

COVID-19 and Economic Relief to Small Business: Determinants of PPP Loan Size

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I. Introduction

For over a year, the coronavirus pandemic has disrupted daily life in every corner of the globe. By mid-2020, half of the world's population was placed on lockdown to prevent the spread of COVID-19. Although the development and distribution of vaccines has given many hope for a brighter future and a possible end to the pandemic, the consequences of COVID-19 have been devastating, far-reaching, and deadly.

Worldwide, approximately 130 million people have been infected by COVID-19, and sadly, approximately 2.8 million have died from the virus. In the United States, over 550,000 Americans have died from COVID-19.¹ In addition to the significant loss of life, Americans have also experienced serious economic disruption. Within the first few months of the pandemic, the stock markets (including the FTSE, Dow Jones Industrial Average, and the Nikkei) all experienced huge drops, with the FTSE dropping 14.3% in 2020, its worst performance since the Great Recession.² Specifically, between February 24 and 28, stock markets across the world reported the largest declines in a single week since 2008. In the first few weeks of the pandemic, there was a sharp rise in unemployment. U.S. unemployment rose from 3.7% in 2019 to 8.9% in 2020, and in October 2020, more than 10 million unemployment cases had been filed within the country.³

Small businesses in particular have been hit hard by the coronavirus, due to safety measures and mandatory closures that sought to slow the spread of the virus. To date, U.S. lawmakers have passed relief programs, totaling over \$5 trillion to help manage the pandemic and alleviate the financial burden on small businesses. One of these programs is the Paycheck Protection Program (PPP Program), which was established through the Coronavirus Aid, Relief, and Economic Security Act (CARES Act) passed by the U.S. Congress in March 2020. This program enables businesses to apply for low-interest private loans to continue to pay their workers during the pandemic. The PPP Program targets small businesses, self-employed workers, sole proprietors, tribal businesses, and some nonprofit organizations. With over \$930 billion dollars dedicated to this program, it is important to evaluate its success and determine whether these funds were distributed in accordance with the objectives Congress laid out when funding the PPP Program. If these loans favored one demographic group over another, it would have significant implications on the economic future of small businesses. For example, if PPP loans for white men and women were prioritized over people of color, we would

¹ CDC, "COVID Data Tracker."

² Jones, Palumbo, and Brown, "Coronavirus."

³ Jones, Palumbo, and Brown, "Coronavirus."

expect that businesses owned by people of color to suffer more economic losses and possibly shutdown during the pandemic. This paper will analyze what factors determined how much money businesses received in their PPP loans. Our analysis shows that PPP loan amounts have many determinants, most notably, the number jobs within the business, the demographics of the business owner, the size of the lending institution, sector of the economy the small businesses falls within, and where the business is located (urban vs. rural; high vs. low income areas; democratic-leaning vs. republican-leaning counties).

This paper proceeds as follows. In section II we review the literature on the determinants for the loan amounts provided to small businesses by financial institutions. Section III provides a description of the data, data sources, and analysis method used. Section IV analyzes the PPP data using a linear regression model, including investigations into functional form, multicollinearity, and heteroskedasticity. Section V explores three alternate regression models to better understand what factors drove the initial regression results. Section VI concludes with a comparison of the findings of our research with those referenced in the literature review, as well as identify any shortcomings and ways to improve future research.

II. Literature Review

This paper explores various theories and schools of thought regarding how financial institutions determine who should receive loans and the quantity of these loans. Specifically, we survey previous academic research on how financial institutions made lending decisions, and what criteria was utilized the most in this decision-making process. We also discuss reports analyzing the impact of gender on credit and small business loans. Finally, the literature review summarizes recent reports and analyses of the Paycheck Protection Program and whether this program was distributed in a way that benefited small businesses and groups that have historically been underserved.

Lending Criteria and Lending Decisions

In general, studies on bank lending reveal that financial institutions and banks tend to be low-risk lenders. Several studies (Berger 2007; Haines et al. 1999) find that the size of a business plays a central role in determining whether the business has access to credit. Specifically, Beck (2006, 2939) found that small businesses are more dependent on bank lending than other sources of external funding. Several studies have analyzed the relationship between the structure and size of financial institutions and their lending to small businesses. Research indicates that small, community based financial institutions, such as credit unions, may provide small businesses with more favorable credit

terms than they might receive from larger lenders (Fabowale 1995, 42). Larger banks, on the other hand, “devote a smaller proportion of their lending portfolios to small businesses than smaller banks” (Mhkaiber 2020, 2). Since smaller banks tend to work closely with borrowers and usually have personal relationships with these businesses, they tend to be more “effective in alleviating credit constraints than large banks” (Mhkaiber 2020, 2). Therefore, Berger (2007) argues that small banks are superior in providing credit to small businesses.

In addition to the size of the business and the lending institution, personal wealth also impacts credit decisions. For example, Avery (1998) found that the owner’s personal wealth was an integral part of how financial institutions review cases when lending to small businesses, especially since the late 1980s. Personal wealth and the owner’s financial history are viewed as strong indicators of whether the small businesses will repay its debts and succeed in its venture. Fabowale (1995, 42) explains that personal wealth “appear to be substitutions for business collateral, at least for lines of credit” and are normally taken into consideration when banks are making lending decisions. Typically, new, small businesses will offer and pledge collateral to signal the quality of their venture when applying for loans in which lenders have less information regarding the business’s profits and operations.

Loan decisions frequently involve both qualitative decisions and quantifiable information provided by the loan applicant (Haines et al. 1999). A good portion of research has defined five criteria financial lending officers often take into account when deciding whether to approve a loan request, referred to as the “5Cs of bank lending” or the “5Cs of Credit.” The 5Cs are character, capacity, capital, collateral, and conditions. Haines et al. (1999) found that when applying for small business loans, the applicant's character and how the lending officer views the applicant is a critical factor in the decision-making process. It is important to note that lending officers have implicit biases and subjective opinions that influence their evaluations and decisions on whether to approve a small business’s loan request.

Gender and Lending Decisions

An extensive literature suggests that female business owners may face difficulties in their attempts to raise capital for their businesses. Some studies (Riding and Swift, 1990; Carter and Rosa, 1998) have found that women encounter credibility problems when dealing with bankers; however as Wilson et al. (2007, 155) argues, it is in the interests of banks to “be seen as non-discriminatory towards women, particularly as women-owned businesses are perceived as one area of the market that is growing.” Wilson et al. (2007) provide helpful distinguishing characteristics between male-owned and female-owned businesses, particularly that female-owned businesses are more likely to operate in the

retail and service sectors, and that female-owned businesses are more likely to be operated from home. Further, the industries in which female-owned businesses are generally formed produce lower returns, and thus usually require lower startup capital (Smith-Hunter, 2000). Additionally, Wilson et al. (2007, 156) found that female-owned businesses are smaller than male-owned businesses, and the smaller business size translates to lower returns, a smaller workforce, and a smaller amount of starting capital. It is also worth noting that several studies (Wilson et al. 2007; Smith-Hunter, 2000) contend that because of these differences between male and female owned businesses, lenders often perceive the purpose of a business differently based on the gender of the owner. Specifically, it is “a common perception that the main objective of a male businesses owners is growth and that business growth for women is a secondary objective”(Wilson et al. 2007, 156). Thus, in turn, lenders might provide more funding and credit to male business-owners.

