PUBLIC ASSISTANCE PROGRAMS DURING THE COVID-19 PANDEMIC: AN EMPIRICAL ANALYSIS OF BUSINESS RECOVERY FRAMEWORK

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While much has been written about government failures, few have examined the importance of public assistance program for small businesses after disasters. Given the nature of disaster response and recovery, government assistance program also aims to correct for market failures, which includes disaster relief programs such as business loans and direct cash assistance. Public assistance programs can improve the survival rate of small businesses. In some instance, qualified small businesses owners often need to mortgage their property to receive assistance. Studies have also shown that minority-owned small businesses face challenges accessing public assistance programs with limited payback capability. The significance of studying effect of disaster assistance programs can be identified in two aspects. First, it can contribute to the theory development of economic recovery that what types of policies are most effective in facilitating business and local economic recovery. In the case of COVID-19 relief programs, both loans and direct cash assistance are offered for small business owners to apply, which provide a great chance to compare the efficiency of two type of assistance in recovery. Secondly, different than other disruptive event, businesses owners are equally impacted by social distance restriction, which allow researchers to explore the factors that can contribute to businesses recovery from marketing perceptive. This study adopts the business recovery framework from existing literature to explore the contribution factors in businesses recovery. When the interruption event strikes, business characteristics, and hazard events decide how much damage has been suffered for a business. Meanwhile, businesses' preparedness measures (e.g., insurance) and assistance policies (e.g., financial assistance) can mitigate economic losses and

accelerate the recovery process. Other than that, business operation capability also affects the outcome of businesses' recovery, which consists of two major aspects: production capacity and market context. This study utilized the SBA datasets in DFW region, which contains businesses characteristics (ownership, employment size, sales volume, and profitability), amount and type of assistance received from SBA, businesses operation statues (inactive or not), and close date (if applied). I employed the Survival Analysis and Septically Analysis to determine factors that explain small businesses recovery outcome. The result of the survival analysis reveals that any type of assistance plays significant role in helping business to keep operation. Further, minority owned businesses are more likely to keep operation than non-minority owned businesses. The results also show that small businesses with higher profitability are active in running their businesses after the pandemic. Minority-owned businesses in the DFW area recovered faster from the pandemic, which contradicts many studies. It supports the argument that even though minority-owned businesses have relatively small business sizes, special cultural roles played by minority-owned businesses can still positively help businesses' recovery. Small businesses with larger sales volumes and fewer employees significantly positively contribute to helping businesses to sustain operations after the pandemic, which correspond to the studies that businesses with higher value-add in operation and lower operation cost are less vulnerable in the pandemic. The findings provide an understanding on the factors explaining public assistance program for small businesses (i.e., direct cash assistance) as an indicator of businesses recovery. The findings also show restricted assistance increased risk of business closure.

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TABLE OF CONTENTS

Page

ACKNOWLEDGMENTS iiii

LIST OF TABLES viii

LIST OF FIGURES ix

CHAPTER 1 INTRODUCTION 1

1.1 Overview 1

1.2 Problem Statement: The Effectiveness Of Public Assistance Programs In Business Recovery After Disasters 3

1.2.1 Public Assistance Programs 3

1.2.2 Public Assistance Programs as Distributive Policy 4

1.2.3 Public Assistance Program for Small Business Disaster Recovery 6

1.2.4 Research Gaps 7

1.3 Research Questions 8

1.3.1 Significance of Research Questions 9

1.3.1.1 Contribution to Theory 9

1.3.1.2 Contribution to Practice 10

1.4 Theoretical Framework 11

1.4.1 Business Recovery Framework 11

1.5 Business Recovery 12

1.5.1 Defining Business Recovery? 13

1.5.2 Measuring Business Recovery? 15

1.6 Methodology 16

1.6.1 Research Site: Dallas-Fort Worth-Arlington Metropolitan Area and the COVID-19 Pandemic 16
1.6.2 Available Programs: Paycheck Protection Program and Economic Injury Disaster Loan 17
1.6.3 Measurement of Business Recovery 18
1.6.4 Data Sources 18
1.6.5 Analysis Methods 19
1.7 Structure of Dissertation 19
CHAPTER 2 BUSINESS RECOVERY AND PUBLIC ASSISTANCE PROGRAMS 22
2.1 Introduction 22
2.2 Business Recovery 23
2.2.1 Factors Studied in the Business Recovery 24
2.2.2 Significance of Small Business Post-Disaster Recovery 27
2.3 Public Assistance Programs in Post-Disaster Recovery 28
2.3.1 Why We Need Restrictions? 28
2.3.2 Why There is Loan and Cash? 30
2.3.3 Significance of Public Assistance Program in Post-Disaster Recovery 31
2.4 Public Assistance Programs for Small Business During the COVID-19 33
2.4.1 Available Programs 33
2.4.2 Research Statues 35
CHAPTER 3 BUSINESS DISASTER RECOVERY FRAMEWORK 37
3.1 Introduction 37
3.2 Businesses Recovery Framework 37

3.3 Neoclassic Economic Theory 40
3.4 Modified Research Framework 41
3.4.1 Public Assistance Programs 42
3.4.2 Business Characteristics 48
3.4.3 Market Context 50
3.4.4 Geographic Location 51
CHAPTER 4 METHODOLOGY 56
4.1 Introduction 56
4.2 The Research Site: Dallas Fort-Worth Metropolitan Area and the COVID-19 pandemic 57
4.3 Measurements 59
4.3.1 Dependent Variable: Business Recovery 59
4.3.2 Independent Variable: Access to Public Assistance Program 60
4.3.3 Independent Variable: Business Characteristics 61
4.3.4 Independent Variables: Market Context 61
4.4 Data Collection 62
4.4.1 Public Assistance Programs: Small Business Administration 62
4.4.2 Business Characteristics: Mergent Intellect 63
4.4.3 Market Context: Census Bureau 63
4.4.4 Data Preparation Process 64
4.5 Methods of Analysis 65
4.5.1 Logistical Regression 65
4.5.2 Cox Regression with Time-Varying Effect 66

4.5.3 Spatial Autocorrelation 67

CHAPTER 5 ANALYSIS AND DISCUSSION 73

5.1 Introduction 73

5.2 Descriptive Analysis 73

5.3 The Effectiveness of Public Assistance Programs in Helping Business Recovery 76

5.3.1 Logistical Regression 76

5.3.2 Cox Regression with Time-Varying Effects 78

5.3.3 The Relationship Between Business Characteristics and Business Recovery 80

5.3.4 The Relationship Between Market Context and Business Recovery 82

5.3.5The Relationship Between Geographic Location and Business Recovery 82

CHAPTER 6 CONCLUSION 87

REFERENCES 95

LIST OF TABLES

Page

1. Summarize the Definition of Business Recovery 14

2. Classification of Public Assistance Programs 35

3. Summarize the Mechanism of Public Assistance Programs in Business Recovery 45

4. Summarize the Hypotheses in This Dissertation. 54

5. Binary Variables Capture Small Business Participation in Assistance Programs 60

6. Variable used in Logistic Regression 69

7. Variable Used in Cox Regression with time varying effect 70

8. Variable Used in Spatial Autocorrelation 71

9. Descriptive Statistics at the Individual Business Level 74

10. Factors Explaining Small Business Recovery (Logistical Regression) 77

11. Factors Explaining Small Business Recovery at Each Stage (Cox-Regression with Time Varying Effect) 79

12. Result of Spatial Autocorrelation 83

LIST OF FIGURES

Page

1. Business Recovery Framework (source: Chang et al. [2022]) 38

2. Modified Businesses Recovery Framework 42

3. Data Preparation Process 655

4. Percentage of Inactive Business at Census Tract Level..... 75

5. Percentage of Business Receive Any Assistance at Census Tract Level 76

6. Percentage of Business Access to Restricted (PPP) Assistance Only and Business Active 84

7. Percentage of Business Access to Unrestricted (EIDL) Assistance Only and Business Active 85

8. Percentage of Business Access to Mixed Assistance (PPP and EIDL) and Business Active ... 86

CHAPTER 1

INTRODUCTION

1.1 Overview

While much has been written about business recovery after disasters (Asgary et al., 2012; Corey & Deitch, 2011; Dahlhamer & Tierney, 1998; Kellenberg & Mobarak, 2011), few have examined the importance of public assistance programs on small businesses during a global pandemic (Wang & Kang, 2023). From a neoclassical perspective, business failure or closure during disasters reflects the effort of the market force that excludes inefficient businesses from the market. In this context, no public assistance is necessary (Okuyama & Rose, 2019; Schmidt, 2018). However, scholars have also argued for the significance of public assistance programs highlighting the notion of market failure in the presence of disasters or extreme shock in the market. Public intervention is justified on equity and public good reasons (Green & Lavery, 2015; G. Smith, 2015; Xu & Mo, 2013).

The purpose of this study is to assess the effectiveness of public assistance programs in helping small businesses recover after disasters. The significance of this study can be appreciated from both theoretical and practical perspectives. First, from a theoretical perspective, this study contributes to the development of theories on business recovery post-disasters and examines how redistributive policies can play a role in recovery. Second, from a practical standpoint, addressing the overall research question can assist policymakers in developing more appropriate policies to facilitate business recovery after disasters.

There are multiple reasons to examine the effectiveness of public assistance programs in promoting business recovery. First, redistributive policies are not expected to lead to economic improvement (Auclert, 2017; Peterson, 1981; Schwartz & Ter-Minassian, 1995). In post-disaster

scenarios, achieving a rapid economic recovery often necessitates allocating resources to larger businesses due to effectiveness concerns, potentially damaging the principle of equality (M. Li, 2021; Watson, 2022). Second, the rationality of mechanisms within public assistance programs can impede or accelerate the recovery process (Chang et al., 2022). The bureaucratic mechanisms in public assistance programs can limit businesses' adaptation behaviors or increase businesses' debt load if it is a loan-based assistance. Public assistance programs linked to certain type of requirements or restrictions can limit the ability of businesses to adapt to their changed conditions and even decisions that determine their long-term operations and business survival. For instance, assistance in a loan-based assistance can increase the number and amount of debt – debt-load, of businesses making them vulnerable to financial risk (Dahlhamer & Tierney, 1998; Graham, 2007; Xiao & Zandt, 2012b).

This study utilized the Business Disaster Recovery Framework, adopted from the theoretical framework proposed by Chang et al., (2022) to examine the role of public assistance programs in long-term business recovery following large-scale disruptive events such as the COVID-19 pandemic. Using data from small businesses in the DFW region, this study employs logistic regression, Cox regression with time-varying effects, and spatial autocorrelation to assess the effectiveness of public assistance programs in reducing the likelihood of business closures, not only considering overall COIVD-19 period but also both temporal and spatial variations.

The analysis results indicate that public assistance programs can help reduce the likelihood of business closures, though their impact varies over time and across geographic locations. In the meantime, restrictions attached to public assistance programs might let business face more risks compare with business without any assistance. Additionally, businesses with more resources are more likely to recover from COVID-19. Furthermore, minority-owned

businesses demonstrated greater resilience than non-minority-owned businesses during the pandemic.

1.2 Problem Statement: The Effectiveness of Public Assistance Programs in Business Recovery After Disasters

Neoclassical economics argue that business closure is the effort of market forces. The concept of perfect competition, introduced by neoclassical economics, describes an ideal market structure in which resources are effectively allocated through interactions among numerous buyers and sellers and individuals have limited impact on the whole market (Clifton, 1977). According to neoclassical approach, the failure of businesses signals their poor decision when allocating resources effectively. No government intervention is necessary.

In the post-disaster context, the reliance on the market force suggested by the neoclassic economics has limitations in its application. For example, the approach relies on perfect information, rational actors, and efficient markets, which are frequently absent in post-disaster situations. Disasters caused major market failures (e.g., information gaps, liquidity shortages, and coordination challenges) hinder businesses from recovering effectively (Atkinson & Sapat, 2013; Dari-Mattiacci & Faure, 2015). Government intervention can provide immediate financial relief---such as grants and low-interest loans---that businesses need to rebuild their businesses, infrastructure, and operations, which is critical for small business recovery after disasters (Yanuarni et al., 2023).

1.2.1 Public Assistance Programs

Governments have multiple tools to help businesses recover when they face a disruptive market in a post-disaster context, which include but not least to regulations, subsidies and taxes, and public goods (Furton & Martin, 2018). The government can enact regulations to restrict

behaviors among sellers and buyers to avoid moral hazards (Foldvary & Klein, 2001; Vining, 2003). Subsidies and taxes are employed by the government to raise market incentives from both internal and external perspectives (Besley, 1992). Government intervention tools do not directly alter the market's resource allocation pattern; instead, they facilitate normal transactions to assist businesses in recovering from disasters.

Government interventions also face challenges. First, scholars suggest that regulations and subsidies can lead to inefficiencies and inequality, which can create new problems instead of addressing the existing problem, which requires caution in policy design (Fuchs & Skrzypacz, 2015; Le Grand, 1991). Further, free raider problems and moral hazards can mitigate the effort of government interventions (Holmstrom, 1982; Moore, 1995). Moral hazards refer to a situation where individuals are more likely to take risks because they would not boundary the cost of increased risk. The free rider problem is defined as the situation in which individuals benefit from goods without contributing to the cost. Therefore, government interventions also need very cautious in designing and implementing to achieve expected outcomes.

1.2.2 Public Assistance Programs as Redistributive Policy

Public assistance programs--a form of redistributive policy-- are government initiatives designed to provide financial and service-based aid by reallocating resources from higher-income groups to the needy and unfortunate, to achieve greater social equality and welfare (Peterson, 1981; Sausgruber & Tyran, 2007). These policies are shown in a wide range of formats including taxation, social welfare programs, public goods, and direct financial assistance to individuals and businesses (Fuchs & Skrzypacz, 2015). The underlying principle of redistributive policy is to address economic disparities and social inequities by reallocating resources from more affluent

segments of society to those in less fortunate circumstances, thereby promoting social welfare and economic stability

The dilemmas of applying redistributive policy in post-disaster scenarios sourcing from two aspects. Firstly, redistributive policy aims to allocate resources to needy and unfortunate groups, but these groups are less likely to promote the recovery process effectively, which conflicts with the expected outcome of redistributive policy in the post-disaster stage (Peterson, 1981; Watson, 2022). For instance, businesses with larger businesses size are likely to facilitate the transaction more effectively but they are not groups who are most needy to assistance (Gerber et al., 2018; M. Li, 2021; Watson, 2022). However, allocating resources to less needy groups can lead needy groups to fall into the poverty trap, which conflicts with the value of redistributive policy and social equality (Balboni et al., 2020; Kraay & McKenzie, 2014).

