBusinessAge is how many years the respondent has owned their business for. *OperationBusinessAge* is the number of years the respondent's business has been in operation for. As 51% of American businesses are ten years old or less, the dataset's average number of years that a SBO has owned their business for (7.65) and the average number of years a SBO's business has been in operation for (13.98) are on target (JP Morgan Chase & Co.).

PreOwnedFamily is a binary variable that takes a value of one if the respondent's business was

previously owned by a member of their family and a value of zero if it had not. Only 10.5% of surveyed businesses are historically family-owned, but 27.1% of surveyed businesses were previously owned. *PreOwnedBus* is a binary variable that takes a value of one if the number of years the respondent has owned their business for is equal to the number of years their business has been in operation for, and takes a value of zero if the two are not equal.

Figure 4: Summary Statistics

	Observation	Mean	Std. Dev.	Min	Max
Gender	95	0.516	0.502	0	1
Age	96	4.167	1.262	2	7
White	96	0.719	0.452	0	1
HighSchoolDegree	96	0.969	0.175	0	1
EducationYears	93	15.194	1.924	12	17
Married	96	0.625	0.487	0	1
Children	96	0.479	0.502	0	1
RiskPersonal	96	1.115	0.63	0	2
IncSource	96	0.708	0.457	0	1
RiskBusiness	95	1.042	0.563	0	2
OwnedBusinessAge	96	7.653	8.705	0.17	48
OperationBusienssAge		13.982	23.116	0.17	145
PreOwnedBusiness	96	0.271	0.447	0	1
PreOwnedFamily	95	0.105	0.309	0	1
GammaRisk	73	0.864	0.79	0	3.764
GammaProfitsE	80	10.671	12.554	-21.889	21.889
GammaProfitsH	83	8.439	14.025	-21.889	21.889

3. Regression Results

Using Ordinary Least Squares, I modeled three relationships with my data. First, I ran a log-linear regression to determine whether or not an SBO's level of risk aversion can be predicted given personal, ownership, and firm related data.

As the measure of risk aversion (*GammaRisk*) is rather arbitrary, it was modeled as a log-linear function so that impacts could be discussed using percentages rather than as per-unit. Thus, *logGammaRisk* is *GammaRisk* logged. Data for the independent variables were collected from the demographic portion of the survey.

The initial regression equation was as follows:

$$logGammaRisk = b_0 + b_1Age + b_2Gender + b_3IncSource + b_4White + b_5EducationYears + b_6$$
$$HighSchoolDegree + b_7OwnedBusinessAge + b_8OperationBusinessAge + b_9PreOwnedFamily +$$
$$b_{10}Married + b_{11}Children + b_{12}RiskPersonal + b_{13}RiskBusiness + b_{14}PreOwnedBus$$

Regression results are displayed in figure five, column one. Given the low R-squared value and the numerous variables that had very large p-values, another regression was run that reduced the number of variables. The categorical variable *RiskPersonal* was dropped as its estimates were insignificant at the 50% level. The *PreOwnedFamily* business variable was dropped for collinearity purposes as it was already being represented by the *PreOwnedBusiness* variable. Similarly, the *HighSchoolEducation* variable was dropped as it was correlating strongly with the *EducationYears* variable.

The second regression took the form of:

$$logGammaRisk = b_0 + b_1Age + b_2Gender + b_3IncSource + b_4White + b_5EducationYears +$$
$$b_6OwnedBusinessAge + b_7OperationBusinessAge + b_8Married + b_9Children + b_{10}RiskBusiness$$
$$+ b_{11}PreOwnedBus$$

Regression results are displayed in figure five, column two. The adjusted R-squared for this regression is higher than the previous one, and several values demonstrated statistical significance. As found in the initial regression, a respondent's educational status was statistically significant in predicting risk aversion levels. In this regression, an increase in schooling by one year lead to a decrease in their level of risk aversion by 20.7%. Conventional thought rebukes this finding. This result suggests that SBOs who are more educated are less risk averse than their less educated counterparts, despite having more knowledge that could allow them to better consider the implications of decisions. Furthermore, respondents who reported that their business was the primary source of income saw a 53.9% decrease in their level of risk aversion in comparison to those who reported that their business was not a primary source of income. This raises the question of whether people whose businesses are their primary sources of income exhibit risk averse tendencies to protect their finances, or if risk averse people are more inclined to make their businesses their primary sources of income.