Though many female entrepreneurs and business owners state that they have been treated differently by lenders due to their gender, research, such as Fabowale et al. (1995), has provided little evidence of systemic gender discrimination. What has accounted and explained the contrast in credit, however, are structural difference between female-owned and male-owned businesses. Moreover, Carter et al. (2007, 1) conclude that the “processes used by male and female lending officers to negotiate loan applicants revealed the greatest” dissimilarities. Their study found that female loan officers are likely to focus on marital status when making loan decisions, and focus on personal stability, which may require men to demonstrate financial responsibility more than women. Carter et al. (2007) also concludes that male bank loan officers were more likely to question the commitment and responsibility of the application, and even more so when the applicant was female. While this research provides insight to how small businesses receive credit and how much funding they receive, we have no information on the gender of the loan officer for PPP loans and so will not analyze or investigate whether the lending officer was male or female and its impact on loan decisions and loan amount.

Buttner and Rosen (1989) reported that lending officers equate male business owners more closely with traits deemed necessary for a successful small business owner. While banks and financial institutions may associate men more than women with economic success, their study and others (Fabowale, 1995; Bellucci et al., 2010) confirm that female-owned businesses did not face gender discrimination in terms of the pricing of loans. However, female entrepreneurs were disadvantaged and experienced tighter credit availability; generally, “female business owners are significantly more likely to pledge collateral” and face stricter credit limits (Bellucci et al. 2010, 2969). Again, research

suggests that the restricted access to credit and smaller credit amounts are due to structural differences between male-owned and female-owned businesses, rather than to gender discrimination. As noted in the previous section, business size, age, capital, and the industry are all taken into consideration when firms apply for bank loans.

Distribution of PPP Loans

With the U.S. government approving over \$900 billion for PPP loans, there has been some preliminary research and analysis as to whether these loans were distributed appropriately over the past year. Bartik et al. (2020, 1) contend that while the Paycheck Protection Program allowed for credit to be quickly distributed to businesses, it “limited the government’s ability to target the funding.” PPP loans were administered by banks but guaranteed by the federal government’s Small Business Administration (SBA). Bartik et al. (2020) concluded that businesses most impacted by the pandemic were more likely to seek funds but were less likely to be approved. These businesses are described as reporting distress due to COVID-19, had less cash on hand, had high payroll costs, and were usually in industries devastated by the pandemic. Instead, businesses with “stronger connections to banks were more likely to have their applications approved” suggesting that “lending to bank customers in better financial positions may have been prioritized” (Bartik et al. 2020, 32). It is possible that business with strong relationships with banks crowded out less connected small businesses, who would have benefitted more from the PPP loans.

An additional study produced by the NYU Stern School of Business investigated the share of PPP loans financial institutions provided to Black-owned businesses. The results of this survey conclude that financial technology (FinTech) and nonprofit lenders distributed more PPP loans to Black and Hispanic-owned businesses and that traditional banks of all sizes (small, medium, and large) were less likely to issue PPP loans to Black-owned businesses. Analyzing the percentage of the population that is Black in zip codes of PPP borrowers, Howell et al. (2020) observed that nonprofits, FinTech, and Minority Depository Institutions (MDIs) made a larger share of their PPP loans in ZIP codes with a “higher share of black residents” (Howell et al. 2020, 4). Though a large share of loans approved by nonprofit institutions were given to minorities and businesses owned by people of color, these loans amount to around 13,000 - an extremely small number compared to total PPP loans distributed in the U.S (approx. 7.8 million). Though minority-owned businesses were less likely to receive credit from traditional banks, this survey argues that these conclusions “do not necessarily indicate discriminatory lending practices” (Howell et al. 2020, 4). Rather, the authors argue that the observations might reflect an increase demand among Black and Hispanic owned businesses to

borrow and work with FinTech lenders, instead of traditional banks. One reason why Black and Hispanic business owners prefer these routes may reflect past experiences of racism with other financial institutions. However, more research is needed to investigate whether racial discrimination did or did not impact the distribution of PPP loans.

Supplementary research regarding the relationship between PPP loans and race concluded that the design and structure of the PPP Program itself and historical precedents made it likely that Black-owned businesses would receive smaller PPP loans than expected. Recent findings show that “Black-owned businesses received loans that were approximately 50% lower than observationally similar white-owned businesses” (Atkins et al. 2020, 1). Though Black-owned businesses were particularly hit hard by COVID-19, they had disproportionately lower access to PPP loans, particularly from commercial banks. Atkins et al. (2020) argue that this is likely due to the fact that commercial banks historically underserve the black community because of limited access to bank locations. Notably, the proportion of minority residences and the probability of a commercial bank located in that community have a negative relationship.

III. Data Overview and Analysis Method

Our data were acquired from several sources. We obtained data for most of our variables from the U.S. Small Business Administration Department and its data on COVID-19 Relief Options and the PPP Program: these data are available to the public due to a Freedom of Information Act request (and a subsequent lawsuit). We acquired the data for the variable “Urban” from the U.S. Census Bureau, and the data for the variable “RepGov” from the USA Civil Service. The variable *NewCasesinMonth* was retrieved from the *New York Times* dataset titled “Coronavirus in the U.S.: Latest Map and Case Count.” We acquired the data for the variable “Income” from the U.S. Department of Agriculture's Economic Research Services. While the U.S. Small Business Administration Department provided data on whether a business was female or male-owned, there were a significant quantity of missing observations. Due to the large number of missing observations, we coded the data to detect the 1000 most popular male and female names from the name of the borrower. This was combined with the U.S. SBA data to create the variable “female.” After cleaning the data, we decided to run an ordinary least squares regression model, which is provided below. SBA data are at the individual loan level; other data are at the county level (or, when needed, at the state level). COVID-19 confirmed cases data are daily and so can be matched with the PPP loan approval date (or lagged as appropriate). The unit of observation in our initial regressions is the PPP loan.