Secondly, as a form of public goods, redistributive policy needs to set certain restrictions to prevent the free rider problem during the implementation, especially in the post-disaster context, unrestricted cash assistance has a limited impact in promoting recovery (Reddy, 2000; Xu & Mo, 2013). However, restrictions set by redistributive policy might reduce recipients' adaption capability (Atteridge & Remling, 2018; McVittie et al., 2017; Ostrom & Ostrom, 2019). For instance, assistance distributed in a loan format aims to enable recipients to generate capital and facilities recovery but might increase the debt load of the affected groups (Dahlhamer & Tierney, 1998). On the other hand, restricted cash assistance typically requires business recipients to maintain their employee count, which limits the businesses' ability to survive by laying off employees (Bartik, Cullen, et al., 2020).

Public assistance programs play a significant role in promoting social stability and economic development by mitigating poverty and inequality (Peterson, 1981). They aim to allow

people suffered from disasters access to necessities such as food, shelter, and healthcare through the redistributive process. This redistribution helps to mitigate the increased crime rates and social unrest resulting from poverty and economic disparities (Devaney et al., 1997; Radelet, 2004). Reduced poverty leads to a broader base of human capital and a healthier workforce, which are essential for long-term economic prosperity (Simões et al., 2022; Yalley et al., 2021). For instance, Nelson, (2012) suggests that higher benefit levels lead to less extensive poverty, thus supporting social stability and economic development.

The implementation of public assistance programs also face challenges in equality, access, efficiency, and effectiveness (Barnes, 2020; Collins et al., 2016; Schneider & Jacoby, 2003; Williamson, 1974). First, during the redistributive process, historical discrimination can prevent certain groups equal access to public assistance programs, undermining the value of social equality (Williamson, 1974). Second, the redistribution process can be an administrative burden, especially when the potential recipient group is relatively large (Barnes, 2020). When assistance needs to be distributed to a large group, a targeted approach is not appropriate from a cost-benefit perspective. The targeting approach itself, however, is resource and time-consuming if distribution agencies want to reach the expected needy group, further increasing administrative burdens (Henman, 2004). Third, ensuring that public assistance programs produce the expected outcomes can be challenging. There is a risk that assistance recipients may become dependent on aid, discouraging self-sufficiency (Schneider & Jacoby, 2003).

1.2.3 Public Assistance Program for Small Business Disaster Recovery

During a small business post-disaster recovery process, public assistance programs can promote recovery by providing financial assistance to restore operations (Hiramatsu & Marshall, 2017; Watson, 2022). Disasters not only cause physical damage but also hinder businesses'

operational capabilities (Watson, 2021). Compared to larger businesses, small businesses are less likely to have preparedness plans for disasters and lack alternative assistance sources other than public assistance programs (Andrew et al., 2022; Marshall & Schrank, 2014). To restore operational capability, small businesses typically need to access assistance from public assistance programs (Watson, 2022).

However, the effectiveness of public assistance programs in helping small businesses is impacted by several factors, which are restrictions attached to the program, the format of those programs, and geographic locations. Restrictions attached to those programs and loan-based assistance are critical to ensure assistance recipients continue work in business activities instead of misuse funding, which aims to promote regional economic recovery (Barbieri, 2021; Gu et al., 2008; Kelly et al., 1998). The restriction and loan-based assistance can also limit business profitability by limiting self-adjust behavior and increasing the debt load (Dahlhamer & Tierney, 1998; Graham, 2007).

1.2.4 Research Gaps

Despite extensive research on the effectiveness of public assistance programs in small business post disaster recovery, significant gaps remain, particularly regarding long-term impact assessment and the comparative analysis of restrictions or unrestricted assistance. Most studies focus on the short-term impacts of public assistance programs, such as job preservation, and financial stability (Haynes et al., 2018; Hiramatsu & Marshall, 2017; Watson, 2021). There is a critical need for studies to examine how these programs affect businesses' survival over the whole pandemic. Understanding these long-term effects will help in designing more effective policies and interventions that promote sustained economic health and community resilience.

Additionally, research is needed to evaluate the impact of policy regulations attached to public assistance programs and compare the effectiveness of restrictions attached to assistance. This is because restrictions can ensure aid is spent effectively, but they may also limit businesses' flexibility to adapt to specific circumstances, potentially hindering recovery. Comparing loan-based programs, which impose a repayment burden, with cash-based assistance, which offers immediate, flexible funds, will provide insights into their respective benefits and drawbacks. This analysis will help policymakers optimize assistance programs to support both immediate recovery and the long-term viability of businesses.

Lastly, the influence of geographic conditions on the effectiveness of public assistance programs is rarely discussed by scholars. When public assistance is distributed to certain areas, it not only affects the recipients but also impacts surrounding businesses by stimulating economic activity through spillover effects. Exploring the impact of geoeconomic conditions can provide valuable insights for assistance distribution agencies, helping them allocate resources more effectively to maximize economic recovery.

1.3 Research Questions

Even though redistributive policy has been equally accessed, the effort of redistributive policy in promoting business recovery can be mitigated by restrictions attached, the format of assistance, businesses' characteristics, and the market context from the supply and demand side (Chang et al., 2022). To explore how redistributive policy contributes to the business recovery process through the given limitation discussed above, this study proposes the following overall research question the guide: Do public assistance programs mitigate the likelihood of business closure after major disasters?

1.3.1 Significance of Research Questions

1.3.1.1 Contribution to Theory

This research advances the business disaster recovery framework by investigating the impacts of public financial support, business characteristics, and market conditions on business recovery after a pandemic. Public financial support, such as grants, low-interest loans, and subsidies, helps businesses cope with immediate financial challenges and stabilize their operations. The businesses characteristics, such as their size, age, industry type, and pre-disaster financial performance, also affect their recovery. The market conditions, which include factors like supply chain reliability, customer demand, and competitive environment, influence how rapidly and effectively businesses can resume normal operations. These elements are key for developing effective recovery strategies that cater to the specific needs of different businesses in the wake of a pandemic.

Additionally, this research investigates the notion of equitable resource allocation during and after the pandemic. Making sure that financial support and other recovery resources are available to all impacted businesses, no matter their size or location, is vital for a comprehensive recovery. Equitable resource allocation ensures that vulnerable and underserved businesses get the support they need to rebuild and prosper. This involves assessing the methods of aid distribution, the eligibility requirements, and the transparency of the allocation process. By exploring these aspects, the research offers insights into how to enhance the effectiveness of disaster recovery programs, making sure that they are inclusive and beneficial to the whole business community.

Furthermore, this study examines the effectiveness of redistributive policies in promoting post-disaster economic recovery. As mentioned earlier, the primary goal of redistributive policies is to address economic disparities and social inequities, which often necessitates restrictions to prevent the free-rider problem. However, the rationale behind these restrictions has rarely been tested, particularly in the context of post-disaster recovery. While restrictions are intended to ensure aid is distributed fairly and efficiently, they may also prevent business owners from participating in economic activities that align with market principles, thereby hindering resource allocation and slowing recovery. By investigating the role of restrictions attached to post-disaster assistance programs, this study provides valuable insights into the rationality and effectiveness of these limitations in the post-disaster context. The findings offer insights into whether these restrictions align with market efficiency principles or inadvertently hinder recovery, providing a foundation for refining policy frameworks to balance equity, efficiency, and economic resilience in post-disaster contexts.

1.3.1.2 Contribution to Practice

This study contributes to practical policy by informing policymakers about the impact of their disaster relief efforts. By analyzing the effects of public assistance on business recovery, the research can highlight whether these efforts significantly reduce business closures. If a strong positive impact is demonstrated, policymakers can use this evidence to strengthen or adjust existing policies to optimize their effectiveness. Such data-driven adjustments could ensure that public funds are used efficiently and that relief programs are tailored to maximize benefits for struggling businesses.

Additionally, this study provides insights into improving the distribution of public assistance following disasters. It emphasizes the importance of ensuring that aid reaches all affected businesses, particularly those in underprivileged or hard-to-reach areas. By identifying gaps and inefficiencies in current distribution methods, the research can suggest ways to make assistance more accessible and equitable. This could involve implementing more targeted outreach strategies, simplifying application processes, or increasing support for businesses that face additional barriers to recovery. Ensuring comprehensive and effective aid distribution can help create a more resilient and inclusive economic recovery.

Lastly, the findings of this study can help small business owners choose the most appropriate assistance programs at different stages to mitigate the risk of closure. By assessing the effectiveness of restricted and unrestricted public assistance programs throughout different phases of the COVID-19 pandemic, this research provides valuable insights into which programs are most effective in helping businesses maintain operations.

1.4 Theoretical Framework

1.4.1 Business Recovery Framework

Chang et al. (2022) present a Business Recovery Framework that provides a comprehensive way to understand how businesses recover from disruptive events like the COVID-19 pandemic. This framework takes into account different factors, such as business features like size and sector, which affect vulnerability, and event characteristics like length and spatial scale, which determine severity. The effects and recovery processes depend on business actions, such as getting insurance, and government policies, like financial aid and lockdowns, which can either slow down or speed up recovery. Recovery mechanisms include internal factors, such as damage to physical capital and managerial choices, as well as external factors

like supply chain interruptions and shifts in household spending habits. These elements generate complex and continuous recovery outcomes for businesses (Chang et al., 2022).

On the other hand, neoclassic economics advocates that businesses can return to the pre-disaster growth path by effectively reallocating resources (Okuyama & Rose, 2019; Radovic Markovic, 2024). Neoclassic economics suggests that market forces can explain the business's recovery outcome. According to neoclassic economics theory, perfect competition refers to an ideal market structure in which resources are effectively allocated through interactions among numerous buyers and sellers and individuals have limited impact on the whole market (Clifton, 1977).

The effectiveness of public assistance programs is not adequately addressed by both the Business Recovery framework and neoclassical economic theory, indicating the need for a modified research framework. This new framework aims to answer the overarching research question: to what extent do public assistance programs mitigate the likelihood of business closures throughout the entire disaster period? Additionally, the modified framework will investigate the impact of various factors—such as restrictions, the format of assistance, and geographic location—on the effectiveness of public assistance programs in helping small businesses avoid closure.

1.5 Business Recovery

Disasters not only damage physical buildings but also disrupt business operations. Business recovery is a critical component of disaster recovery, supporting overall economic stability, community resilience, and long-term regional recovery (Aghababaei et al., 2020). Effective business recovery helps maintain employment and economic stability, promoting a

quicker and more robust recovery for the affected area (Tierney, 2019). However, there are multiple definition associate with the business recovery,

1.5.1 Defining Business Recovery?

The concept of business recovery after a disaster lacks a universally accepted definition because recovery has multiple facets and characteristics. To define business recovery, the essential first step is to clarify what "recovery" refers to. According to Lindell, (2013), disaster recovery has three interconnected meanings: a goal, a phase, and a process. The goal is to restore normal community activities that were disrupted by the disaster, often envisioned as a return to pre-disaster conditions (Ransikarbum & Mason, 2016). The phase, which starts with stabilizing disaster conditions, marks the end of emergency response and concludes when the community resumes its usual routines (Rittinghouse & Ransome, 2006). The process encompasses both planned activities established before the disaster and improvised actions taken afterward (Chang & Rose, 2012; Lindell, 2013). This study focuses specifically on how public assistance programs aid small businesses during the recovery process.

Second, how recovery is characterized is critical to define business recovery as well. According to Chang (2010) when recovery means a process, it can refer to the situation that: 1) returning to pre-disaster conditions, 2) achieving a state that could have been reached if the disaster had not occurred, or 3) attaining a new stable stage. Returning to pre-disaster conditions means the performance of businesses returns to the pre-disaster level after disruption (Cheng et al., 2015). Aiming to achieve a hypothetical state that could have been reached if the disaster had not occurred incorporates a more progressive vision, but such a definition also makes recovery hard to measure (Hosoya, 2017). Lastly, reaching a new stable stage recognizes that recovery is

not just a restoration but an evolution (Freitag et al., 2014). This characterization views recovery as an adaptive process where businesses reinvent themselves to fit new post-disaster realities.

Table 1 summarizes the conceptual definition proposed by scholars regarding business recovery. As indicated in Table 1, scholars commonly highlight two elements regarding the definition of business recovery. First, recovery refers to a process instead of a goal or a phrase. Second, scholars underscore the importance of restoring the functionality of businesses instead of performance reaching certain points. Following these two highlighted points, this study proposed the concept of business recovery.

Table 1. Business Recovery – Definition

Literature Sources	Concepts	Conceptual Definition
Chang et al. (2022)	Business Recovery	Conceptualizes business recovery as the process by which businesses restore their operational, financial, and strategic capabilities after a disaster.
Dahl Hamer & Tierney (1998)	Business Recovery	Defines business recovery as a holistic process encompassing the restoration of both physical assets and organizational functionality within a disrupted market.
Xiao & Van Zandt (2012)	Business Resilience	Views business resilience as a broader capability that includes the ability to anticipate, prepare for, respond to, and adapt to incremental changes and sudden disruptions.
Hamamatsu & Marshall (2018)	Business Recovery	Discusses business recovery in terms of long-term sustainability and resilience, focusing on the capacity of businesses to adapt to new norms and maintain continuity.
Watson (2021, 2022)	Business Recovery	Examines business recovery as the ability of businesses to leverage public assistance effectively in order to mitigate the impacts of disasters and resume normal operations.
Zobel (2014)	Business Recovery	Describes recovery as an adaptive process that involves strategic reevaluation and operational adjustments in response to changing environmental and market conditions.