Just et. al. (2009) models how business owners who are risk-loving make more ambitious investment decisions than those who are risk-averse. In my model, I follow a similar approach to show that we can predict how small business owners make investment and hiring decisions based on their levels of risk averseness. I again used Ordinary Least Squares (OLS) to model these relationships. I ran two structurally similar linear regressions to determine if a SBO's previously calculated level of risk aversion, along with any, personal, ownership, or firm characteristics, determines their hiring and investment decisions.

Figure 5: Risk Aversion Regression Results

	(1) logGammaRisk	(2) logGammaRisk
Age	-0.102 (.147)	-.110 (.140)
Gender	0.346 (.313)	.298 (.295)
IncSource	-0.512 (.336)	-.539* (.319)
White	0.443 (.370)	.379 (.352)
EducationYears	-0.204** (.082)	-.207** (.077)
HighSchoolDegree	0	-
OwnedBusinessAge	0.014 (.027)	.016 (.026)
OperationBusinessAge	-0.011 (.010)	-.011 (.007)
PreOwnedFamily	0.132 (.711)	-
Married	-0.155 (.310)	-.134 (.300)
Children	0.305 (.295)	.337 (.279)
RiskPersonal_1	0.129 (.656)	-
RiskPersonal_2	0.478 (.676)	-
RiskBusiness_1	-0.379 (.653)	-.283 (.429)
RiskBusiness_2	-0.991 (.747)	-.633 (.534)

PreOwnedBusiness	-4.639	-.403
	(.323)	(.372)
Constant	3.772	3.979
	(1.395)	(1.310)
Observations	61	61
R-squared	0.3972	0.3871

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

For the investment decision regression, *GammaProfitsE* was the dependent variable. For the hiring decision regression, *GammaProfitsH* was the dependent variable. Both the investment and hiring decision regressions controlled for demographic characteristics. However, I also needed to create two new independent variables, *Uncertain* and *UncertainGammaRisk* to study how a SBO's level of risk aversion correlates with the level of risk aversion demonstrated by their investment/hiring decision choices. *Uncertain* is a binary variable that takes the value of one if there is a *GammaRisk* calculated for that respondent. Otherwise, *Uncertain* takes a value of zero. *UncertainGammaRisk* takes the value of GammaRisk if *Uncertain* equals one. Otherwise, if *Uncertain* equals 0, *UncertainGammaRisk* also equals 0. The use of both of these variables allowed for respondents who were assigned a missing *GammaRisk* value to be accounted for in the regression.

First, I examined whether or not a small business owner's investment decision could be determined by their level of risk aversion.

The initial regression is modeled as follows:

$GammaProfitsE = b_0 + b_1Uncertain + b_2UncertainGammaRisk + b_3Age + b_4Gender + b_5IncSource + b_6White + b_7EducationYears + b_8OwnedBusinessAge + b_9OperationBusinessAge + b_{10}PreOwnedFamily + b_{11}PreOwnedBus + b_{12}RiskPersonal + b_{13}RiskBusiness$

Regression results are displayed in figure six, column one. Again, the low R-squared value and few number of statistically significant variables made me run a modified regression. This new model neglected controlling for how long the respondent had owned their business for as the variable was found to be largely insignificant as its p-value of 0.827 suggests it was not statistically significant even at the 20% confidence level. Furthermore, it was moderately correlated (52.47%) to how long the firm

had been in operation for. Similarly, the respondents' self-identified measure of business-related risk aversion was not included in the regression as the level of statistical insignificance for both risk-neutral and risk-loving individuals was below even a 35% confidence level.