IV. Initial Regressions Results

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. regress InitialApprovalAmount female Term MediumLender LargeLender Urban RepGov NewBusiness NewCasesinMonth JobsReported SecondarySector ServiceSector QuaternarySector Income, vce(robust)

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Linear regression

Number of obs	=	4,464,461
F(13, 4464447)	=	16648.63
Prob > F	=	0.0000
R-squared	=	0.6168
Root MSE	=	1.8e+05

InitialApprovalAmount	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]
female	-5536.853	179.0183	-30.93	0.000	-5887.722 -5185.983
Term	-47.85752	4.525585	-10.57	0.000	-56.72751 -38.98754
MediumLender	5116.27	266.6953	19.18	0.000	4593.556 5638.983
LargeLender	1335.202	236.4137	5.65	0.000	871.8392 1798.564
Urban	114.8585	3.238682	35.46	0.000	108.5107 121.2062
RepGov	-1455.827	171.6105	-8.48	0.000	-1792.178 -1119.476
NewBusiness	-10925.39	287.2004	-38.04	0.000	-11488.3 -10362.49
NewCasesinMonth	.013418	.0015134	8.87	0.000	.0104517 .0163842
JobsReported	7854.201	31.64981	248.16	0.000	7792.169 7916.234
SecondarySector	42367.44	431.5853	98.17	0.000	41521.55 43213.33
ServiceSector	-274.6693	311.0902	-0.88	0.377	-884.3951 335.0565
QuaternarySector	-1915.862	470.7493	-4.07	0.000	-2838.514 -993.2097
Income	.2869735	.0055303	51.89	0.000	.2761344 .2978127
_cons	-23843	486.1288	-49.05	0.000	-24795.8 -22890.21

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. estat ovtest

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Ramsey RESET test using powers of the fitted values of InitialApprovalAmount

Ho: model has no omitted variables

F(3, 4464444) =	8689.07
Prob > F =	0.0000

Interpretations of the Coefficients (average loan size is \$92,983.57)

1. Female
 - a. A small business being female-owned is associated with \$5,536 decrease in the PPP loan amount as compared to male-owned small businesses, ceteris paribus.
2. Term
 - a. Adding a month to the maturity date of a PPP loan is associated with \$47.86 decrease in its initial approval amount of PPP loans, ceteris paribus.
3. Medium Lender
 - a. Borrowing from a medium lender (a lender issuing 300 to 1,500 PPP loans between March 2020 and February 2021) is associated with a \$5,116.27 increase in the individual loan amount as compared to a small lender, ceteris paribus.
4. Large Lender
 - a. Borrowing from a larger lender (a lender issuing more than 1,500 loans) is associated with a \$1,335.20 increase in the individual loan amount when compared to a small lender, ceteris paribus.

5. Urban
 - a. A one percentage point increase in the percentage of the population that live in urban areas (within the county that the small business is located) is associated with a \$114.86 increase in loan size, *ceteris paribus*.
6. Republican Governor
 - a. Being a borrower located in state with a Republican governor (in 2020) is associated with a \$1,455.83 decrease in initial approval amount of PPP loans when compared to being in a state with a Democratic governor, *ceteris paribus*.
7. New Business
 - a. Being a small business that is less than two years old is associated with a \$10,925.39 decrease in loan size as compared to loans for more established businesses, *ceteris paribus*.
8. New Cases in Month
 - a. Each new COVID-19 case from the previous month, lagged 14 days, is associated with a \$0.01 increase in initial approval amount of PPP loans, *ceteris paribus*.
9. Jobs Reported
 - a. Each additional job to be protected by the PPP loan is associated with a \$7,854.20 increase in loan size, *ceteris paribus*.
10. Secondary Sector
 - a. Being in the secondary sector of the economy is associated with a \$42,367.44 increase in loan size as compared to loans for firms in the primary sector, *ceteris paribus*.
11. Service Sector
 - a. Being in the service sector is associated with a \$274.67 decrease in loan size as compared to loans for firms in the primary sector, *ceteris paribus*.
12. Quaternary Sector
 - a. Being in the quaternary sector is associated with a \$19,15.86 decrease in loan size when compared to loans for firms the primary sector, *ceteris paribus*.
13. Income
 - a. Each dollar increase in the median household income in the borrower's county is associated with a \$0.29 increase in loan size, *ceteris paribus*.

Analysis of Goodness of Fit and Overall Significance

The above model has a R-Squared of 0.6168, which means that our model explains 61.68% of the variation in the dollar amount of PPP loans that were given to small businesses, a relative good fit given the limited information available. In addition, the above model passes the F-test for overall significance at the 1% level (p-value of 0.0000). Twelve of the independent variables are statistically significant at the one percent level. The only variable that is not statistically significant is ServiceSector, indicating that loan sizes were similar in the primary sector and the service sector (*ceteris paribus*).⁴ As can be seen in Table 2, 69.1% of the businesses in our data fall within the service industry.

Within our initial regression, JobsReported was the variable that had the most impact on our regression. With both its large range and coefficient, JobsReported had the highest impact on our regression by a substantial amount, which was expected. Small businesses that report a higher number of jobs should and do receive larger PPP loans. The goal of the PPP Program is to help businesses, particularly small business and those self-employed, continue to pay their workers during the COVID-19 pandemic. Thus, firms with a high number of employees would require larger loan amounts to cover payroll costs.

Two other variables that were rather impactful in our model were female (a dummy equal to one if the firm was female owned) and Income (median income in the county of the borrowing firm). We expected that if the business was owned by a woman, the firm would receive a smaller PPP loans when compared to small businesses owned by a man. Since female-owned businesses are likely to be run from the owner's home and compete in industries that earn smaller profit margins, we expected that woman-owned small businesses would receive smaller PPP loan amounts. In addition to this variable, another impactful independent variable was Income. Prior to our regression, we predicted that small businesses located in counties with a high median household income in 2019 (when compared to the national average), would likely receive larger PPP loans. Since the cost of labor is likely higher in these counties, small business located in this area would have higher payroll expenses and need more funding to cover the pay of the employees throughout the pandemic. Our regression analysis validated our expectations; every dollar increase in the median household income in the county in which a small business resides is associated with a \$0.29 increase in initial approval amount of PPP loans, *ceteris paribus*.

⁴ As can be seen in Table 2, 69.1% of the businesses in our data fall within the service industry.

Three independent variables (Term, RepGov, and Service Sector) have coefficients in the unexpected direction, which could be the result of econometric problems in the model. Alternatively, this could be due to flaws in our theoretical reasoning and predictions, and we therefore explored alternative theoretical perspectives. At first, we anticipated that the longer term for the PPP loan would signal an increase in the amount of PPP loan amount. However, it is possible that financial institutions were willing to provide businesses with larger PPP loans in the short-term, if they were confident the business would pay back the loan, or if the small business was approved for loan forgiveness, in which case the length of the PPP loan would be relatively inconsequential. Further, the coefficient for RepGov also went in the opposite direction than we initially anticipated. If the threshold for borrowing was more lenient in a Republican-controlled state, PPP lending would attract applications not just from large firms but also from smaller firms. Thus, while the overall lending amount in the Republican-controlled state might be higher (due to more loans being made), the average loan size would be smaller. Lastly, the Service Sector coefficient was also in the unexpected direction. We have theorized that this might be the case since most businesses within the service sector were able to continue operations remotely and experienced relatively stable profits, and thus did not need large PPP loans.