This study defines business disaster recovery as *the process by which businesses regain stability and avoid closure after experiencing disruptions due to disasters.* As previously noted,

defining business recovery requires addressing two key aspects: what recovery refers to and how it is characterized. This study proposes this definition to address both concerns.

First, recovery can refer to a goal, a phase, and a process that depends on the context (Lindell, 2013). In the present study, we conceptualize recovery as a process, which is in alignment with other studies regarding small business post-disaster recovery (Chang et al., 2022; Dahlhamer & Tierney, 1998; Marshall & Schrank, 2020). Viewing recovery as a process includes both the planned activities established before a disaster and the improvised actions taken afterward (Lindell, 2013).

Although there is disagreement about what status can be considered recovery, all definitions generally emphasize that business functionality has resumed (Chang et al., 2022; Marshall & Schrank, 2014; Watson, 2021; Xiao & Zandt, 2012b). Functionality, in this context, relates to the ability of a business to resume operations, generate revenue, and maintain its workforce. According to Chang and Rose (2012) that point, businesses may not always return to pre-disaster performance levels, but if functionality reaches a new stable state, it still can be considered recovery from disasters.

1.5.2 Measuring Business Recovery?

Building on how recovery is characterized, scholars have adopted different measurements to capture business recovery post-disaster. For instance, Khan and Sayem, (2013) define recovery as a process that returns businesses to pre-operational levels, assessed by re-establishment behavior and the speed of business revival. Further, Hosoya (2017) indicates that the hypothetical state that recovery is understood as achieving a state that would have been reached if the disaster had not occurred can work as a benchmark to evaluate the success of the recovery effort.

Chang (2010) highlights the drawback of defining recovery that refers to 'return to "pre-disaster"' level and conditions as 'attaining what is supposed to reach without a disaster occurring.' The former definition ignores the complicity of recovery that the 'pre-disaster' level can never be reached. Disasters can cause a significant decrease in the demand side, which makes businesses' performance hard to return to the 'pre-disaster' level (Josephson & Marshall, 2016). The latter definition requires predicting a hypothetical state, which can introduce errors, uncertainties, and inconsistencies across scholars (Cheng et al., 2015; Stevenson et al., 2018).

As an alternative, Chang and Rose (2012) propose that recovery refers to reaching a new, stable stage after a disaster. In this approach, business attributes like customer and employee retention become indicators of post-disaster adaptation (Aghababaei et al., 2020) Further, Marshall and Schrank (2014) also suggest that business recovery should be measured over time and include multiple factors such as business profitability, customer retention, and resource availability. Moreover, following the definition of reaching a new stable stage, scholars use subjective indicators to capture business recovery as well. For instance, Quarantelli (1999) advocates for a subjective measure: when a business perceives itself as recovered, it is considered recovered.

1.6 Methodology

1.6.1 Research Site: Dallas-Fort Worth-Arlington Metropolitan Area and the COVID-19 Pandemic

This study was conducted in the Dallas-Fort Worth-Arlington (DFW) Metropolitan Area. The DFW metropolitan area consists of two separate metropolitan statistical divisions: the Dallas-Plano-Irving metropolitan division and the Fort Worth-Arlington-Grapevine metropolitan division. The DFW Metropolitan Area includes 11 counties: Collin County, Dallas County,

Denton County, Ellis County, Hunt County, Kaufman County, Rockwall County, Johnson County, Parker County, Tarrant County, and Wise County.

The DFW Metropolitan Area and COVID-19 is an appropriate research site for this study because of two reasons. First, according to Moody's Analytics (2019) that the DFW Metropolitan Area has the second most diverse economic structure among metropolitan areas in the US. The diverse economic structure provides a sufficient sample size for this study. Second, the DFW Metropolitan Area is the first metropolitan area that returns job levels to the pre-pandemic level (Maddox, 2022), which provides a great chance to study the factors contributing to this outcome.

The U.S. economy suffered greatly from the COVID-19 pandemic, social distance restrictions following the pandemic forced many businesses to shut down and caused GDP losses of $3.2-$4.8 trillion in two years. Many workers lost their jobs or hours, while health costs and fears added more pressure. Small businesses saw lower revenues and higher bankruptcies, with some new businesses forming. According to the statistical report from Yelp (2020) that 163,735 U.S. businesses closed, 60% for permanent, mostly in restaurants and retail. The economy may lose $14 trillion by 2023, with big effects on air travel, dining, and health services. Government actions helped some businesses, but the long-term economic damage will last, showing the need for more resilience and recovery support.

1.6.2 Available Programs: Paycheck Protection Program and Economic Injury Disaster Loan

The Paycheck Protection Program (PPP) and Economic Injury Disaster Loan (EIDL) are the two main assistance programs administrated by the Small Business Administration (SBA) during the COVID-19 pandemic. Both programs are available in the format of loans and cash. Compared with EIDL, PPP loan recipients could use loans to pay for payroll costs, mortgage

interest, rent, and utilities. PPP loan recipients are eligible for forgiveness if they spend more than 60% of the funds on eligible payroll costs.

Compared with PPP, EIDL loan has fewer restrictions on the usage of assistance. EIDL advances were direct funds that did not require repayment but were in smaller amounts. The PPP gave $650 billion of aid from April 3, 2020, in two rounds of funding to over 5 million firms until it stopped on August 8, 2020. The SBA closed EIDL loans or advance applications as of January 2022. EIDL loans of $200 billion went to 3.6 million firms, and EIDL advances of $20 billion went to 5.8 million firms.

1.6.3 Measurement of Business Recovery

This study operationalizes whether a business is considered active or inactive as an indicator of a business's recovery outcome. Whether businesses still maintain operations is an indicator that is well-adopted by scholars in the business recovery field to measure business recovery outcomes (Aghababaei et al., 2020; Headd, 2003; Stevenson et al., 2018).

The source of the information about the activity status of businesses is Mergent Intellect. Mergent Intellect offers a searchable database with comprehensive information on over 280 million businesses, covering both active and inactive firms in a chosen region. Mergent Intellect uses the presence or absence of trading activities to identify if a business is inactive (Leaming, 2016). A business that is inactive, according to Mergent Intellect, is no longer trading or operating. A business that is active, according to Mergent Intellect, until January 2023 is seen as recovered by this study; otherwise, it is seen as not recovered.

1.6.4 Data Sources

This dissertation relies on three sources of data. First, this study acquired the list of PPP and EIDL recipients from SBA websites. Second, Mergent Intellect, a searchable database of

business information, provides data about businesses in the DFW region, such as business name, address, sales volume, employee size, sector, and active status. Third, data from the Census Bureau are used to capture market context, such as minority population, median household income, and the number of housing units.

1.6.5 Analysis Methods

This dissertation employs three analytical methods to examine different facets of business recovery during the COVID-19 pandemic: (1) logistic regression, (2) Cox regression with time-varying effect, and (3) spatial autocorrelation. The three methods address three dimensions of the overall research question. The logistic regression evaluates whether public assistance programs help small businesses avoid closure throughout the pandemic period. The Cox regression with time-varying effect further explores the impact of public assistance programs at different phases of the pandemic. Finally, the spatial autocorrelation assesses the effectiveness of public assistance programs from a geographic perspective.

1.7 Structure of Dissertation

The structure of this dissertation is as follows: Chapter 2 examines the factors that contribute to business recovery by reviewing relevant literature. It also discusses both internal and external factors that affect the effectiveness of business recovery. The study of business recovery and the effectiveness of public assistance programs, especially in relation to COVID-19, is reviewed. The conditions attached to public assistance programs, the types of public assistance programs, and the geographic location related to business recovery are explored and identified.

In Chapter 3, we use the Business Recovery framework and neoclassic economic theory is discussed to examine the factors that influence the business recovery outcome after a disaster.

We also modify the research framework to address its limitation of not identifying the mechanisms through which public assistance programs aid small businesses in recovering from disasters. In the modified framework, we consider how the restrictions, format, and geographic locations of the public assistance program affect its effectiveness, as well as how the business characteristics and market context impact the business recovery process.

This dissertation's data and methods are described in Chapter 4. The data sources consist of Small Businesses Administration assistance recipient data, Mergent Intellect businesses demographic data, and Census Bureau demographic data. Four dataset are merged based on their geographic location and businesses names. The final dataset contains the information about business characteristic, access to public assistance programs, market context, and activity. To answer the research question, do public assistance programs mitigate the likelihood of business closure after disasters, logistical regression, cox-regression with time-varying effects, and spatial autocorrelation are performed to investigate the effectiveness of public assistance in small business recovery.

Chapter 5 provides a descriptive analysis of the data that this dissertation uses. It also reports the results from logistic regression, Cox regression with time-varying effects, and spatial autocorrelation in Chapter 5. The results suggest that when businesses have access to a single type of public assistance, it positively contributes to the recovery process. However, when businesses access multiple types of assistance simultaneously, the effort can be impeded. Further the result of spatial autocorrelation suggests that businesses in rural areas are easier to recover even with relative low access rate to public assistance programs.

Chapter 6 reviews the main findings and the implications that the results and discussions suggest. It also covers the limitations and future research directions in Chapter 6.

CHAPTER 2

BUSINESS RECOVERY AND PUBLIC ASSISTANCE PROGRAMS

2.1 Introduction

This chapter investigates factors that explain business recovery after diesters and how public assistance programs help business recovery. In addition, this chapter reviewed available public assistance programs for small business owners during the COVID-19 pandemic and research statutes. This is done based on the literature on business recovery and empirical studies regarding the effectiveness of public assistance programs. Business recovery is defined as "a process by which return to a new stable situation" (Chang & Rose, 2012), which is a complicated process that mixed impacts from business characteristics, government intervention, and marketing context. Regarding public assistance programs, restrictions attached to assistance programs, the format of assistance, and geographic locations can influence the efforts of those programs.

Business characteristics refer to features inherent in business, such as size, sector, and ownership. Business characteristics are often associated with how much damage businesses experience from disasters by determining the business's ability to absorb shocks from disasters (M. A. U. Khan & Sayem, 2013; Marshall et al., 2015; Morrish & Jones, 2020). In this process, public assistance programs aid business recovery by providing funding to help small businesses restore operations (Josephson & Marshall, 2016). However, market context also influences business recovery by determining profitability (Morrish & Jones, 2020).

Restrictions and loan-based assistance are necessary to ensure assistance recipients behave following certain ways that promote economic activities instead of misusing funding (Chrisman & McMullan, 1996; Gu et al., 2008). However, irrational restrictions can limit

recipients' self-adaptation measures (Graham, 2007). Loan-based assistance can increase the debt load of recipients (Dahlhamer & Tierney, 1998).

Additionally, public assistance programs may have different impacts depending on geographic locations, because some areas may have more favorable conditions for businesses to access the programs, such as well-developed industrial chain (Andersson & Larsson, 2016; Crass et al., 2016). However, these advantages in accessing public assistance programs can undermine the principle of equality because, after a disaster, areas that suffer more damage require more help to resume economic activities (Domingue & Emrich, 2019a).

This chapter has the following structure: First, it reviews the factors that affect business recovery and the mechanisms behind them; Second, it explains why public assistance programs have restrictions and offer loans or cash and how these factors and geographic locations influence the effectiveness of public assistance programs. The available public assistance programs for small businesses during the COVID-19 and research statutes are also discussed.

2.2 Business Recovery

Business recovery is defined as "the process by which businesses return to conditions of stability (Chang & Rose, 2012)". This definition encompasses two key dimensions: first, the restoration of a business's operational capability, and second, the achievement of a stable performance level. Instead of strictly defining recovery as reaching a specific point, this definition offers a more dynamic definition.

Following this definition, scholars employ objective and subjective indicators to measure business recovery. Subjective indicators in business recovery after disasters focus on perceptions and experiences. For example, Dwyer & Horney (2014) measure recovery through qualitative data from disaster recovery experts and researchers, emphasizing the importance of adaptability,

comprehensiveness, and self-evaluation. Bronson et al., (2006) measure business owners' optimism in recovery to understand the influence following disasters. These subjective measures offer valuable insights into the personal and communal aspects of recovery, capturing the subtleties of individual and collective experiences.

Objective indicators use measurable and verifiable data to evaluate business recovery. Horney et al., (2017) created and tested recovery indicators based on empirical data, covering metrics such as economic recovery and infrastructure restoration. Chang (2010) proposed a framework for measuring urban disaster recovery using statistical indicators, recording objective indicators such as population change and socioeconomic indicators. Aghababaei et al., (2020) applied objective indicators like business stop operation days, revenue recovery, customer retention, and employee retention to quantify and forecast business recovery through Bayesian linear regression. These objective measures offer a solid and systematic method to understand the scope and pace of recovery efforts.

2.2.1 Factors Studied in the Business Recovery

Recovering from disasters is a complicated process for businesses, as it involves resuming operations, ensuring financial viability, and reconstructing infrastructure. Disasters can result in serious physical harm, interrupted supply chains, and large financial losses, making recovery a difficult and multi-dimensional endeavor (Altay & Ramirez, 2010; Khan & Sayem, 2013; Sydnor et al., 2017). Recovery depends on a mix of government assistance, such as grants and low-interest loans, business resilience, and market context (Hiramatsu & Marshall, 2017; Watson, 2021). The degree of damage, access to financial resources, and quality of social and economic networks all influence how fast and well businesses can bounce back from the effects of disasters.

Public assistance programs promote business recovery by providing liquidity for business owners to reduce financial stress and restore business operation capability (Josephson & Marshall, 2016). Disasters can cause physical damage; businesses with physical damage need to purchase new equipment to restore operation (Sydnor et al., 2017). Even though in the case of COVID-19, some businesses still need to purchase new equipment to reduce contact for employee safety. Empirical studies suggest that public assistance programs play a significant role in helping businesses recover after disasters (Berger et al., 2021; Marshall & Schrank, 2020; Watson, 2021). However, the effectiveness of public assistance programs is influenced by the rationality attached to and format of these programs, which will be discussed in the following part of this chapter (Dahlhamer & Tierney, 1998; Xiao & Zandt, 2012a).