The modified regression was then modeled as follows:

$GammaProfitsE = b_0 + b_1Uncertain + b_2UncertainGammaRisk + b_3Age + b_4Gender + b_5IncSource + b_6EducationYears + b_7PreOwnedFamily + b_8PreOwnedBus + b_9RiskPersonal$

Regression results are displayed in figure six, column two. This modified regression yields more variables with statistical significance. The variable *Uncertain's* statistical significance at the 90% level suggests that respondents who at least demonstrated some level of risk taking (by responding that they would at least take the uncertain option in first two questions of the risk aversion questionnaire) saw a -16.78 unit decrease in their investment risk score in comparison to those who only selected the uncertain option in the first question. This suggests that they make more risky investment decisions. Interestingly, subsequent *GammaRisk* scores had a statistically insignificant impact on investment decisions, as exemplified by the .277 p-value of the variable *UncertainGammaRisk*.

Furthermore, gender influenced the investment risk measure at a 95% statistically significant level with women scoring 6.44 less than men for their investment decision score. This suggests that they are more likely to make risky investment decisions. Additionally, respondents' self-identified measure of risk aversion in their personal lives also seems to have a statistically significant impact on investment decisions as risk-neutral respondents had an implied risk aversion coefficient that was 8.19 less than those who were risk averse, and those who claimed that they were risk loving had a 12.71-point lower score than those who were risk averse.

In my third regression I examined whether or not a small business owner's hiring decisions could be determined by their level of risk aversion.

The initial model was as follows:

$GammaProfitsH = b_0 + b_1Uncertain + b_2UncertainGammaRisk + b_3Age + b_4Gender + b_5IncSource + b_6White + b_7EducationYears + b_8 OwnedBusinessAge +$

$b_9OperationBusinessAge+ b_{10}PreOwnedFamily + b_{11}PreOwnedBus+ b_{12} RiskPersonal +$

$b_{13}RiskBusiness$

Regression results are displayed in figure six, column three. Again, the variable *Uncertain* is statistically significant at the 90% level, meaning that respondents who at least demonstrated some level of risk-taking (by responding that they would at least take the uncertain option in first two questions of the risk aversion questionnaire) saw a -19.36 unit decrease in their in comparison to those who only selected the uncertain option in the first question, suggesting that they are more likely to make risky hiring decisions.

 As this model already has very low R- and adjusted R-square values, I decided not to run a modified regression with less controls. However, it is worth noting that the *IncSource* and *PreOwnedBus* variables were almost statistically significant at the 90% level. The *IncSource* coefficient of 6.68 suggests that respondents whose businesses are their primary source of income will have a higher hiring score (and thus are more risk-averse) than those whose businesses are not their primary source of income. The *PreOwnedBusiness* coefficient of -7.73 suggests that business owners who purchased their businesses (meaning they did not start them) will have a lower hiring score (and are thus more risk-loving) than business owners who founded their businesses.

Figure 6: Business Scenario Regression Results

	(1) GammaProfitsE	(2) GammaProfitsE	(3) GammaProfitsH
Uncertain	(19.256)** 9.07	-16.781* (8.944)	-19.363* (11.485)
UncertainGammaRisk	1.830 (1.151)	1.212 (1.102)	.992 (1.465)
Age	-.307** (1.628)	-.932 (1.385)	-1.080 (1.977)
Gender	-6.796 (3.226)	-6.441** (3.105)	3.390 (4.146)
IncSource	3.544 (3.460)	4.769 (3.292)	6.681 (4.433)
White	1.385 (3.805)	-	-1.126 (4.708)

EducationYears	1.064 (.891)	1.054 (.847)	-.174 (1.154)
OwnedBusinessAge	-.065 (.294)	-	-.145 (.358)
OperationBusinessAge	.032 (.104)	-	.149 (.128)
PreOwnedFamily	-5.641 (7.223)	-4.577 (5.900)	-.667 (8.854)
PreOwnedBusiness	-2.720 (4.136)	-3.164 (3.584)	-7.728 (5.488)
RiskPersonal_1	-5.667 (8.000)	-8.185* (4.286)	.154 (10.030)
RiskPersonal_2	-15.629* (7.894)	-12.716* (4.657)	10.576 (10.049)
RiskBusiness_1	-3.459 (7.658)	-	-6.498 (9.780)
RiskBusiness_2	6.951 (8.241)	-	-8.327 (10.579)
Constant	23.03 (15.877)	24.087 (14.888)	30.694 (22.956)
Observations	60	60	62
R-squared	0.3753	0.3063	0.2499

Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Conclusion:

Given the first regression results, it seems that demographic factors such as a small business owner's level of education and their valuation of their business as a source of income influences their level of risk aversion. Furthermore, it seems that to some extent, a small business owner's level of risk aversion can predict how risk-averse they are in regards to making hiring and investment decisions. In these scenarios, demographic factors do not have much of a direct impact themselves (but an indirect impact as, again, they influence general risk-aversion).

I found it very interesting the variable *RiskBusiness* was not significant in any of the five regressions that I ran. Thus, I have come to the conclusion that small business owners are not aware of their work-related level of risk-aversion. Continued work on this research could be used to further identify what factors contribute to a small business owner's level of risk aversion. With this knowledge, small business owners can make more strategic decisions that will allow for their businesses to perform

better.

Ultimately, it must be noted that there are several points of weaknesses within my research that were out of my control. Respect and regard for privacy limited the types of questions I could ask. The small sample size puts the impact of the findings in question. Mathematical constraints in the construction of the risk aversion and hiring/investment scores limits the potential values of these variables. Further expanded research of this study can correct these limitations and provide more clarity on the preliminary findings identified.

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Survey Instrument

Small Business Owner Risk Analysis Survey

Hello, my name is Gabrielle Tammaro and I am a senior economics major at the College of the Holy Cross in Worcester, MA. For my honors economics thesis, I am conducting a survey that analyzes how small business owners respond to risky business scenarios. By taking this survey, you, as a small business owner, will learn what factors influence your business' decisions, and can use this information to make more strategic choices for your company. The knowledge gained from this survey can be applied to your everyday work, thus potentially increasing your business' profits. The survey takes about 7 minutes to complete and all responses are, and will be kept, anonymous. Thank you!

After section 1   Continue to next section

Survey Part 1: Risk Aversion

For this part of the survey, you will be presented with a series of hypothetical questions. For each question, you will have to choose whether you prefer option #1 or option #2.

Option #1 is always the same: if you choose it, you receive $10.

Option #2 involves an uncertain payoff that depends on whether you choose a red chip or a blue chip out of a bag. If you pull out a red chip from the bag, you will receive $20. If you pull out a black chip, the maximum you receive is $10, but you could receive as little as $0. There are 100 total chips in the bag, and all of the chips are either red or black chips. There are 50 red chips in the bag and 50 black chips in the bag.

When answering the following questions, please take your responses seriously and really suppose that your answers were affecting real profits and real money.

Would you select option 1 or option 2?

Question	Option #1: Sure thing	Option #2: Uncertain payoffs
1	$10	If red chip: $20 If black chip: $10

○ Option 1

○ Option 2

Would you select option 1 or option 2?

Question	Option #1: Sure thing	Option #2: Uncertain payoffs
2	$10	If red chip: $20 If black chip: $8

○ Option 1

○ Option 2

Would you select option 1 or option 2?

Question	Option #1: Sure thing	Option #2: Uncertain payoffs
3	$10	If red chip: $20 If black chip: $6.50

○ Option 1

○ Option 2

Would you select option 1 or option 2?

Question	Option #1: Sure thing	Option #2: Uncertain payoffs
4	$10	If red chip: $20 If black chip: $5

○ Option 1

○ Option 2

Would you select option 1 or option 2?

Question	Option #1: Sure thing	Option #2: Uncertain payoffs
5	$10	If red chip: $20 If black chip: $4

○ Option 1

○ Option 2

Would you select option 1 or option 2?

Question	Option #1: Sure thing	Option #2: Uncertain payoffs
6	$10	If red chip: $20 If black chip: $3.50

○ Option 1

○ Option 2

Would you select option 1 or option 2?