Indications of econometric problems

While our initial model does have overall significance, certain results give indications of econometrics problems of the model. One such result is that two of the independent variables have coefficients that are in the unexpected direction, both of which are significant (RepGov and Term). This could indicate a specification error such as omitted variables, which could cause bias in coefficient estimates if the omitted variable is correlated with included variables.

Given the size of our dataset, multicollinearity has not been an issue.⁵ While multicollinearity does not appear to be an issue, with a cross-sectional dataset with a wide range of loan sizes heteroskedasticity is likely. The Breusch-Pagan test confirms this and, for that reason, all regressions used heteroskedasticity-robust standard errors.⁶

⁵ The use of VIFs (variance inflation factors) does not suggest severe multicollinearity in our model (VIFs greater than 5). Looking at simple correlations, there are no correlation coefficients above 0.8, which is another indicator that there is no severe multicollinearity in our model, as was expected with a dataset of this size.

⁶ Because our data is cross-sectional, we must investigate heteroskedasticity. As was mentioned above, the Breusch-Pagan test for heteroskedasticity showed evidence of heteroskedasticity in the model. We expected this result (error terms not of constant variance) and decided to run all regressions with robust standard errors. Heteroskedasticity can cause our estimator terms to be less efficient, lowering our t-score values. Yet, as can be seen in the regression results

Ramsey RESET Test and Interpretation

The Ramsey RESET test of the model reveals potential issues with functional form in the model. The F-test value produced by the test is 8689.07 (p-value of 0.0000), thus rejecting the null hypothesis that the nonlinear combinations of the explanatory variables are irrelevant. Given the number of variables and datapoints, clearly there can be more work done here in future studies.

V. Alternative Regression Models and Analysis

Alternative Model #1: Addition of Ethnicity, Race, and Veteran Variables

The changes we made to the first alternative model focused on theory while also attempting to correct potential problems with omitted variable bias. Recent research and analysis of the Paycheck Protection Program indicated that minority-owned small businesses received smaller amounts of credit than was initially expected. Currently, there is no consensus on why non-White businesses received less PPP funding compared to White-owned businesses (as discussed in Section II). We expect that dummy variables for Hispanic, Asian, Black/African America, and OtherRace (Non-White) to be associated with smaller PPP loans, *ceteris paribus*, based on the literature examining other types of lending. We also include a dummy variable that reflects the applicant's veteran status.

above, almost all our t-scores are extremely high. Thus, we believe that the lower efficiency caused by heteroskedasticity does not make a significant difference in our model.

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. regress InitialApprovalAmount female Term MediumLender LargeLender Urban RepGov NewBusiness NewCasesinMonth JobsReported SecondarySector
> or ServiceSector QuaternarySector Income Hispanic VeteranDummy Asian BlackOrAfricanAmerican OtherRace, vce(robust)

Linear regression                               Number of obs   =   854,513
                                                F(18, 854494)  =   3295.67
                                                Prob > F        =   0.0000
                                                R-squared       =   0.5716
                                                Root MSE       =   1.6e+05

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InitialApprovalAmount      Coef.   Robust   t    P>|t|   [95% Conf. Interval]
                        Std. Err.
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      female             -9736.381   344.4887  -28.26  0.000   -10411.57   -9061.194
      Term                -38.1612   11.2532   -3.39  0.001    -60.2171   -16.1053
      MediumLender        6514.537   658.3811   9.89  0.000   5224.132   7804.942
      LargeLender         2008.387   589.811    3.41  0.001    852.3772   3164.397
      Urban                193.158    7.675818  25.16  0.000    178.1136   208.2023
      RepGov              -1785.982   363.5557  -4.91  0.000   -2498.539  -1073.425
      NewBusiness         -13321.88   689.175  -19.33  0.000  -14672.64  -11971.12
      NewCasesinMonth     .0188138   .0024619   7.64  0.000    .0139886   .0236389
      JobsReported        7154.143   78.09943  91.60  0.000   7001.071   7307.216
      SecondarySector     49688.04   1006.167  49.38  0.000   47715.99   51660.09
      ServiceSector       5508.229   757.299   7.27  0.000   4023.948   6992.51
      QuaternarySector    6842.07    1020.449   6.70  0.000   4842.023   8842.117
      Income              .2528541   .0118433  21.35  0.000    .2296417   .2760666
      Hispanic            -14195.64   627.5153  -22.62  0.000  -15425.55  -12965.73
      VeteranDummy        -238.7633   747.7763  -0.32  0.750   -1704.38   1226.853
      Asian               -22174.51   540.6446  -41.01  0.000  -23234.16  -21114.86
      BlackOrAfricanAmerican -8167.42   521.5168  -15.66  0.000   -9189.576  -7145.264
      OtherRace           -7755.288   713.758  -10.87  0.000   -9154.23   -6356.346
      _cons               -24048.08   1073.799  -22.40  0.000  -26152.69  -21943.47

. estat ovtest

Ramsey RESET test using powers of the fitted values of InitialApprovalAmount
Ho: model has no omitted variables
      F(3, 854491) =   3466.94
      Prob > F =   0.0000

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Note that the missing data for these variables substantially reduces the sample size.⁷ The new model has a R-square value of 0.5716. Nineteen of the twenty independent variables are statistically significant at the one percent level (VeteranDummy is insignificant). The addition of these variables caused the coefficient of one variable to change signs. The sign of the coefficient of ServiceSector is now positive which is the expected direction, which indicates that it could have been caused due to omitted variable bias. Finally, it is not surprising that this model still fails the Ramsey RESET test.⁸

Alternative Model #2: Logged Initial Approval Amount and Income (now lnLoanAmount and lnIncome, respectively),

As a second alternative model, we logged key variables: the dependent variable (loan size), income, and JobsReported. Logging these variables allows us to interpret their coefficients as

⁷ An interesting addition to our work would be to look at selection criteria, i.e., what factors influence whether or not data are reported.

⁸ The Ramsey RESET test of the model again reveals potentially severe problems with functional form in the model. The F-test value produced by the test is 3,467.17, which is substantially lower than it was in the initial regression (8,689.07). This value indicates a p-value of .0000. Thus, we still reject the null hypothesis that the coefficients of the added Y terms are equal to zero. As this is likely due to a specification error of functional form and as this alternative model only added variables, it is not surprising that there are still issues with functional form.

elasticities. It may also address heteroskedasticity and the functional form issues the RESET test identified.