Business characteristics, such as sector and size, determine the extent of impact caused by disasters (Altay & Ramirez, 2010). Businesses' reliance on infrastructure varies in restoring functionality, depending on their sector. Businesses operating in sectors that rely on infrastructure not impacted by disasters will recover faster than others. Further, businesses with more employee size have more market experience and resources, which help them cope with the negative effects of crises. They also have stronger networks and savings, which let them restart their operations faster than smaller or newer businesses (Webb et al., 2002). For instance, according to Khan & Sayem (2013) retail and larger firms with over four employees have an edge in bouncing back from disasters. Further, businesses with a larger number of employees typically receive preferential treatment when applying for public assistance, as distributive agencies also take unemployment rates into consideration (Hartwell et al., 1996). Small businesses provide a large proportion of job opportunities, and an increase in unemployment can lead to other social problems (Ayyagari et al., 2011; Paul & Moser, 2009). Distribution agencies,

typically public organizations, are concerned with the unemployment rate due to its impact on broader social well-being and economic stability (Luechinger et al., 2012).

Market context can influence businesses' capability to maintain profitability after a disaster, which is essential for business recovery (Aghababaei et al., 2020). Disasters can lead to a short-term demand increase in certain sectors, such as the construction industry, but massive relocation following disasters and economic loss from survivors challenge business profitability (Corey & Deitch, 2011; Kousky, 2014; Sampson et al., 2018). Empirical studies suggest that businesses that can rapidly restore their customer base are more likely to survive and prosper after a disaster (Marshall & Schrank, 2014). Further, businesses with access to customers with higher consumption power are more likely to recover (Xiao et al., 2022). In this case, appropriate marketing and communication strategies adopted by business owners can help preserve customer groups and even bring in new customers during the recovery period (Morrish & Jones, 2020).

Socioeconomic factors often cluster geographically due to localized influences, resource disparities, and the spatial concentration of social and economic conditions. Clustered socioeconomic factors can influence the likelihood of local businesses accessing public assistance programs. According to Gu et., (2008) that small assistance programs often target businesses in certain areas with specific economic needs or development goals, which can influence the allocation of public resources. In the post-disaster context, individual business recovery and regional economic recovery are often associated (Rosenfeld, 1997). For example, businesses in related sectors often cluster together, forming a robust industrial chain. Allocating public assistance to these areas can more effectively promote recovery, benefiting not only small businesses but also the regional economy (Albors-Garrigos & Collado, 2019; Skokan et al., 2012).

2.2.2 Significance of Small Business Post-Disaster Recovery

Researching in small business post-disaster recovery have significant values for economic recovery and regional recovery by creating new job positions and facilizing community recovery through local networks (Saliola & Bernt, 2012; Torres et al., 2018).

Although small businesses—typically defined as those with fewer than 500 employees or less than $2 million in sales—are not economically comparable to large corporations, they remain a significant source of jobs in the United States (Spremo & Mićić, 2016). According to Bureau of Labor Statistics, (2024) that 55% of total net job creation are contributed by small business between 2013 to 2023. Compare with big firms, small business have advantages in flexibility, which allows them easier to adjust operation strategy and create more jobs (Saliola & Bernt, 2012). Increased job positions are key to post-disaster recovery because it let local residents maintain purchase power have capability to participants in economic transaction process, which can lead broader economic recovery (Greenbaum & Petras, 2009).

Secondly, differ than large business, small business can work as a social unit in local community instead of a simply economic unit (Xiao et al., 2018). In communities with a limited number of residents, small businesses often serve as gathering spaces, while business owners act as community anchors, fostering strong local networks. These connections play a crucial role in post-disaster recovery and enhancing community resilience. (Aldrich, 2012; Dua et al., 2020).

However, small business recovery faces challenges such as supply chain disruptions, labor shortages, and a reduced customer base. To overcome these obstacles and resume operations, small business owners must seek financial assistance (Morrish & Jones, 2020). Studies indicate that small business owners often face challenges in accessing assistance from traditional lenders due to their financial condition and the unpredictable market conditions in a post-disaster situation

(Graham, 2007). In such cases, public assistance programs become a critical source of support, enabling small business owners to resume operations and facilitate economic recovery.

2.3 Public Assistance Programs in Post-Disaster Recovery

Public assistance programs are critical for post-disaster recovery by minimizing disruptions, enhancing community resilience, and ensuring equitable recovery efforts (Davlasheridze & Miao, 2021; Domingue & Emrich, 2019a; Kamel & Loukaitou-Sideris, 2004; Olshansky & Johnson, 2014). These programs minimize disruptions after disasters by providing rapid and organized efforts (Olshansky & Johnson, 2014). According to Davlasheridze & Miao (2021) disaster aid programs in the form of low-interest loans and investments in infrastructure can significantly improve community resilience to future risks. Vulnerable groups, compared to wealthier groups, have limited choices for seeking help to promote recovery other than public assistance programs (Vickery, 2018). Distributing public assistance to needy groups promotes equitable recovery.

Inappropriate public assistance programs not only fail to promote recovery but also increase long-term financial risks for governments. For instance, increased grants from FEMA's Public Assistance programs can lower households' preference for purchasing flood insurance because it gives home owners a signal that government will cover the damage cause by disasters and increasing federal financial exposure to natural disasters and climate change (Garrett & Sobel, 2003).

2.3.1 Why We Need Restrictions?

Restrictions often attached to public assistance programs due to concerns about effectiveness (Gu et al., 2008; Xu & Mo, 2013). To ensure that public assistance programs help small businesses recover, recipients are expected to use the assistance for activities related to

business operations, which promote the recovery process. Moreover, free-riding is a major problem with public goods; businesses that do not need help can still access and benefit from unrestricted public assistance programs (Chrisman & McMullan, 1996; Reddy, 2000). Restrictions are necessary to ensure that assistance is not misused by recipients (Gu et al., 2008).

Restrictions attached to public assistance programs for small businesses come with eligibility criteria and performance-based criteria (Gu et al., 2008). Eligibility criteria determine whether a business is eligible to receive assistance based on size, type, and geographic location. For instance, some assistance programs require businesses to reopen at the same location before the disaster to receive funding (Graham, 2007). Performance-based criteria require businesses to meet certain standards to continue receiving assistance. For example, programs like the Paycheck Protection Program require businesses to spend a certain amount of received loans to continue qualifying for forgiveness (Barbieri, 2021).

The rationality of restrictions can influence business self-adaptation, which further impacts the effectiveness of public assistance programs (Chang et al., 2022; Graham, 2007). A decrease in demand after disasters requires businesses to adopt self-adaptation strategies to survive. However, restrictions that require businesses to maintain employee size can limit their ability to survive by laying off employees (Bartik, Cullen, et al., 2020).

Compared to restricted public assistance programs, unrestricted assistance lacks stringent requirements or qualifications on a verification process, allowing applicants to receive funds more quickly (Olshansky & Johnson, 2014). Early access to assistance enables businesses to resume operations sooner, which is vital for local recovery because business provides essential goods and service to local communities (Xiao et al., 2022). Furthermore, the reopening of businesses provides residents with a sense of normalcy and restoration, which is essential for the

broader community recovery process. This swift re-establishment of local businesses not only supports economic resilience but also fosters community morale and a quicker path to recovery (Watson, 2022).

2.3.2 Why There is Loan and Cash?

Public assistance programs for small businesses are typically available in loan-based and cash-based formats. Loan-based assistance is typically distributed as long-term, low-interest loans. The loan-based format plays a significant role in helping businesses recover by providing liquidity to small businesses and maintaining fiscal responsibility at the same time (Kelly et al., 1998). The purpose of the public assistance program is to support local economic recovery by giving financial liquidity to small businesses to resume their operations. Assistance based on loans can motivate recipients to maintain their business activities instead of just spending the money by demanding repayment. Empirical studies suggest that loan-based assistance programs can promote the creation and expansion of small businesses, which further promotes the recovery process (Bach, 2014; Gu et al., 2008). However, loan-based assistance programs face criticism for increasing the debt load of businesses, which can impede recovery, especially when businesses face a decreased demand market after disasters (Dahlhamer & Tierney, 1998; Sampson et al., 2018).

Compared with loan-based assistance, cash-based assistance with less restrictions is a more appropriate format for small businesses experiencing significant impacts from disasters (Chang et al., 2022). Small businesses that experience significant damage cannot have repayment capability compared with others. Cash-based assistance can immediately reduce financial stress and promote local economic recovery by allowing those business owners to start money to restore their businesses (Gallagher et al., 2020; Gazi, 2018).

Cash-based assistance programs are often criticized for the potential misuse and long-term insufficiency (Marshall & Schrank, 2020; Watson, 2021). The purpose of cash-based assistance is to provide flexibility for businesses with unique needs to restart and participate in local economic activities, promoting recovery. However, post-disaster business operations can be risky due to reduced demand, which may lead business owners to spend received funds on non-recovery-related expenses (Doocy et al., 2008). Compared with loan-based assistance, cash-based assistance requires oversight measures to ensure assistance is not misused. Otherwise, it can damage the recovery efforts (Watson, 2021).

Although cash grants provide immediate relief, it is expensive for governments and may not be sufficient for long-term recovery (Josephson & Marshall, 2014). Unlike loan-based assistance, cash-based assistance does not require repayment from recipients, making it costly for the government. The high cost associated with cash-based assistance means that each business owner receives only a limited amount of funding, which may be sufficient for restarting but not for sustaining long-term adjustments (Roel A. Serrano, 2022).

2.3.3 Significance of Public Assistance Program in Post-Disaster Recovery

In post disaster stage, only a portion of the population can access to public assistance programs because traditional targeting approach is not appropriate for distributing public assistance programs in the context of post-disaster recovery. The targeting approach, well adopted by public assistance programs in distribution, is a method that is designed to identify and provide support specifically to individuals or groups who are mostly in need (Bartik, Cullen, et al., 2020; Devereux, 2016). But applying such a method in post-disaster scenarios faces challenges in cost and efficiency (Fraser, 2004; Henman, 2004). The targeting approach itself is a

resource and time-consuming if distribution agencies want to reach the expected needy group, which conflicts with the urgency of the post-disaster scenario (Henman, 2004).

On the other hand, in a post-disaster scenario, an increasing number of individuals become the needy group, and implementation of the target approach can overwhelm the capability of distribution agencies (Jaspars & Shoham, 1999). Thus, to promote the recovery process at the post-disaster stage through redistributive policy, policy designers and implementing agencies need to be cautious in designing access policies and restrictions associated with assistance.

Broader assistance or universal assistance after disasters, opposite to targeting approach, distributed to affected business cannot lead an effective recovery as well (Yi & Tu, 2018). First, universal assistance to small businesses often associated with insufficient funds to meet the needs of impacted businesses, especially small ones lack of alternative funding potion, which can lead slower recovery process (Watson, 2022). Secondly, the universal distribution of assistance can exacerbate procedural inequities in public assistance programs, limiting vulnerable businesses' accessibility to public assistance programs and creating inefficiencies that leave gaps in recovery outcomes (Domingue & Emrich, 2019b).

Even portion of population can access to public assistance, still can lead broader economic recovery by economic multiplier effect and stabilizing key business (Gallagher et al., 2020; Haynes et al., 2018). First, when financial aid given to specific sectors, like construction or small businesses, generates a ripple effects. In the post disaster context, demand of reconstruction can experience increase, their initial spending can create jobs, boosts local spending, and stimulates related sectors, which can benefit the broader economic recovery (Andrew et al., 2022; Janvry et al., 2016; Sina et al., 2019).

Second, small businesses are not simply economic units but also play an important social roles in community function. The distributed assistance to businesses helps maintain local employment and supply chain making a community more cohesive (Gallagher et al., 2020; Xiao et al., 2018). Locally owned small businesses are often closely connected to their communities, frequently serving additional roles, such as providing spaces for community gatherings. These businesses are vital for fostering community cohesion, which becomes especially important in the post-disaster stage. The assistance contributes to the recovery process (Bonanno & Goetz, 2012; Townshend et al., 2015). For instance, Xiao et al., (2018) use business surveys conducted in New York 2012 after Hurricane Sandy to explore the recovery pattern of local small business. The result suggests that even local small business have dual characteristic, economic and community cohesion, in local community recovery.

Although public assistance programs may not reach all businesses affected by disasters, they can still play a positive role in recovery by generating economic multiplier effects and stabilizing key businesses within the local community.

2.4 Public Assistance Programs for Small Business During the COVID-19

2.4.1 Available Programs

The Paycheck Protection Program (PPP) and the Economic Injury Disaster Loan Program (EIDL) are two main programs that small businesses could apply for during the COVID-19 pandemic. The PPP, administered by the Small Business Administration (SBA), was the largest public assistance program for small businesses during COVID-19. The PPP aimed to help small business owners keep their businesses running and retain employees on the payroll. PPP loans could be used to pay for payroll costs, mortgage interest, rent, and utilities. Small business owners could apply for the PPP through local lenders such as banks, credit unions, and other

financial institutions. The PPP loan amount was typically based on 2.5 months of average payroll costs. The SBA also offered forgiveness if recipients used more than 60% of the funds for eligible payroll costs. The PPP started providing assistance on April 3, 2020, with a total of $650 billion. After two rounds of distribution, more than 5 million firms received support from the PPP until August 8, 2020.

The EIDL is another public assistance program run by the SBA. The EIDL aimed to provide either loans or advances for businesses that lost revenue due to COVID-19. The EIDL loan could be used to cover up to 6 months of essential expenses for maintaining operations. EIDL advances were direct funds that did not require repayment but were in smaller amounts. Small business owners could apply directly to the SBA for an EIDL loan or advance. The EIDL started providing assistance in March 2020. As of January 2022, the SBA stopped taking new applications for EIDL loans or advances. A total of 3.6 million firms were approved for EIDL loans with a total of $200 billion, and 5.8 million firms were approved for EIDL advances with a total of $20 billion.