Question	Option #1: Sure thing	Option #2: Uncertain payoffs
7	$10	If red chip: $20 If black chip: $3

○ Option 1

○ Option 2

Would you select option 1 or option 2?

Question	Option #1: Sure thing	Option #2: Uncertain payoffs
8	$10	If red chip: $20 If black chip: $2.50

○ Option 1

○ Option 2

Would you select option 1 or option 2?

Question	Option #1: Sure thing	Option #2: Uncertain payoffs
9	$10	If red chip: $20 If black chip: $2

○ Option 1

○ Option 2

Would you select option 1 or option 2?

Question	Option #1: Sure thing	Option #2: Uncertain payoffs
10	$10	If red chip: $20 If black chip: $1

○ Option 1

○ Option 2

Would you select option 1 or option 2?

Question	Option #1: Sure thing	Option #2: Uncertain payoffs
11	$10	If red chip: $20 If black chip: $0

Section 3 of 4

Demographic Information

Description (optional)

Personal Information

Description (optional)

What is your gender?

○ Male

○ Female

○ Other

How old are you?

○ 15 or Under

○ 16-19

○ 20-24

○ 25-34

○ 35-44

○ 45-54

○ 55-65

○ 65+

○ Other...

What is your race?

○ White - Not Hispanic/Latino

○ Black

○ White - Hispanic

○ White - Latino

○ Asian

○ Other

What is the highest level of education you have completed?

○ No high school degree

○ High school degree

○ Associate's degree

○ Bachelor's degree

○ Advanced degree (M.A., M.S., Ph. D., M.B.A., etc.)

What state are you from?

Short answer text

If you are currently in school, what type of degree are you actively pursuing?

○ I am not currently enrolled in school

○ High school degree

○ Associate's degree

○ Bachelor's degree

○ Advanced degree (M.A., M.S., Ph. D., M.B.A., etc.)

Are you currently married?

○ Yes

○ No

Do you have any children that qualify as legal dependents?

○ Yes

○ No

In your personal life, how do you consider yourself in terms of how you feel about taking risks?

○ Risk averse

○ Risk neutral

○ Risk loving

Firm Information

Description (optional)

How long have you owned your business for? Please respond in years.

Short answer text

How long has the business that you own been in operation for (i.e. - consider if it was in operation before you acquired ownership of it)? Please respond in years.

Short answer text

Who is the primary decision-maker(s) for everyday operations at your business? Please check all that apply

☐ You

☐ Your co-business owners

☐ One/or more of your employees who do not have any ownership in the business

What industry is your business a part of?

○ Construction

○ Retail Trade

○ Real Estate and Rental and Leasing

○ Utilities

○ Information

○ Finance and Insurance

○ Agriculture, Forestry, Fishing and Hunting

○ Manufacturing

○ Mining, Quarrying, and Oil and Gas Extraction

○ Management of Companies and Enterprises

○ Administrative and Support, Waste Management and Remediation Services

○ Educational Services

○ Health Care and Social Assistance

○ Arts, Entertainment and Recreation

○ Accommodation and Food Services

○ Repair and Maintance

○ Personal and Laundry Services

○ Wholesale Trade

○ Transportation and Warehousing

○ Professional, Technical, and Scientific Services

○ Other...

How much ownership do you have in your business? Please enter as a percent.

Short answer text

How many people have ownership in your business? Please enter a number.

Short answer text

Please select which statement best describes who works at your business.

○ I am the owner of, and the only employee at, my business

○ My co-business owners and I are the only employees at our business

○ My business employs workers who do not have ownership in the business

Including yourself (and your co-business owners, if you have them) how many people does your business employ? Please respond with a number.

Short answer text

Before you owned your business, was it owned by a member of your family?

○ Yes

○ No

○ No - but it was owned by someone in my co-business owner's family

○ Other...

In the future, do you intend or expect to transfer the ownership of your business to a member of your family?

○ Yes

○ No

○ No - but I intend/expect to transfer ownership to someone in my co-business owner's family

Is your business your primary source of income?