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. regress lnLoanAmount female Term MediumLender LargeLender Urban RepGov NewBusiness NewCasesInMonth JobsReported SecondarySector ServiceSector Q
> uaternarySector lnIncome Hispanic VeteranDummy Asian BlackOrAfricanAmerican OtherRace, vce(robust)

Linear regression                               Number of obs   =    854,513
                                                F(18, 854494)   =    9600.50
                                                Prob > F         =    0.0000
                                                R-squared       =    0.3457
                                                Root MSE      =    1.0888

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	Coef.	Robust Std. Err.	t	P> t	[95% Conf. Interval]	
female	-.2503609	.0026232	-95.44	0.000	-.2555023	-.2452195
Term	-.0092264	.0000776	-118.88	0.000	-.0093785	-.0090743
MediumLender	.1632631	.0059108	27.62	0.000	.1516782	.174848
LargeLender	.1369653	.0054704	25.04	0.000	.1262434	.1476871
Urban	.0046384	.0000605	76.71	0.000	.0045199	.0047569
RepGov	-.0295676	.0025354	-11.66	0.000	-.0345369	-.0245984
NewBusiness	-.2592941	.0048624	-53.33	0.000	-.2688241	-.249764
NewCasesInMonth	3.16e-07	2.21e-08	14.34	0.000	2.73e-07	3.60e-07
JobsReported	.0255914	.0002168	118.05	0.000	.0251665	.0260163
SecondarySector	.6742283	.0056666	118.98	0.000	.663122	.6853345
ServiceSector	.3156525	.0046751	67.52	0.000	.3064894	.3248156
QuaternarySector	.2518563	.0062619	40.22	0.000	.2395833	.2641293
lnIncome	.2286112	.0054366	42.05	0.000	.2179557	.2392667
Hispanic	-.2469628	.0047148	-52.38	0.000	-.2562036	-.237722
VeteranDummy	.0253713	.0050395	5.03	0.000	.0154942	.0352485
Asian	-.2293575	.0038204	-60.04	0.000	-.2368453	-.2218697
BlackOrAfricanAmerican	-.2980227	.0035567	-83.79	0.000	-.3049936	-.2910517
OtherRace	-.1449557	.0066719	-21.73	0.000	-.1580324	-.131879
_cons	7.212677	.0591691	121.90	0.000	7.096707	7.328646

```

.
. estat ovtest

Ramsey RESET test using powers of the fitted values of lnLoanAmount
Ho: model has no omitted variables
F(3, 854491) = 129076.73
Prob > F = 0.0000

```

The second alternative model has a R-square of 0.3457. Although this model explains significantly less variation in the initial approval amount, we cannot meaningfully compare R-Squared values when the dependent variables are different (as they are here). The advantage of the log specification is that the residuals follow a more normal distribution than the initial regression (see Figure 1 v. Figure 2), suggesting results less sensitive to outliers. Furthermore, all eighteen variables are significant at the one percent level. Two variables (Term and RepGov) still have coefficients in the unexpected direction, so these results are likely not due to the influence of outliers. The specification does, however, still fail the Ramsey RESET test.

Alternative Model #3: Regression at State Level with Number of Loans as the Dependent Variable to investigate effect of Republican Governor

For all previous regressions, the coefficient for RepGov went in the opposite direction than we expected. Since the bulk of PPP funding was disbursed during the Trump administration, we initially anticipated that states with Republican governors might benefit more from the program and thus PPP loans would be bigger. Our analysis, however, finds the opposite. We hypothesized that this could happen if states with Republican governors received more loans and that some of those

went to small businesses. This pattern could result in the amount of the PPP loan being, on average, smaller than for states with Democratic governors. To explore this, we decided to aggregate to the state level and look at the number of PPP loans per state. Given the range in the number of loans, there was no need to use negative binomial regression, and we continued to use OLS regression.

```
. regress lnNumLoans RepGov lnPopulation lnMedianIncome, vce(robust)
```

Linear regression

Number of obs	=	50
F(3, 46)	=	246.51
Prob > F	=	0.0000
R-squared	=	0.9431
Root MSE	=	.233

		Robust				
lnNumLoans	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
RepGov	.3712209	.0990957	3.75	0.000	.1717516	.5706903
lnPopulation	.867666	.0367359	23.62	0.000	.7937206	.9416115
lnMedianIncome	.3289335	.1675882	1.96	0.056	-.0084041	.666271
_cons	-5.732708	1.905595	-3.01	0.004	-9.568471	-1.896944

The above regression relatively supports the position that states with Republican Governors gave out a higher number of PPP loans. A state with a Republican Governor is associated with a 0.37% increase in the number of PPP loans issued when compared to a state with a Democratic Governor, ceteris paribus. This would cause the average amount of the loan to decrease which would cause the unexpected coefficient results in our previous regressions.

VI. Conclusion

Our research investigated what factors determined how much money businesses received in their PPP loans. Our analysis shows that PPP loan amounts have many determinants, most notably, the number jobs within the business, the demographics of the business owner, the size of the lending institution, sector of the economy the small businesses falls within, and where the business is located (urban vs. rural; high vs. low income areas; democratic-leaning vs. republican-leaning counties).

Comparison of our research with those in the Literature Review

When comparing our regression results with past findings and research, we have found that our conclusions generally reflect the conclusions made in earlier studies, particularly those referenced in the literature review. Studies examining lending criteria typically anticipate that small businesses are

more likely to borrow money from banks and financial institutions when compared to other businesses in the U.S. economy. Previous research suggests that female-owned businesses applying for loans will, on average, receive smaller loan amounts when compared to male-owned businesses. Wilson et al. (2007) found that female businesses usually produce lower returns (due to the business structure and industry), and thus require less capital and loans than male-owned small businesses. While our research did not analyze the businesses structure of female-owned businesses, our regressions did show that PPP loans granted to female-owned businesses were of smaller amounts when compared to PPP loans granted to male-owned businesses.

Some recent research on the PPP Program have found that businesses most impacted by COVID-19 are less likely to receive PPP loans. Our findings, however, indicate that among the firms that did receive loans, businesses located in areas hit harder by the pandemic received larger loans. We found that businesses in areas with more COVID-19 cases in the previous month, lagged two weeks, and businesses with high JobsReported received large PPP loan amounts. Small businesses with a high number of employees and businesses located in areas with an increase in COVID-19 cases are likely to experience financial losses, due to government lockdown measures to prevent the spread of the virus and high labor costs. Based on our results, it appears that these businesses did receive larger PPP loans and economic assistance. Additionally, the research discussed in the literature review predicts that banks were likely to provide smaller PPP loans amounts to minority-owned small business. Some research (Howell et al. 2020) believes this to be the case since banks traditionally underserve minority communities and minorities are more likely to borrow from non-traditional financial institutions, like MDIs and FinTech. Though we did not evaluate the type of lender (i.e., compared commercial banks to Fintech), our research does show that small businesses owned by minorities did receive smaller PPP loan amounts, even after controlling for various other characteristics.