The PPP has certain performance requirements for recipients to continue receiving forgiveness, unlike the EIDL. This study classifies the PPP as a restricted public assistance program and the EIDL as an unrestricted public assistance program. Specifically, the PPP loan is considered restricted loan-based assistance, PPP forgiveness is considered restricted cash assistance, the EIDL loan is considered unrestricted loan-based assistance, and the EIDL advance is considered unrestricted cash assistance. Table 2 summarizes the classification of assistance programs.

Table 2. Classification of Public Assistance Programs

	Restricted Assistance	Unredirected Assistance
Loan-Based Assistance	PPP loan	EIDL loan
Cash-Based Assistance	PPP forgiveness	EIDL advance

2.4.2 Research Statues

In the context of the COVID-19 pandemic, studies found that these assistance programs played a positive role in financial stability for small businesses, business continuity, and job preservation (Dore & Mach, 2022; Fairlie & Fossen, 2021; Katare et al., 2021; McCall et al., 2022; Sanchez-Moyano, 2022). Under the impact of social distancing restrictions, small businesses faced a decreased market from the demand side. Programs like PPP and EIDL provided critical financial support to small businesses to maintain financial stability (McCall et al., 2022; Sanchez-Moyano, 2022). This financial support was crucial for businesses with cash flow problems to avoid closure (Katare et al., 2021). Additionally, funds provided through restricted public assistance programs like PPP helped small business owners cover payroll costs, preventing mass unemployment in vulnerable sectors (Fairlie & Fossen, 2021; McCall et al., 2022).

The implementation of assistance programs faces criticism regarding inequitable distribution and short-term focus (Granja et al., 2020; Katare et al., 2021; M. Li, 2021; McCall et al., 2022). Similar to other public assistance programs after disasters, programs like PPP and EIDL face criticism that these assistance do not reach needy groups (Fairlie & Fossen, 2021; Ko et al., 2022). Implementing agencies tend to distribute funding to businesses that show better repayment capability because of accountability concerns instead of businesses that need the assistance most (M. Li, 2021; Watson, 2022). While PPP and EIDL provide necessary financial

liquidity for businesses, they cannot ensure long-term stability (Berger et al., 2021). PPP and EIDL were primarily temporary measures, and businesses still face a decreased demand market, which can impede the effectiveness of these programs (Granja et al., 2020).

CHAPTER 3

BUSINESS DISASTER RECOVERY FRAMEWORK

3.1 Introduction

In this chapter, the theoretical framework is developed by exploring the business disaster recovery framework proposed by Chang et al., (2022) and neoclassic economic theory. Both frameworks include factors that explain the business recovery outcome, but the modified farmwork is necessary to understand how public assistance programs help small businesses recover from disasters. The modified framework explored the impact of public assistance programs, business characteristics, market context, and geographic factors.

3.2 Businesses Recovery Framework

This Business Recovery Framework proposed by Chang et al. (2022) provides a comprehensive structure to consider how businesses recover from disruptive events like the COVID-19 pandemic. Figure 1 synthesizes the factors, moderators, and mechanisms influencing business recovery outcomes after disruptive events. Factors include business characteristics, such as size and sector, which affect vulnerability, and event attributes, like duration and spatial extent, which indicate severity. These impacts and recovery processes are moderated by business actions, such as obtaining insurance and government policies, including financial assistance and lockdowns, which can either hinder or help recovery. Mechanisms affecting recovery involve internal processes, like damage to physical capital and managerial decisions, as well as external factors, such as supply chain disruptions and changes in household consumption patterns. Together, these elements create nuanced and ongoing recovery outcomes for businesses (Chang et al., 2022).

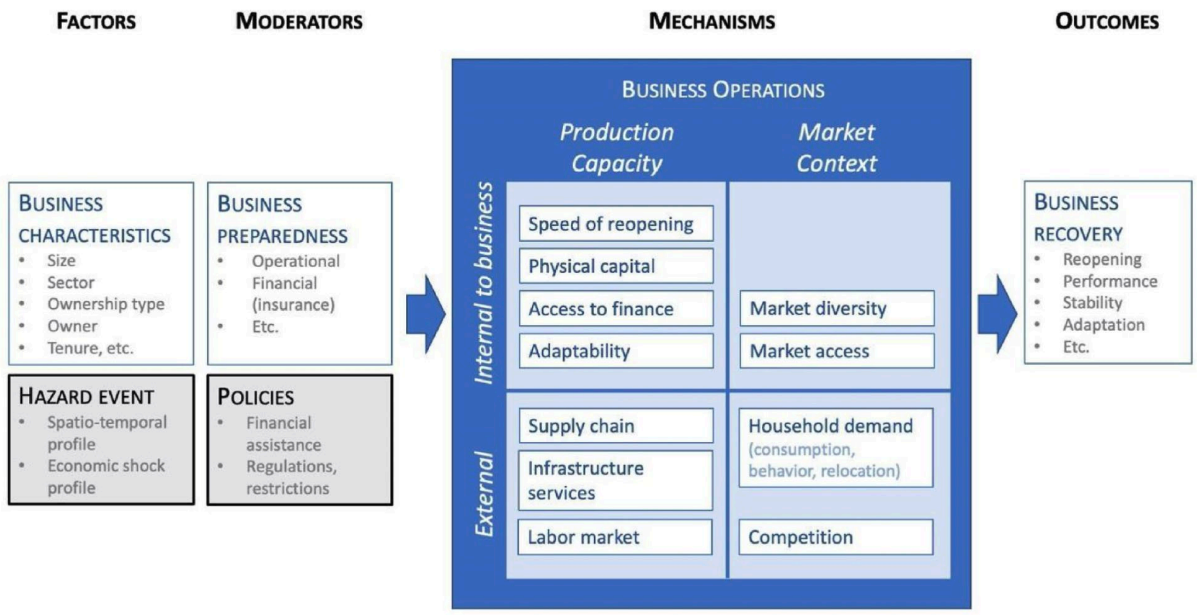


Figure 1. Business Recovery Framework (source: Chang et al. [2022])

Business characteristics can significantly influence a business's initial pathway of recovery. Businesses in certain sectors have a harder recovery than others (Altay & Ramirez, 2010). For instance, businesses that rely on infrastructure to maintain operations can lose their ability to function if a disaster damages that infrastructure (Ding, 2024). Further, business size and ownership (e.g: woman- or minority- owned business) often associate with limit profitability, which limit their access to finance assistance and final recovery outcome (Andrew et al., 2022; Chang et al., 2022).

Business actions do not always accelerate the business recovery process. A business owner's decision can significantly influence this process. For example, businesses that have preparedness measures, such as purchasing insurance, are more likely to survive after disasters (Han & Nigg, 2011). Further, successful adaptation strategies made by businesses owners can help business to restore profitability rapider than business without a rational adaptation strategies

(Y. G. Lee et al., 2017). On the other hand, irrational public assistance programs can impede businesses recovery by increasing business debt load and limit their adaptation behavior (Chang et al., 2022; Dahlhamer & Tierney, 1998; Xiao & Zandt, 2012b).

Market disruption can still impede the recovery process. Massive relocations following disasters not only impact business productivity due to labor shortages but also lead to decreased demand. Furthermore, after disasters, people's purchasing behavior tends to become conservative because of economic losses, potentially resulting in permanent changes in consumption patterns. This forces businesses to face a diminished market demand.

However, there are still weaknesses in the research framework proposed by Chang et al., (2020). Firstly, the research framework does not capture the dynamic features of the recovery process (Marshall & Schrank, 2014; Zobel, 2014). The recovery process is not a linear process, the economic environment may change in response to the impact of a disaster, a process that takes time to become apparent (Zobel, 2014). For instance, in the context of COVID-19, as the pandemic spread globally, the initial challenges evolved to include significant disruptions in the international supply chain (Ardekani et al., 2023).

Although the framework listed public assistance programs as a contributing factor, the discussion is insufficient considering the complexity of public assistance programs (Kapucu, 2008). To prevent the free rider problem, public assistance programs are normally associated with restrictions. As illustrated above, the rationality of the assistance restrictions significantly impacts whether it has a positive or negative effect. However, how to evaluate the rationality of funding restrictions is rarely discussed by authors in the framework. On the other hand, the framework also does not fully explain whether loan-based assistance increases the debt load of

businesses or supports businesses in maintaining operations at some level to recovery (Marshall & Schrank, 2014).

3.3 Neoclassic Economic Theory

Neoclassical economics explains business disaster recovery by focusing on market transactions and effective resource allocation (Okuyama & Rose, 2019). Scholars suggest that businesses can return to the pre-disaster growth path by reallocating employees and assets effectively (Okuyama & Rose, 2019; Radovic Markovic, 2024). Neoclassical economics argue that business closure is the effort of market forces. The concept of perfect competition, introduced by neoclassical economics, describes an ideal market structure in which resources are effectively allocated through interactions among numerous buyers and sellers, and the individual has a limited impact on the whole market (Clifton, 1977). This expected market framework has three strict assumptions. First, buyers and sellers have perfect knowledge. Second, there are no barriers to entry or exit the market. And lastly, homogeneous demands for products (Hunt & Morgan, 1995). Under this perfect competition mechanism, governments are unnecessary to be involved because the market can adjust itself.

Assumptions of neoclassical economics also lead to critiques. (Keen & Standish, 2006) argue that the perfect competition suggested by neoclassical economics cannot capture the real-world complexities. Further, asymmetric information significantly challenges the assumption of perfect information among buyers and sellers, which also leads to problems like adverse selection (Chiappori & Salanié, 2000). Besides, empirical studies suggest the diversity of consumer preferences, which is against the assumption of homogeneous demands (Allenby et al., 1998). Lastly, individuals' bounded rationality further challenges the neoclassical model that all agents are fully rational (Camerer, 1998).

3.4 Modified Research Framework

The limitations of both neoclassical economic and business recovery frameworks proposed by Chang et. al (2022) indicate that a modified framework is needed to explore business disaster recovery outcomes. The modified framework provides the factors that impact small businesses' recovery outcome, which include, business characteristics (Andrew et al., 2022; Han & Nigg, 2011; Marshall et al., 2015), the effectiveness of public assistance (Dahlhamer & Tierney, 1998), and market context (Asgary et al., 2012; Brown et al., 2015). Figure 2 summarizes the modified theoretical framework.

The modified business recovery framework is developed based on the Business Recovery Framework proposed by Chang et al. (2022). Although Chang et al. (2022) included public assistance programs as one of the moderators in the framework, the factors that impact the effectiveness of these programs are still unclear. The modified framework suggests that government actions and public assistance programs help businesses recover by providing funds to restore their functionality. However, the effectiveness of public assistance programs is influenced by the restrictions attached, the format of funding, and geographic locations. Business characteristics, such as size, ownership, and sector, influence recovery by determining a business’s ability to absorb shocks from disasters. Lastly, market context, such as the availability of a consumer group, can impact business profitability during the recovery process.

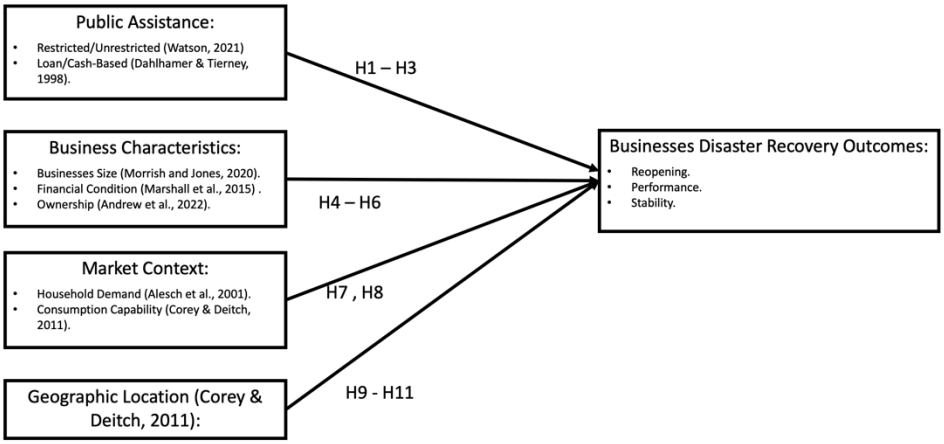


Figure 2. Modified Businesses Recovery Framework

3.4.1 Public Assistance Programs

Public assistance programs does not reimburse all the losses do citizens experienced, the principal of public assistance program is to meet basic need and help citizens get back through their effort, which decided the public assistance programs can not be universal (Kosar et al., 2005; Yi & Tu, 2018). Public assistance programs can play significant role in helping small business recovery after disasters in both short-term relief and long-term replacement through different strategy. From short-term recovery perceptive, public assistance programs helps small business recovery by overcome cash flow disruptions and improve adaptive capacity (Carton et al., 2006; Haynes et al., 2018; Josephson & Marshall, 2014). From long-term recovery perceptive, public assistance programs can help small business recovery by enhancing community resilience, promoting infrastructure development, and retaining employees (Graham, 2007; Olshansky & Johnson, 2014; Xiao et al., 2018).

Compared to large businesses, small businesses are more prone to cash flow issues due to limited financial management knowledge, lack of resources, and reliance on external credit (Cheatham et al., 1989; Isle & Freudenberg, 2015). Revenue losses caused by disasters can exacerbate the likelihood of cash flow problems (Davlasheridze & Geylani, 2017). Public assistance programs are effective in the immediate recovery stage by providing financial assistance to affected businesses and allows small bossiness to resume operations rapidly (Brooy, 2009). For instance, according to Maisel and Roman (2013) small bossiness in the state of Florida that lock of immediate funds after natural disasters often prevents businesses from reopening.

Disasters can alter market conditions through mass relocation and shifts in consumption patterns, which require small business adopt rapidly to survive (Jiang et al., 2016; M. Wagner et al., 2014). Increasing adaptive capacity often associated with extra investments, such as new equipment and new employees (Stafford et al., 2013). Public assistance programs can support this by providing crucial financial stability and allow businesses to develop robust adaptive strategies. For instance, the Economic Injury Disaster Loan (EIDL), administered by the SBA for businesses affected by disasters, provides assistance to business needing to adapt to changing market conditions for post-disaster profitability. Multiple studies show that this support has a significant effect on business continuity after disasters (Davlasheridze & Geylani, 2017; Fairlie & Fossen, 2021; Hiramatsu & Marshall, 2017; Watson, 2021).