○ Yes, my business is my only source of income

○ Yes - I have multiple sources of income, but my business is my primary source of income

○ No - I have multiple sources of income, but my business is not my primary source of income

How would you describe the relationship between your business and other similar businesses?

○ Highly competitive with eachother

○ Somewhat competitive with eachother

○ Not very competitive with eachother

○ Not competitive at all with eachother

Section 4 of 4

Survey Part 3: Investment and Hiring Scenarios and Accompanying Questions:

Description (optional)

There is a piece of equipment available for you to immediately rent/lease for your business. If you purchase this piece of equipment, there are ONLY two ways it could affect your business's profits:

Possibility 1: Renting/leasing the piece of equipment leads you to have LOWER annual profits than you currently have without the equipment because revenue only increased by 50% of the equipment's price.

Possibility 2: Renting/leasing the piece of equipment leads you to have HIGHER annual profits than you currently have without the equipment because revenue increased by 150% of the equipment's price.

If there was a 100% chance that renting/leasing the equipment would bring you higher annual profits than you currently have without the equipment, and thus a 0% chance it would bring you less profits, would you rent/lease the equipment?

○ Yes, I would rent/lease the equipment

○ No, I would not rent/lease the equipment

○ Other...

If there was a 75% chance that renting/leasing the equipment would bring you higher annual profits than you currently have without the equipment, and thus a 25% chance it would bring you less profits, would you rent/lease the equipment?

○ Yes, I would rent/lease the equipment

○ No, I would not rent/lease the equipment

If there was a 50% chance that renting/leasing the equipment would bring you higher annual profits than you currently have without the equipment, and thus a 50% chance it would bring you less profits, would you purchase the equipment?

○ Yes, I would rent/lease the equipment

○ No, I would not rent/lease the equipment

If there was a 25% chance that renting/leasing the equipment would bring you higher annual profits than you currently have without the equipment, and thus a 75% chance it would bring you less profits, would you purchase the equipment?

○ Yes, I would rent/lease the equipment

○ No, I would not rent/lease the equipment

If there was a 0% chance that renting/leasing the equipment would bring you higher annual profits than you currently have without the equipment, and thus a 100% chance it would bring you less profits, would you purchase the equipment?

○ Yes, I would rent/lease the equipment

○ No, I would not rent/lease the equipment

A potential employee has come to your place of business and asked for a job. If you hire this worker, there are ONLY two ways the worker could affect your business's profits:

Possibility 1: Hiring the worker leads you to have LOWER annual profits than you currently have without the worker because revenue only increased by 50% of the worker's salary.

Possibility 2: Hiring the worker leads you to have MORE in annual profits than you currently have without the worker because revenue increased by 150% of the worker's salary.

If there was a 100% chance that hiring the worker would bring you higher annual profits than you currently have without him/her, and thus a 0% chance that the worker would decrease your annual profits, would you hire the worker?

○ Yes, I would hire the worker

○ No, I would not hire the worker

If there was a 75% chance that hiring the worker would bring you higher annual profits than you currently have without him/her, and thus a 25% chance that the worker would decrease your annual profits, would you hire the worker?

○ Yes, I would hire the worker

○ No, I would not hire the worker

If there was a 50% chance that hiring the worker would bring you higher annual profits than you currently have without him/her, and thus a 50% chance that the worker would decrease your annual profits, would you hire the worker?

○ Yes, I would hire the worker

○ No, I would not hire the worker

If there was a 25% chance that hiring the worker would bring you higher annual profits than you currently have without him/her, and thus a 75% chance that the worker would decrease your annual profits, would you hire the worker?

○ Yes, I would hire the worker

○ No, I would not hire the worker

If there was a 0% chance that hiring the worker would bring you higher annual profits than you currently have without him/her, and thus a 100% chance that the worker would decrease your annual profits, would you hire the worker?

○ Yes, I would hire the worker

○ No, I would not hire the worker

Thank you for taking the survey. If you have any comments or questions please leave them below.

Long answer text