Shortcomings and future improvements

For future research, we would suggest breaking down economic sector even more, especially within the service sector. This would allow one to detect what types of businesses within the service sector needed PPP loans the most (i.e. hospitality, travel) and if PPP loans matched their need. We would also suggest to further investigate the functional form issues of our model, with one specific change in mind: to take the natural log of NewCasesinMonth, which would allow one to interpret their coefficients as elasticities and may address heteroskedasticity and the functional form issues the RESET test identified. Furthermore, in future research, we believe that analyzing the length of the

PPP loan and how that impacts its size, would produce insightful results in relation to the PPP Program. At the start of our research, we initially anticipated that the longer term for the PPP loan would signal an increase in the amount of PPP loan amount. However, our regression produced unexpected results, and we theorized that it is possible that financial institutions were willing to provide businesses with larger PPP loans in the short-term, if they were confident the business would pay back the loan, or if the small business was approved for loan forgiveness, in which case the length of the PPP loan would be relatively inconsequential.

After adding additional race, ethnicity, and veteran dummy variables, our number of observations decreased significantly. An interesting addition to our work would be to look at selection criteria, i.e., what factors influence whether or not data are reported. Data for these variables was acquired from the U.S. Small Business Administration PPP Loan Data, and the selection criteria of this data is something that we believe is worthwhile to investigate.

Appendix

Table 1: Variables

Variable	Definition	Source
InitialApprovalAmount	Dollar amount of PPP loans that were given to small businesses (in USD).	U.S. Small Business Administration (2021)
female	1 if business is female-owned, 2 if business is male-owned.	U.S. Small Business Administration (2021)
Term	Length of PPP loan (in months).	U.S. Small Business Administration (2021)
SmallLender	Omitted lender variable, includes all servicing lenders that issued less than 300 total loans; includes 2,514 servicing lenders.	U.S. Small Business Administration (2021)
MediumLender	1 if the servicing lender has given out 300 or more total loans and less than 1500, 0 if otherwise; includes 1,797 servicing lenders.	U.S. Small Business Administration (2021)
LargeLender	1 if the servicing lender has given out 1500 or more total loans, 0 if otherwise; includes 576 servicing lenders.	U.S. Small Business Administration (2021)
Urban	Percent of the population in urban areas of the county with which the small business is located.	United States Census Bureau (2021)
RepGov	1 if Republican Governor in 2020 for the county with which the small business is located, 0 if otherwise.	Civil Services USA (2021)
NewBusiness	1 if business is less than two years old, 0 if business has existed for more than two years.	U.S. Small Business Administration (2021)
NewCasesinMonth	New COVID-19 cases in the month in the county that the small business is located in, lagged two weeks to account for the decision-making process.	New York Times (2021)

JobsReported	Number of jobs to be protected by the PPP loan.	U.S. Small Business Administration (2021)
PrimarySector	Omitted sector variable, primary sector includes extraction of raw materials e.g., mining, fishing, agriculture.	U.S. Small Business Administration (2021)
SecondarySector	1 if business belongs to the secondary sector of the economy, 0 if otherwise; secondary sector is concerned with producing finished goods e.g., construction, manufacturing, utilities.	U.S. Small Business Administration (2021)
ServiceSector	1 if business belongs to the service sector of the economy, 0 if otherwise; service sector is concerned with offering intangible goods and services to consumers e.g., retail, tourism, banking, entertainment.	U.S. Small Business Administration (2021)
QuaternarySector	1 if business belongs to the quaternary sector of the economy, 0 if otherwise; quaternary sector includes knowledge economy, education, R&D.	U.S. Small Business Administration (2021)
Income	Median household income in 2019 for the county that the small business resides in (in USD).	USDA Economic Research Service (2021)
Hispanic	1 if small business owner identifies as Hispanic or Latino, 0 if otherwise.	U.S. Small Business Administration (2021)
VeteranDummy	1 if small business owner is a veteran, 0 if otherwise.	U.S. Small Business Administration (2021)
White	Omitted race variable, small business owner identifies as White.	U.S. Small Business Administration (2021)
Asian	1 if small business owner identifies as Asian, 0 if otherwise.	U.S. Small Business Administration (2021)

BlackOrAfricanAmerican	1 if small business owner identifies as Black or African American, 0 if otherwise.	U.S. Small Business Administration (2021)
OtherRace	1 if small business owner identifies as Eskimo & Aleut, Puerto Rican, Native Hawaiian or Other Pacific Islander, American Indian or Alaskan Native, or Multi Group, 0 if otherwise.	U.S. Small Business Administration (2021)

Table 2: Descriptive Statistics

Variables	Observations	Mean	Std. Dev.	Min	Max
InitialApproval Amount	4,446,461	86957.311	283000	0	10000000
female	4,446,461	.344	.475	0	1
Term	4,446,461	39.786	17.863	7	63
MediumLender	4,446,461	.181	.385	0	1
LargeLender	4,446,461	.766	.424	0	1
Urban	4,446,461	80.723	25.778	0	100
RepGov	4,446,461	.474	.499	0	1
NewBusiness	4,446,461	.092	.289	0	1
NewCasesin Month	4,446,461	12938.345	45494.659	0	431744
JobsReported	4,446,461	10.164	28.081	0	500
SecondarySector	4,446,461	.128	.334	0	1
ServiceSector	4,446,461	.691	.462	0	1
QuaternarySector	4,446,461	.078	.269	0	1
Income	4,446,461	69693.93	18994.81	24732	151806
Hispanic	854,513	.077	.267	0	1
VeteranDummy	854,513	.059	.236	0	1
Asian	854,513	.128	.334	0	1
BlackOrAfricanAmerican	854,513	.139	.345	0	1
OtherRace (nonWhite)	854,513	.042	.199	0	1

Table 3: Expected v. Actual Impact of Independent Variables

Independent Variable	Expected Impact on Initial Approval Amount (holding all else constant)	Reasoning	Actual Impact on Initial Approval Amount (holding all else constant)
female	Negative	If a small business is female-owned, they will likely receive a smaller amount of PPP loans when compared to small businesses owned by men, because the industry and business structure likely need less capital.	Negative (Significant at 10%, 5%, and 1% levels in 2-tailed T test)
Term	Positive	PPP loans issued for longer term periods are expected to be larger as the small business owner has a longer period of time to pay back the loan.	Negative (Significant at 10%, 5%, and 1% levels in 2-tailed T test)
MediumLender	Positive	Financial institutions who give out more loans are less strict and prudent when lending PPP loans to small businesses.	Positive (Significant at 10%, 5%, and 1% levels in 2-tailed T test)
LargeLender	Positive	Financial institutions who give out more loans are less strict and prudent when lending PPP loans to small businesses.	Positive (Significant at 10%, 5%, and 1% levels in 2-tailed T test)
Urban	Positive	Small business located in urban areas are likely to be hit harder by the COVID-19 pandemic, when compared to small businesses in rural and suburban areas and are expected to request and receive larger PPP loan amounts.	Positive (Significant at 10%, 5%, and 1% levels in 2-tailed T test)
RepGov	Positive	Republican governors are more likely to support small businesses by providing tax breaks or PPP loans.	Negative (Significant at 10%, 5%, and 1% levels in 2-tailed T test)
NewBusiness	Negative	New small businesses will likely not have large payroll costs, when compared to existing small businesses and are thus expected to receive smaller PPP loan amounts. Furthermore, existing businesses are likely to have stronger relationships with financial institutions, thus banks are likelier to give them larger loans.	Negative (Significant at 10%, 5%, and 1% levels in 2-tailed T test)