Public assistance program can support business recovery by stabilizing the community's economic and social environment, which is critical for business' long-term recovery (Olshansky & Johnson, 2014). A stable economic and community environment can offer small businesses a consistent customer base and reliable consumption capacity, which allows small business to keep

a stable income (Victoria & Victoria, 2018). Other than assistance in the format of fundings, public assistance programs for community resilience available in the format of partnerships between university and state government as well. According to G. P. Smith and Nguyen (2021) Hurricane Matthew Disaster Recovery and Resilience Initiative (HMDRRI) is a disaster recovery program lead by North Carolina Division of Emergency Management and local universities to deliver research, teaching, and engagement actives related to disaster recovery to local communities. HMDRRI was able to offer technical support to rural communities and lead broader recovery in local areas.

Public assistance programs also assists in rebuilding community-wide infrastructure, which can lead broader economic recovery and indirectly benefits small businesses' recovery (Olshansky & Johnson, 2014). After disasters, the demand of reconstruction can experience dramatic increase because essential public service need to be restored (Andrew et al., 2022). The rebuilding process is often associated with government contract opportunities, which can aid small businesses in disaster recovery by providing a stable income (Atkinson & Sapat, 2013). Businesses in the construction sector have cross-sectoral links to over 31 economic sectors, including manufacturing and retail (Migliore, 2019). Assistance in construction sector can stimulate these areas by increasing demand for materials, equipment, and consumer products and lead broader recovery.

Public assistance program can effectively stabilizing business environment and local environment by providing assistance to small business owners to retain employees (Knight, 2020). Retaining employee size are directly associated to small businesses revenues recovery and continuity because employees helps business to keep productivity (Aghababaei et al., 2020; Runyan, 2006a). Revenue loss from disasters and the relocation options available to survivors

can make it difficult for small businesses to find the labor needed to continue operations (Zhang et al., 2019). Further retained employee also can feedback broader economic recovery by spending in local business (Watkins et al., 2015).

Table 3. Summarize the Mechanism of Public Assistance Programs in Business Recovery

Literature Source	Recovery Stage	Mechanism
Maisel and Roman (2013)	Short-term	Overcome cash flow disruptions
Stafford et al., (2013)		Improve adaptive capacity
Victoria & Victoria (2018)	Long-term	Enhancing community resilience
Atkinson & Sapat (2013)		Promoting infrastructure development
Knight (2020)		Retaining employees

Table 3 summarizes the mechanisms the extent to which public assistance programs can promote small business recovery after disasters from both short-term and long-term perspectives.

Restrictions associated with public assistance are critical for post-disaster recovery, addressing two key concerns: social equity and economic stability. In a post-disaster context, resources available can be limited, restrictions attached to public assistance programs are necessary because unrestricted aid often leads to inefficient resource relocation and exacerbate social inequalities (Domingue & Emrich, 2019b; Sovacool et al., 2018). Unrestricted assistance may benefit business owners who do not need aid but have the social status to apply, making it

easier for them to secure assistance (Domínguez-Navarro et al., 2019). In contrast, business owners in lower social status may fall into a poverty trap after disasters because they does not obtain sufficient assistance to restart. Restrictions on public assistance programs help ensure that aid reaches those most in need thought setting application criteria (Kunreuther, 1968; Olshansky & Johnson, 2014).

Further, attaching restrictions to public assistance programs also plays significant role in stabling economic after disasters by distributing resources to business in certain sectors (Graham, 2007; Watson, 2022). Distributing restricted assistance to businesses in sectors with high cross-sector linkages supports economic stability by retaining employment rates and promoting recovery across related sectors. After disasters, immediate revenue losses may lead business owners to cut operational costs by laying off employees, and decreased income can prevent these individuals from participating in economic activities until they find new sources of income. By setting restrictions on assistance programs to ensure businesses retain their employees, these programs help sustain local economic activity, which is critical for economic recovery (Haynes et al., 2011). Second, allocating resources to bossiness in sectors with high cross-sector linkages can stimulate demand from related sectors, which indirectly benefit other local bossiness and lead broader economic recovery (Janvry et al., 2016).

Unrestricted public assistance programs also critical for post-disaster recovery because it allows more rapid resource allocation, which can promote comprehensive community recovery (Olshansky & Johnson, 2014). Compare with restricted public assistance program, unrestricted assistance does not have strict eligibility criteria, which allows it can be distributed to applicants more rapidly. In post disaster context, rapid distributed assistance allows business resume their

operation earlier, which can prevent further revenue loss, closures and potential permanent closure, maintaining local economic stability (Watson, 2022).

Additionally, the local community recovery process benefits from the reopening of small businesses, which are essential for providing goods and services. Rapid support through unrestricted assistance programs not only helps businesses reopen but also allows residents to quickly regain access to these vital goods and services (Xiao et al., 2022). Further, reopening of local business can signal a return to normalcy, which is critical for local residents to restore a feeling of stability and reliance and promote comprehensive community recovery (Watson, 2022).

In addition, rationality of restrictions attached to public assistance programs can have a positive or negative effect on business recovery because restrictions can limit business owners self-adjustment behavior (Graham, 2007; Xiao & Zandt, 2012b). For instance, businesses may need to relocate to survive due to disruptions in their original community and market. However, some assistance programs impose location-based restrictions, limiting businesses' ability to relocate and reducing their chances of survival (Graham, 2007; Xiao & Zandt, 2012b). Additionally, business profitability can be challenged by decreased demand after disasters, as individuals affected by disasters tend to reduce consumption due to economic uncertainties. In this context, restrictions requiring businesses to maintain employee levels may increase financial risk for those businesses (M. A. U. Khan & Sayem, 2013). Based on the counter arguments illustrated above, this study proposes the following hypothesis:

Hypothesis 1: Small businesses accessing to restricted public assistance are more likely to recover compared to businesses without public assistance.

Hypothesis 2: Small businesses accessing to unrestricted public assistance are more likely to recover compared to businesses without public assistance.

Hypothesis 3: Small businesses accessing to mixed public assistance are more likely to recover compared to businesses without public assistance.

3.4.2 Business Characteristics

Business characteristics (e.g., employee size, financial condition, and ownership) interacted with hazard events and decided the initial pathway of the subsequent recovery process (Chang et al., 2022). Businesses with larger employee sizes can support businesses with more available resources that can be used to initiate the recovery process (M. A. U. Khan & Sayem, 2013; Marshall et al., 2015). Businesses with larger employee sizes means businesses have sufficient labor resources to meet emerging market demands (Morrish & Jones, 2020). This includes more effectively reallocating resources or to replace damaged infrastructure and supply chains. For example, the study of business recovery in Bangladesh reveals that larger employee size allows these businesses to implement recovery strategies more rapidly than smaller firms (M. A. U. Khan & Sayem, 2013).

Businesses with higher sales volume, which suggests better financial conditions, can support businesses' recovery after a disaster in two ways (Marshall et al., 2015). First, businesses with better financial conditions are capable of adopting measures to prepare for disasters, such as insurance, which significantly relates to business recovery (Chang et al., 2022; Han & Nigg, 2011). Secondly, even though disasters can lead to loss of customers, businesses with higher sales volumes normally have a reserved cash flow in hand, which can promote some level of operation during and after the disaster (Marshall & Schrank, 2014).

Further, businesses owned by minorities are reported to be harder to recover after disasters because they have limitations in accessing financial assistance compared with other businesses (Andrew et al., 2022). Minority-owned businesses normally have small business sizes, which are deemed indicators of business repayment capability (Atkins et al., 2022; Dua et al., 2020; Page et al., 1979). Assistance distribution agencies have accountability concerns, which cause them to allocate resources to businesses that have better repayment capabilities (M. Li, 2021; Watson, 2022).

On the other hand, Morrish and Jones (2020) suggest that the success of business recovery may be less about business characteristics and more about capacity for adaptation. Further scholars argue that businesses with larger employee sizes mean relatively high operational costs, which make businesses vulnerable when facing a disruptive market after disasters (S. M. Wagner et al., 2017). Furthermore, minority-owned businesses have shown more resilience than others in industries such as arts and cultural entrepreneurship because they can provide locally formed cultural production (Wang et al., 2021; Wang & Richardson, 2021). These competing arguments regarding business characteristics lead to the following hypothesis:

Hypothesis 4: Small businesses with larger number of employees are likely to recover after disasters.

Hypothesis 5: Small businesses with higher sales volume are likely to recover after disasters.

Hypothesis 6: Minority-owned small businesses are likely to recover compared with non-minority-owned businesses after disasters.

3.4.3 Market Context

Businesses face a disruptive market that is more difficult to recover, which involves changes in customer population and consumption capability (Alesch et al., 2001; Corey & Deitch, 2011). These two factors describe a business's potential profitability from the demand side.

Businesses in certain industries are likely to face a demand decrease caused by a decrease in customer population (Corey & Deitch, 2011; Runyan, 2006b). Large-scale population relocation and disruption of the local community network, normally followed by disasters, can significantly lead to customer decreases for businesses (Corey & Deitch, 2011; Wang et al., 2021). This reduction in customer base not only impacts immediate revenue sources but also affects businesses' market position, which leads to business closure.

On the other hand, disasters can change consumption behavior because customers also face the challenge of decreasing income and other concerns (Chang et al., 2022). For example, in the case of COVID-19, the unemployment caused by the pandemic can lead to consumption behaviors that tend to be conservative, and concerns about exposure to the virus positively contribute to consumption decreasing (Felix & Shampine, 2021). Based on the counter arguments illustrated above, this study proposes the following hypothesis:

Hypothesis 7: Small Businesses with access to larger consumer base are likely to recover after disasters.

Hypothesis 8: Small businesses with access to higher consumption capability groups are likely to recover after disasters.

3.4.4 Geographic Location

Further, geographic location can influence the effectiveness of public assistance programs in helping small businesses recovery but the mechanism is still unclear (Crass et al., 2016; McCann & Folta, 2011). Studies geographic clustering can significantly increase the likelihood of businesses receiving public assistance because of the localized advantages, for instance, a well-developed industrial chain and scale of the labor market (Andersson & Larsson, 2016; Porter, 1998). These clusters create an environment that attracts and justifies the allocation of public resources. Areas with more public resources allocated suggest businesses in this area with more financial support to resort function and anticipate a relatively rapid recovery process (Jia-shan, 2009).

Restricted assistance focused on job retention plays a significant role in promoting regional economic recovery by stabilizing local demand and supporting broader recovery through sustained workforce participation (Bosworth & Gray, 2012; Felsenstein, 1992). Areas with established economic structure plays significant role in providing job opportunities to local communities. More restricted assistance to areas with established economic structure can prevent mass job losses. Stabled local job retention rate positive contributed to ensuring local demands, which also can furtherly feedback to business recovery in these regions (Bosworth & Gray, 2012).

Additionally, allocating restricted assistance focus on sector stability to businesses in sectors with high cross-sector linkages can more effectively drive broader economic recovery in a region (H. Li et al., 2022). Businesses in related sectors tend to cluster geographically to reduce transportation costs and improve access to shared resources (Joyal et al., 2000). By directing

resources to central industries in a region, the economic benefits can diffuse more broadly, leading to a more efficient recovery (Guillon & Mathonnat, 2020).

However, areas with more public resources allocated can also suggest those areas experience more damage during disasters because equity is a major concern when allocating public resources after disasters (Domingue & Emrich, 2019). Areas that experience more damage need more resources to recover. Compared with the private sector, public resources are required to be allocated to needy groups to ensure social equality (Peterson, 1981). At the same time, those areas are often associated with a longer recovery process, which can hinder the effectiveness of public assistance programs (Marshall & Schrank, 2014).

Further, business located in economic hub aeras not always associated with recovery because of operation cost and economic structure (Gray et al., 1996; Monga, 2020). Economic hubs, which rely on dense business clustering (or agglomeration), often face unique recovery challenges. High business density means a greater concentration of affected entities, creating bottlenecks that reduce individual adaptability and resilience (Monga, 2020). In contrast, businesses in rural areas tend to be less reliant on economic hubs and serve a relatively stable customer base, which supports consistent profitability. In these cases, even a small amount of assistance can lead to an effective recovery process, as rural businesses are often more resilient and can quickly bounce back with targeted support if there is not a significant change from demand side (Ring et al., 2010; Young, 2010).

Flexibility associated with unrestricted public assistance program plays significant role in promoting regions' recovery by letting business address their own specific needs and lead broader recovery (Griego et al., 2020). Disasters do not impact all sectors equally, and a region's business demands can vary significantly afterward (Gallagher et al., 2022; Haynes et al., 2011).

For example, the retail sector may need to maintain cash flow, the utility sector may require new equipment, and the construction sector might need to adopt new operational strategies. However, restricted public assistance programs may not fully capture the diverse needs of affected businesses or design appropriate conditions for each of them, which requires unrestricted public assistance to help business with specific needs to recovery. By providing flexibility to businesses in a region, unrestricted public assistance allows bossiness to address their own critical challenges and foster recovery in the whole region (Chang et al., 2022). For instance, after the 2024 tsunami, unrestricted cash assistance, distributed by Sri Lanka government, allowed recipient businesses greater spending flexibility, leading to faster recovery in the retail sector (Mel et al., 2010).

Further, businesses with a flexible fund assistance are able to have a stronger purchasing power, which helps local region to establish a self-reinforcing cycle of local purchasing and economic stability (Bolin & Stanford, 1998). Business recovery needs can vary widely after disasters, generating diverse demands from a market perspective. This diversity enables businesses across different sectors to maintain profitability, as demand for various goods and services stimulates economic activity. By helping businesses regain their purchasing power, these demands indirectly benefit the entire regional business ecosystem, fostering a more resilient and interconnected local economy (Roenigk, 1993).

Based on the counter arguments illustrated above, this study proposes the following hypothesis:

Hypothesis 9: Areas with a higher percentage of businesses receiving restricted assistance are positively associated with a higher percentage of recovery.