NewCasesinMonth	Positive	An increase in COVID-19 cases will likely lead to government policies that limit business hours and operations, thus creating a greater need for economic support among small businesses in this area.	Positive (Significant at 10%, 5%, and 1% levels in 2-tailed T test)
JobsReported	Positive	Small businesses with a higher number of employees will likely request and receive higher PPP loan amounts to help cover payroll costs.	Positive (Significant at 10%, 5%, and 1% levels in 2-tailed T test)
SecondarySector	Positive	Lockdown and government restrictions seeking to prevent the spread of COVID-19 will likely result in the shutdown or limited business operations of manufacturing plants, thus creating a greater need for economic support among small businesses in the secondary sector.	Positive (Significant at 10%, 5%, and 1% levels in 2-tailed T test)
ServiceSector	Positive	Since the majority of small businesses fall within the service sector and were likely adversely impacted by the public health limitations placed on business operations, we expect that small businesses within the service sector to request and receive large PPP loan amounts.	Negative (Insignificant at 10%, 5%, and 1% levels in 2-tailed T test)
QuaternarySector	Negative	Businesses with the quaternary sector provide crucial resources and need to stay open during the pandemic, and thus do not need as big of loans to keep up with operations.	Negative (Significant at 10%, 5%, and 1% levels in 2-tailed T test)
Income	Positive	Small business located in counties that have high median household income in 2019 (when compared to the national average), will likely request and receive larger PPP loan amounts because the cost of labor is likely higher compared to small business located in areas with a below average median household income.	Positive (Significant at 10%, 5%, and 1% levels in 2-tailed T test)

Table 4: Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) InitialApprova~t	1.000													
(2) female	-0.027	1.000												
(3) Term	-0.086	-0.000	1.000											
(4) MediumLender	0.004	-0.043	-0.008	1.000										
(5) LargeLender	0.009	0.055	0.003	-0.851	1.000									
(6) Urban	0.056	0.074	-0.034	-0.230	0.314	1.000								
(7) RepGov	-0.029	-0.010	0.010	0.035	-0.042	-0.132	1.000							
(8) NewBusiness	-0.030	0.028	-0.188	-0.065	0.080	0.065	0.007	1.000						
(9) NewCasesin Month	-0.008	0.016	0.243	-0.080	0.098	0.192	-0.132	-0.063	1.000					
(10) JobsReported	0.783	-0.019	-0.107	0.002	0.011	0.053	-0.024	-0.024	-0.016	1.000				
(11) SecondarySector	0.084	-0.076	-0.026	0.020	-0.021	-0.022	-0.001	-0.023	-0.022	0.043	1.000			
(12) ServiceSector	-0.028	0.086	-0.033	-0.064	0.095	0.213	-0.035	0.009	0.059	-0.004	-0.572	1.000		
(13) QuaternarySec~r	0.012	0.048	-0.007	-0.031	0.039	0.056	-0.004	0.009	0.012	0.024	-0.112	-0.436	1.000	
(14) Income	0.041	0.034	-0.030	-0.118	0.164	0.407	-0.291	0.034	0.089	0.023	-0.005	0.080	0.033	1.000

Table 5: Estimation Results

	(1)	(2)	(3)
female	-5536.9** (-30.93)	-9736.4*** (-28.26)	-0.250*** (-95.44)
Term	-47.86*** (-10.57)	-38.16*** (-3.39)	-0.00923*** (-118.88)
MediumLender	5116.3*** (19.18)	6514.5*** (9.89)	0.163*** (27.62)
LargeLender	1335.2*** (5.65)	2008.4*** (3.41)	0.137*** (25.04)
Urban	114.9*** (35.46)	193.2*** (25.16)	0.00464*** (76.71)
RepGov	-1455.8*** (-8.48)	-1786.0*** (-4.91)	-0.0296*** (-11.66)
NewBusiness	-10925.4*** (-38.04)	-13321.9*** (-19.33)	-0.259*** (-53.33)
NewCasesinMonth	0.0134*** (8.87)	0.0188*** (7.64)	0.000000316*** (14.34)
JobsReported	7854.2*** (248.16)	7154.1*** (91.60)	0.674*** (118.05)
SecondarySector	42367.4*** (98.17)	49688.0*** (49.38)	0.316*** (118.98)
ServiceSector	-274.7 (-0.88)	5508.2*** (7.27)	0.316*** (67.52)
QuarternarySector	-1915.9*** (-4.07)	6842.1*** (6.70)	0.252*** (40.22)
Income	0.2870*** (51.89)	0.2528*** (21.35)	
Hispanic		-14195.6*** (-22.62)	-0.247*** (-52.38)
VeternDummy		-238.8	0.0254***

		(-0.32)	(5.03)
Asian		-22174.5***	0.229***
		(-41.01)	(-60.04)
BlackOrAfricanAmerican		-8167.42***	-0.298***
		(-15.66)	(-83.79)
OtherRace		-77.55.3***	-0.145***
		(-10.87)	(-21.73)
lnIncome			0.229***
			(42.05)
N	4464461	854513	854513

t-statistics in parentheses based on robust SEs; * .1 ** .05 *** .01

(1) Dependent Variable: InitialApprovalAmount

(2) Dependent Variable: InitialApprovalAmount; Added ethnicity, veteran, and race variables

(3) Dependent Variable: log of InitialApprovalAmount; logged Income variable and condensed Race variables

Figure 1: Distribution of Residuals for Initial Regression

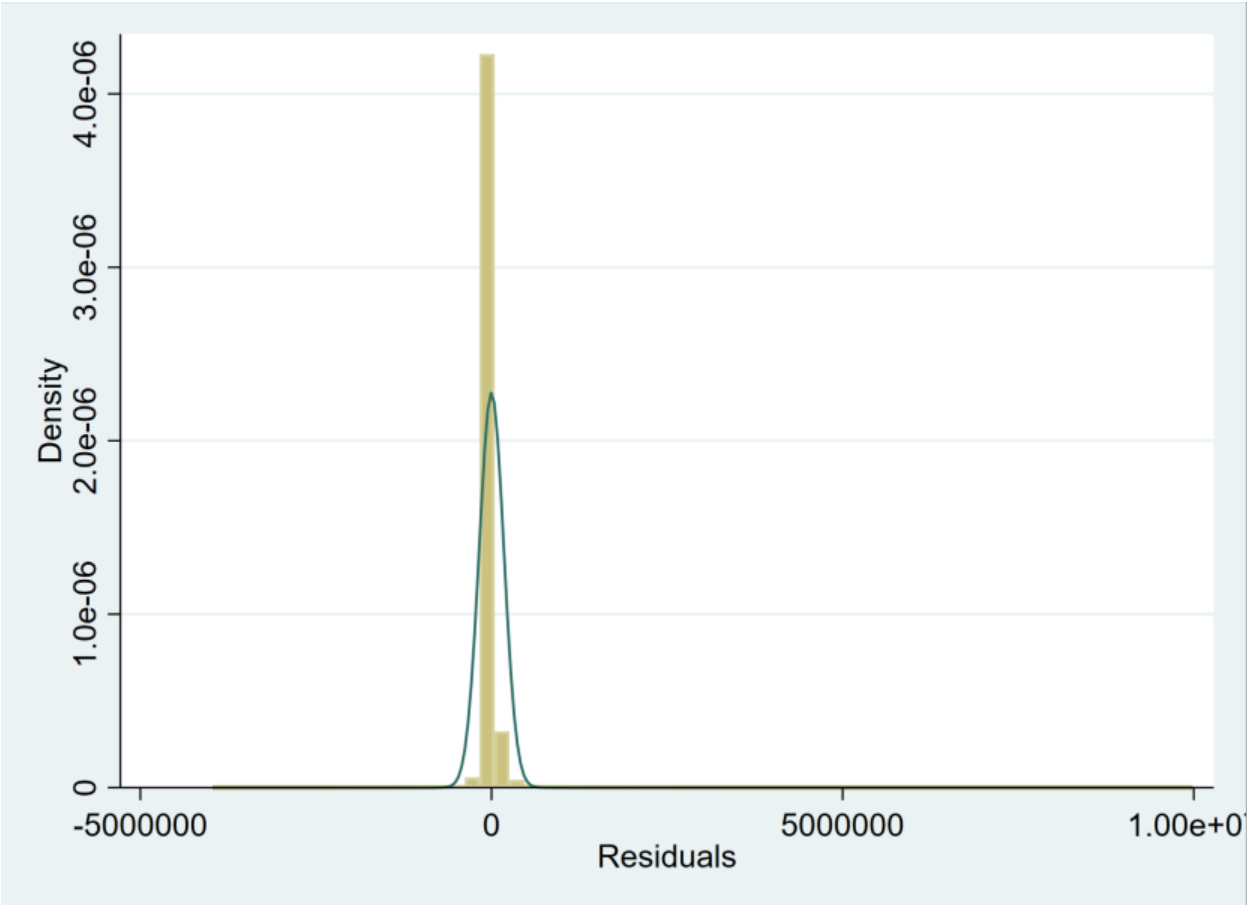
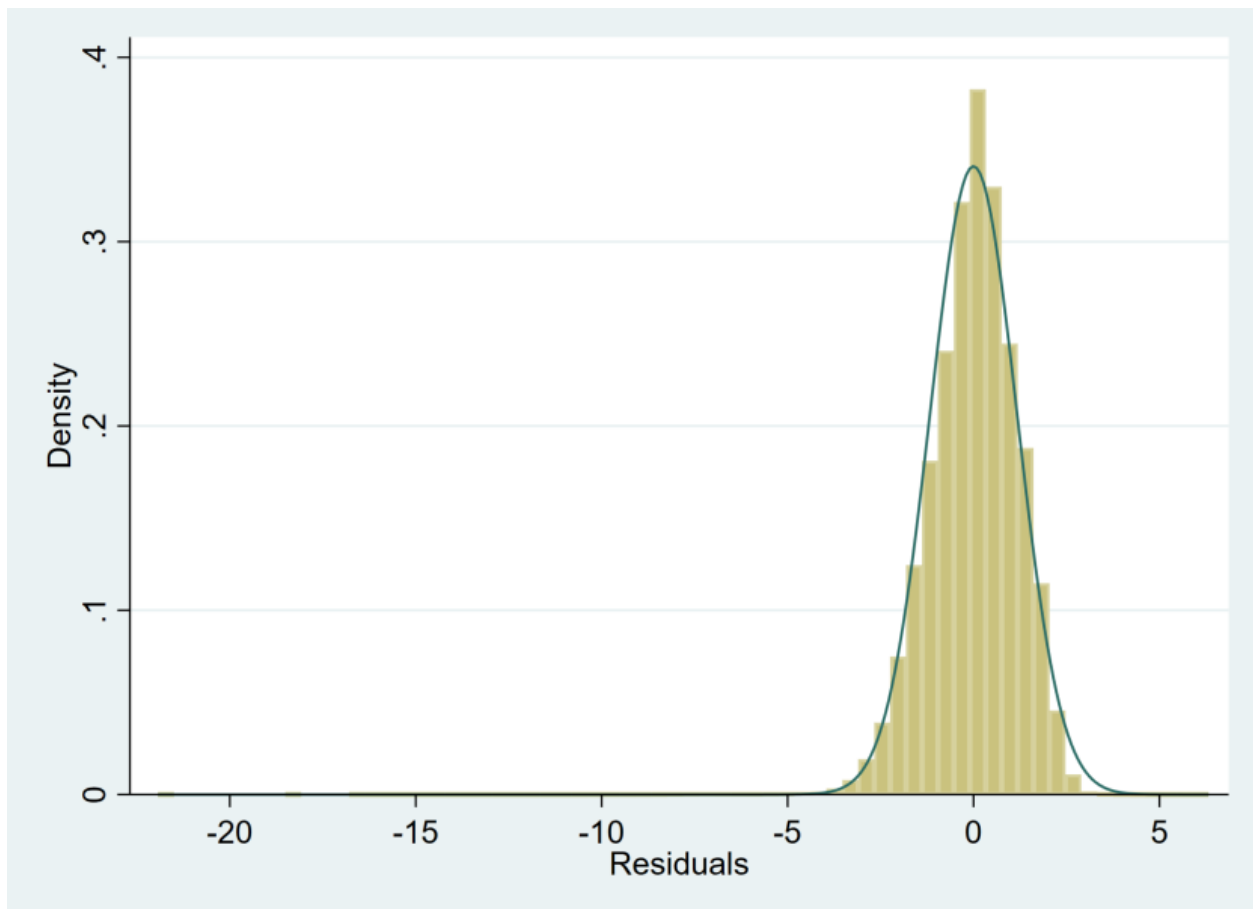


Figure 2: Distribution of Residuals for Alternative Model #2



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