Hypothesis 10: Areas with a higher percentage of businesses receiving unrestricted assistance positively associated with a higher percentage of recovery.

Hypothesis 11: Areas with a higher percentage of businesses receiving mixed assistance are positively associated with a higher percentage of recovery.

Table 4. Summary of Hypotheses

	Research Hypotheses
H1	Small businesses accessing to restricted public assistance are more likely to recover compared to businesses without public assistance.
H2	Small businesses accessing to unrestricted public assistance are more likely to recover compared to businesses without public assistance.
H3	Small businesses accessing to mixed public assistance are more likely to recover compared to businesses without public assistance.
H4	Small businesses with larger number of employees are likely to recover after disasters.
H5	Small businesses with higher sales volume are likely to recover after disasters.
H6	Minority-owned small businesses are likely to recover compared with non-minority-owned businesses after disasters.
H7	Small Businesses with access to larger consumer base are likely to recover after disasters.
H8	Small businesses with access to higher consumption capability groups are likely to recover after disasters.
H9	Areas with a higher percentage of businesses receiving restricted assistance are positively associated with a higher percentage of recovery.
H10	Areas with a higher percentage of businesses receiving unrestricted assistance positively associated with a higher percentage of recovery.
H11	Areas with a higher percentage of businesses receiving mixed assistance are positively associated with a higher percentage of recovery.

In the next chapter, the research site, measurement, data source, and analysis methods are discussed. This study employs data from the Mergent Intellect, US Census Bureau, and SBA to answer the overall research question. The data from these three sources are merged based on their businesses name and geographic locations. The logistical regression, Cox regression with time varying effect, and spatial autocorrelation are performed to analysis the data.

CHAPTER 4

METHODOLOGY

4.1 Introduction

This dissertation tests the theoretical framework and hypotheses in the Dallas Fort Worth Metropolitan Area during the COVID-19 pandemic. The DFW metropolitan area is an appropriate research site because the diverse economic structure can provide a sufficient sample size from different sectors and recovery outcomes achieved.

This study's framework proposes that business recovery outcomes are shaped by access to public assistance programs, business characteristics, market context, and geographic location. Since business owners can apply for multiple types of assistance, seven binary variables were used to track access, grouped to show whether a business utilized one, two, or all available forms of support. Business recovery was measured by two variables: whether the business remained active until January 2023, and the duration it continued operating before becoming inactive.

Business characteristics were assessed using four variables: minority ownership, sales volume, employee size, and business sector (based on the first two digits of the 2017 NAICS code). For market context, three factors were considered: minority population, median household income, and the number of housing units within a 5-kilometer service range.

Lastly, seven variables were used to capture geographic context, reflecting the percentage of businesses accessing different combinations of public assistance and the business activity rate at the census tract level.

This dissertation relies on data mainly from three sources: Small Business Administration (SBA), Mergent Intellect, and Census Bureau. SBA provides a list of assistance recipients from different programs on its official website, which includes the recipient's names, addresses, and

the amounts of assistance received. This dissertation obtains business records from Mergent Intellect for the DFW metropolitan area, which include business name, address, employee size, ownership, and sectors. These two datasets are matched based on company names and addresses. Finally, this study uses a 5-kilometer service range distance to conduct the spatial analysis to estimate the potential customer population and purchasing power for each business based on demographic data from the American Community Survey (2021) by the US Census Bureau.

This dissertation uses three analytical methods to investigate different aspects of business recovery during the COVID-19 pandemic: (1) logistic regression, (2) Cox regression with a time-varying effect, and (3) spatial autocorrelation. The three methods answer three dimensions of the main research question. The logistic regression examines whether public assistance programs prevent small businesses from closing during the pandemic period. The Cox regression with a time-varying effect further analyzes the influence of public assistance programs on different stages of the pandemic. Lastly, the spatial autocorrelation evaluates the effectiveness of public assistance programs from a geographic viewpoint.

4.2 The Research Site: Dallas Fort-Worth Metropolitan Area and the COVID-19 pandemic

This study chooses the Dallas-Fort Worth (DFW) Metropolitan Area as the research site because even though the DFW area suffered a significant loss of jobs and economic decrease, DFW demonstrated a profound resilience among Metropolitan Areas in the United States (Maddox, 2022).

Before the COVID-19 pandemic, the DFW metropolitan area experience a strong economic growth, a diverse and expanding workforce, and population growth. The DFW metroplex was home to 24 Fortune 500 company headquarters, ranking it third in the nation behind New York and Chicago (Kotkin & Clark, 2021). Between 2012 and 2022, employment in

the DFW region increase by 29 percentage, which over the average number in Texas(23.5 percent) and the U.S. (13.9 percent) (Texas Comptroller of Public Accounts, 2024).

During the COVID-19 pandemic, the DFW metropolitan area experienced significant economic loss, which included $23 billion in real gross product loss and over $15 billion in lost personal income (Bill Hethcock, 2020). All sectors were affected, including the airlines, automobiles, energy equipment, and service industries, which had particularly significant impacts(Luka Vidovic, 2022). Decreased demand, supply chain disruption, and market uncertainties challenge businesses' capability to maintain operations.

However, DFW shows resilience because of its diverse economic structure and well-developed infrastructures. First of all, the DFW Metropolitan Area has the second most diverse economic structure among Metropolitan Area s in the United States (Moody's Analytics, 2019). Regions' diverse economic structure can significantly contribute to regional economic recovery (Xiao & Drucker, 2013). In the meantime, the diversity in economic structure allows us to capture recovery patterns for businesses from different industries under the context of the pandemic.

Further, increasing investment in infrastructure in DFW Metropolitan Area promotes businesses' recovery after disasters (Maddox, 2022). Well-developed infrastructure provides basic services for businesses to maintain normal operations (Ding, 2024). For instance, interruption of water supply has a significant impact on businesses in the agriculture sector.

After the pandemic, the pandemic, the DFW region demonstrated a rapid recovery. In 2022, the Gross Domestic Product (GDP) of the DFW metropolitan area reached $688.9 billion, with a real GDP growth of 5.7 percent—well above the national average of 2.1 percent for the same period (Bureau of Economic Analysis, 2023). Further, the DFW region continued to

experience strong population growth, with an increase of 152,600 residents from July 2022 to July 2023.

On the other hand, the DFW Metropolitan Area is the first metropolitan area that returns job levels to pre-pandemic levels (Maddox, 2022). In addition, according to Glenn Hegar (2022) federal stimulus funds distributed to Texas, they have a positive impact on mitigating revenue losses and maintaining economic stability. This provides an excellent opportunity to study the factors contributing to this remarkable recovery.

4.3 Measurements

4.3.1 Dependent Variable: Business Recovery

This study uses the method utilized by Watson, (2021) to determine whether a business is considered active or inactive as an indicator of a business's recovery outcome. Whether businesses still maintain operations is an indicator that is well-adopted by scholars in the business recovery field to measure business recovery outcomes (Aghababaei et al., 2020; Headd, 2003; Stevenson et al., 2018). The inactiveness of businesses can caused by both positive and negative reasons, such as strategic adjustment or lock of profitability (Bates, 2005). However, the inactiveness of businesses indicates business owners' lost confidence in future profitability during the recovery process (H. Khan & Upadhayaya, 2019).

The information about whether businesses are active or not is sourced from Mergent Intellect. Mergent Intellect provides a fully searchable database with detailed information on over 280 million businesses, including both active and inactive firms. The database induced a wide range of information, which includes company profiles, financials, industry profiles, and other details (Winn & Goodrich, 2018). The database is well adopted by scholars in business administration fields (Chandrasekhar et al., 2022; Federico & Banks, 2020).

Mergent Intellect determines whether a business is inactive by detecting the presence or absence of trading activities (Leaming, 2016). If a business is identified as inactive by Mergent Intellect, it is deemed as no longer trading or operating. If a business is considered active by Mergent Intellect until January 2023, deems the business as recovered; otherwise, it is considered not recovered. This study also collected how many months the business sustained operations from Dec 2019 for cox regression analysis.

4.3.2 Independent Variable: Access to Public Assistance Program

During COVID-19, small business owners had the option to apply for both the PPP and EIDL programs, enabling simultaneous access to both types of assistance. This study uses three binary variables to capture small business participation in these programs: businesses accessing only restricted assistance programs (PPP loans and PPP forgiveness), businesses accessing only unrestricted assistance programs (EIDL loans and EIDL advances), and businesses accessing both restricted and unrestricted assistance (PPP and EIDL) simultaneously.

Overall, there were about 12,150 businesses only receiving assistance from the PPP program, comprising 1.68% of the total number of businesses. Additionally, 6,548 businesses only received from EIDL programs, accounting for 0.91%; and 1,188 businesses received assistance from PPP and EIDL simultaneously, making up 0.16%.

Table 5. Binary Variables Capture Small Business Participation in Public Assistance Programs

Variables	Descriptions
Restricted Assistance Only	Business only access to restricted assistance (PPP loan or PPP forgiveness).
Unrestricted Assistance Only	Business only access to unrestricted assistance (EIDL loan and EIDL Advance).
Mixed Assistance Received	Business access to restricted and unrestricted assistance (PPP and EIDL).

4.3.3 Independent Variable: Business Characteristics

The variables used to capture business characteristics include employee size, sales volume, ownership, and sectors.

Employee size is a fundamental indicator for businesses to measure their scale and capability of operation (O'Boyle et al., 2016). This indicator is well adopted by scholars in the business recovery field to measure business size (Aghababaei et al., 2020; J. Lee, 2019). Businesses' employee size is captured by the actual number of employees that are sourced from Mergent Intellect.

This study uses the method adopted by Morrish & Jones (2020) to use actual average annual sales volume in the past year as an indicator to measure businesses' financial condition. Sales volume serves as a direct indicator to measure business performance in gaining interest from scholars (Aghababaei et al., 2020; Heileman et al., 2016). This study uses the natural log of businesses' sales volume to represent the financial condition.

This study also controls for whether a business is owned by minority groups by a binary variable because empirical studies suggest that minority-owned businesses show different accessibility to public assistance programs and recovery patterns compared with non-minority-owned businesses (Andrew et al., 2022). There are 0.46% of businesses are considered minority-owned businesses by Mergent Intellect. Further the business sector are controlled based on the first two digits of the 2017 NACIS code.

4.3.4 Independent Variables: Market Context

This study uses 5 5-kilometer service range distance to perform the spatial analysis to determine the possible customer population and purchasing power for each business. The 5 kilometers, service range distance, is frequently adopted by studies in service range because

empirical studies suggest that individuals prefer to use services within the 5-kilometer distance of their homes (Hillsman & Hypothesis oda, 1978; Wardrop et al., 2018).

This study uses the number of housing units and total minority population and housing units within a 5 km service area as indicators of the potential customer population and demands. To capture whether minority-owned businesses gain support from minority populations suggested by Wang et al., (2021) or not, this study uses the total minority population as an indicator instead of the total population. Further, empirical studies have also frequently adopted the number of housing units to capture customer demand (Fahrioglu & Alvarado, 2001).

This study employes a similar approach adopted by Oka (2022), i.e., the average median household income within the 5km service range at the US Census tract level, to capture the purchasing power of the potential population.

4.4 Data Collection

4.4.1 Public Assistance Programs: Small Business Administration

The United States Small Business Administration (SBA) is an independent government agency dedicated to supporting entrepreneurs and small businesses. Its mission is “to maintain and strengthen the nation’s economy by enabling the establishment and viability of small businesses and assisting in the economic recovery of communities after disasters. During the COVID-19 pandemic, public assistance programs provided by federal government are administrated by SBA. Applicants need to process application through SBA to access to federal assistance. SBA publishes and manages PPP and EIDL recipient databases separately. The database is public on the SBA website, and it has data on the recipient’s name, address, state, city, zip, amount of assistance received, and received date.

4.4.2 Business Characteristics: Mergent Intellect

Mergent Intellect is a web-based business research tool that provides a fully searchable database of worldwide business information and has been well-adopted by scholars in the area of business administration (Sen, 2022; Winn & Goodrich, 2018). In 2012, Mergent partnered with Dun & Bradstreet (D&B) and soon released an expanded online version of D&B's Million Dollar Directory (MDDI). This resource was later integrated with other datasets to launch Mergent Intellect in 2014. Designed as a comprehensive resource for business data and market research, Mergent Intellect combines datasets and products from D&B/Hoovers with new, complementary modules. While Hoovers' company profiles, along with First Research and Key Business Ratios (KBR), have been long-established, Mergent enhanced the platform with integrated directory, demographic, consumer, and job modules. This expansion allowed it to compete with major players like InfoGroup, DatabaseUSA, and Gale. The result is Mergent Intellect—a robust, global database offering extensive business-to-business (B2B) and business-to-consumer (B2C) data.

The database includes information on over 100 million private businesses in the US, Canda, and globally, and over 6,000 public companies in the US. This study obtains a whole list of business records of DFW MSA along with their basic characteristic information from Mergent Intellect, which include business name, sales volume, employee size, addresses, state, city, and zip code.

4.4.3 Market Context: Census Bureau

This study utilized census tract-level demographic data from the American Community Survey (ACS) 5-Year Data (2022) provided by the U.S. Census Bureau. As part of the U.S. Department of Commerce, the Census Bureau is the federal government's primary source of data

on the nation’s population and economy. The ACS is an annual demographic survey conducted by the Census Bureau, covering a wide range of information, including ancestry, U.S. citizenship status, educational attainment, income, language proficiency, migration, disability, employment, and housing characteristics. The ACS 5-year estimates represent averages for a geographic area, derived from data collected over a five-year period. While they are the most reliable and precise estimates available from the ACS, they are also the least up-to-date.

To capture the market context for each business, which includes various demographic factors such as population density, income levels, age distribution, educational attainment, and employment statistics. This study incorporates three variables into this study, which are the total minority population, total number of housing units, and median housed income.

4.4.4 Data Preparation Process

Figure 2 summarizes the data preparation process for this study. This study performs three steps to obtain the final dataset. First, this study obtains all the business records within the DFW Metropolitan Area and filters out businesses that do not meet the Small Business Administration's criteria for small businesses based on the first two dights of the 2017 North American Industry Classification System (NACIS) code. Furthermore, this study identifies whether a small business received loan-based and cash-based assistance from the PPP and EIDL by identifying common business addresses and names from the SBA recipient list. This is achieved by matching addresses and business names with the recipient list from the SBA. Lastly, this study performs spatial analysis for each business to identify the total number of minority populations, average median household income, and total number of housing units within a 5-kilometer service range at the census tract level.

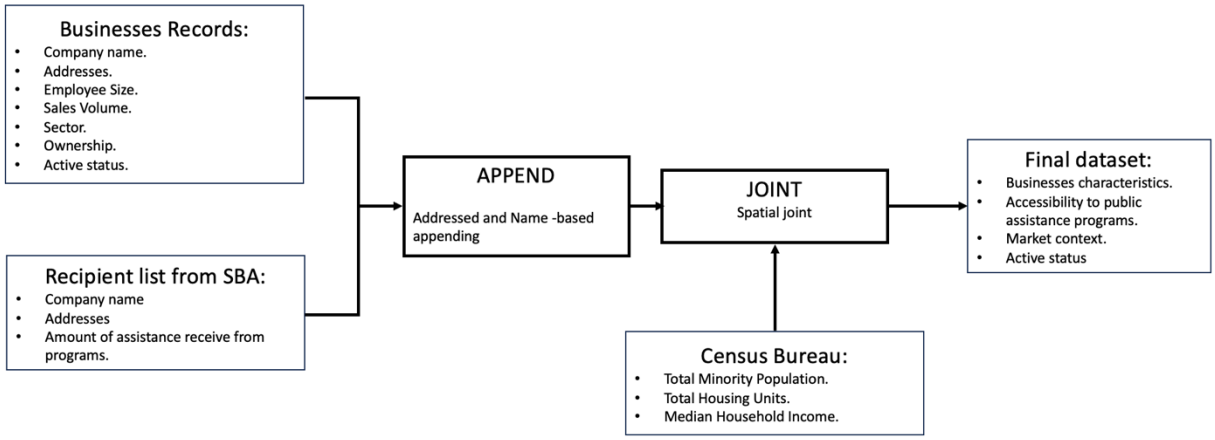


Figure 3. Data Preparation Process

4.5 Methods of Analysis

4.5.1 Logistical Regression

To answer the overall research question, to what extent do public assistance programs mitigate the likelihood of business closure after disasters, this study employs the logistical regression as the analysis approach. The logistic regression is used because the dependent variable in this study is binary, with proportions of 46.70% of businesses remaining active and 53.3% of businesses being detected as inactive. This distribution fits the assumptions of logistic regression.

The logistic regression model can be expressed as follows:

$$logit(P) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n \quad (1.)$$

where:

P is the probability of successful disaster business recovery;

$logit(P)$ is the natural logarithm of the odds of successful disaster business recovery;

β_0 is the intercept term;

β_1, β_2, ..., β_2 are the regression coefficients for the independent variables;

X_1, X_2, ..., X_n are the independent variables that influence disaster business recovery.

4.5.2 Cox Regression with Time-Varying Effect

Logistic regression has two key limitations in studies of disaster recovery: it cannot track survival time and it fails to account for environmental changes within the chosen study timeframe. Unlike Cox regression, logistic regression does not consider how long businesses sustain operations, an important indicator for evaluating the effectiveness of public assistance programs in preventing closures. Additionally, disaster recovery is a dynamic process influenced by environmental changes, which logistic regression is unable to capture.

To further investigate the efforts of public assistance programs in mitigating the likelihood of disaster-induced business closure in different stages of the COVID-10 pandemic, this study employs cox regression with a time-varying effect proposed Crowley and Hu (1977) to analyze the data. Compared with standard cox regression, cox regression with a time-varying effect has a distinctive advantage in that it can capture the changing challenges faced by businesses at different stages of recovery.

In the case of the COVID-19 pandemic, businesses encountered different challenges at various stages; for instance, at the beginning, businesses may face the issue of decreasing demand (Bartik, Cullen, et al., 2020); at the middle stage, businesses may face challenges of shortages in the international supply chain (Ardekani et al., 2023); at the later stage, business may face challenges of policy uncertainty (Trump & Linkov, 2020). At different stages, the efforts of public assistance programs in helping businesses recover may be different. Cox regression with a time-varying effect can help us to capture this. The entire time frame of this

study has been divided into three stages, which are Stage 1 from January 2020 to November 2020; Stage 2 from December 2020 to January 2022; and Stage 3 from February 2022 onwards.

The equation of Cox regression with a time-varying effect can be represented as follows:

$$h\big(t \mid X(t)\big) = h_0(t)\exp\left(\beta_1(X_1(t)\cdot g(t)) + \cdots + \beta_n(X_n(t)\cdot g(t)) + \gamma_1\big(X_1(t)\cdot g(t)\big) + \cdots + \gamma_n\big(X_n(t)\cdot g(t)\big) + \mu_1\big(X_1(t)\cdot g(t)\big) + \cdots + \mu_n(X_n(t)\cdot g(t))\right) \quad (2.)$$

and

$$g(t) = 0, if\ t\ is\ not\ within\ chosen\ time\ frame; \\ = 1, if\ t\ is\ within\ the\ chose\ time\ frame. \quad (3.)$$

Where:

$h\big(t \mid X(t)\big)$ is the hazard function at time t given time-dependent covariates $X(t)$;

$h0(t)$ is the baseline hazard function, representing the hazard for an individual with the baseline level of covariates.

$X_1(t),\ X_2(t),\ \ldots, X_p(t)$are the time-dependent covariates;

$\beta_1, \ldots, \gamma_1, \ldots, \mu_1, \ldots$ are the coefficients for the time-dependent covariates at each stage, representing the log hazard ratio;

$g(t)$ is a function of time.

4.5.3 Spatial Autocorrelation

According to the framework proposed in this study (Fig. 2), geographic location plays a significant role in business recovery. However, neither logistic regression nor Cox regression with time-varying effects can fully capture the impact of geographic variations. Socioeconomic structures are often geographically clustered, and surrounding areas are influenced by spillover effects, which shape business operations and profitability. For example, businesses in urban centers

may have better access to resources and infrastructure compared to those in rural areas. When businesses in these areas receive public assistance to restore purchasing power and re-engage in economic activities, the resulting spillover effects can benefit surrounding businesses—an effect that cannot be fully captured by logistic or Cox regression. Additionally, geographic variations influence key factors such as customer bases, supply chains, and labor availability, all of which are critical to post-disaster recovery. Given these complexities, spatial analysis is essential to better understand and quantify the impact of geographic factors on business recovery.

This study uses spatial autocorrelation at the census tract level to analyze the data and explore whether areas with higher public resource allocated is positive related to business recovery in all the DFW region. Spatial autocorrelation is employed because socioeconomic environmental factors may cluster at the spatial level. For example, businesses in the downtown area of Dallas typically incur relatively higher operational costs compared to surrounding areas, which can influence the business recovery process.

The equation of Moran's I, commonly used for spatial autocorrelation, can be represented as follows:

$$I = \frac{N}{W} \cdot \frac{\sum_i \sum_j w_{ij}(X_i - \bar{X})(Y_j - \bar{Y})}{\sum_i (X_i - \bar{X})^2 \sum_j \left(Y_j - \bar{Y}\right)^2} \quad (4.)$$

Where:

N is the number of spatial units indexed by i and j;

X_i and Y_j are the values of two variables at locations i and j;

$\bar{X}$ and $\bar{Y}$ are the means of X and Y variables;

w_{ij} is a spatial weighting between locations i and j;

W is the sum of all w_{ij}, $\sum_i \sum_j w_{ij}$.

To examine the effectiveness of public assistance programs and various combinations of them in supporting small businesses' continued operations from a geographic perspective, we conducted seven spatial autocorrelation analyses. The combinations included restricted cash assistance only, unrestricted loan only, unrestricted cash only, restricted cash and unrestricted loan, restricted cash and unrestricted cash, unrestricted loan and unrestricted cash, and all three types of assistance.

Tables 6 to 8 summarize the variables, descriptions of variables, and corresponding analysis used in this study.

Table 6. Variable used in Logistic Regression

Variables	Descriptions
Active	Whether a business is identified as inactive by Mergent Intellect, it is deemed as no longer trading or operating until January 2023.
Restricted Assistance Only	Business only access to restricted assistance (PPP).
Unrestricted Assistance Only	Business only access to unrestricted assistance (EIDL).
Mixed Assistance Received	Business access to restricted and unrestricted assistance (PPP and EIDL).
Minority Owned	Whether a business is owned by minority group; 0 = No; 1= Yes.
Sales	Businesses' sales volume in the last calendar year.
Sales (logged)	Natural log of businesses' sales volume in the last calendar year.
Employee size (freq.)	Business's employee size.
Total minority population within 5KM service range (unit:1,000)	Total minority population can be covered by a business within 5KM service range
Average median household income within 5KM service range (unit:1,000)	Average median income of areas that can be covered by a business within 5KM service range.

Total housing units within 5KM service range (unit:1,000)	Total housing units can be covered by a business within 5KM service range.
Sectors	Business sector that classified based on first two-digit of 2017 NACIS code.

Table 7. Variables Used in Cox Regression with Time Varying Effect

Variables	Descriptions
Survival Months	How many months does business sustain operation from Dec 2019.
Active	Whether a business is identified as inactive by Mergent Intellect, it is deemed as no longer trading or operating until January 2023.
Restricted Assistance Only	Business only access to restricted assistance (PPP).
Unrestricted Assistance Only	Business only access to unrestricted assistance (EIDL).
Mixed Assistance Received	Business access to restricted and unrestricted assistance (PPP and EIDL).
Minority Owned	Whether a business is owned by minority group; 0 = No; 1= Yes.
Sales	Businesses' sales volume in the last calendar year.
Sales (logged)	Natural log of businesses' sales volume in the last calendar year.
Employee size (freq.)	Business's employee size.
Total minority population within 5KM service range (unit:1,000)	Total minority population can be covered by a business within 5KM service range
Average median household income within 5KM service range (unit:1,000)	Average median income of areas that can be covered by a business within 5KM service range.
Total housing units within 5KM service range (unit:1,000)	Total housing units can be covered by a business within 5KM service range.
Sectors	Business sector that classified based on first two-digit of 2017 NACIS code.

To perform spatial autocorrelation, this study grouped individual business data at the census tract level and weighted it by the total number of businesses in each corresponding census

tract. This approach allowed us to calculate the percentage of businesses receiving different combinations of assistance and the percentage of businesses still active. The spatial autocorrelation test examined the relationship between the percentage of businesses receiving various combinations of assistance and the percentage of businesses that remained active.

Table 8. Variables Used in Spatial Autocorrelation

Variable	Descriptions
Active Rate	Percentage of active business at the census tract level.
Restricted Assistance Only Rate	Percentage of business access to restricted (PPP) assistance at the census tract level.
Unrestricted Assistance Only Rate	Percentage of business access to unrestricted (EIDL) assistance at the census tract level.
Mixed Assistance Rate	Percentage of business access to restricted (PPP) unrestricted (EIDL) assistance at the census tract level.

In summary, this study selected the DFW Metropolitan Area as the research site due to its diverse economic structure and notable resilience during the COVID-19 pandemic. Three binary variables were used to capture business access to public assistance programs, while sales volume, ownership, and employee size measured business characteristics. Market context was assessed through potential consumer population and purchasing power. The data primarily came from three sources: Mergent Intellect, the Census Bureau, and the SBA. To address the research question, to what extend public assistance programs mitigate the likelihood of business closure,

this study employed logistic regression, Cox regression with time-varying effects, and spatial autocorrelation analysis.

CHAPTER 5

ANALYSIS AND DISCUSSION

5.1 Introduction

This dissertation conducted logistical regression, cox-regression with time-varying effect, and spatial autocorrelation to explore the overall research question that to what extend public assistance programs mitigate the likelihood of business closure, and three dimension of business recovery during the COIVD-19 pandemic.

5.2 Descriptive Analysis

The analysis covers 722,280 individual business data. Of these, 46.7% of businesses remain active until Jan 2023. The mean duration of keeping the business running for inactive businesses is 29.75 months, with a standard deviation of 9.70.

Among 722,280 businesses, 3,355 businesses are minority-owned, which represents 0.46%. Regarding businesses that receive assistance from programs, most of the businesses that receive assistance, about 12,150 (1.68%), access only restricted assistance (PPP). Next, 6,548 businesses, or 0.91% of the total sample size, only access to unrestricted (EIDL) assistance. Finally, 1,188 businesses, or 0.16%, access both restricted (PPP) and unrestricted (EIDL) assistance. Table 9 presents the descriptive statistics at the individual business level.

In terms of business characteristics, the mean business sales volume is $127,276, with a standard deviation of 500,632.30. After applying the natural log transformation to the variable, the mean value becomes 7.26, with a standard deviation of 5.63. The mean business employee size is 6.69, with a standard deviation of 26.89. After applying the natural log transformation of the variable, the mean value becomes 1.1, with a standard deviation of 0.96.

Table 9. Descriptive Statistics at the Individual Business Level

Variable	Mean	Min	Max	S.D	Obs.	[%]
Active					337,279	46.7%
Restricted Cash Only					12,150	1.68%
Unrestricted Loan Only					6,548	0.91%
Mixed Assistance Received					1,188	0.16%
Minority Owned					3,355	0.46%
Survival Months	29.75	1	37	9.70		
Sales	127,276	0	13,484,630	500,632.30		
Sales (logged)	7.26	0	16.42	5.63		
Employee size (freq.)	6.69	0	985	26.89		
Employee size (logged)	1.1	0	6.89	0.96		
Total minority population within 5KM service range (unit:1,000)	57.26	0.1	173.82	29.85		
Average median household income within 5KM service range (unit:1,000)	80.38	30.79	178.11	23.53		
Total housing units within 5KM service range (unit:1,000)	65.84	1.72	170	31.62		
Total N = 722,280						

Business Sector: Agriculture, Forestry, Fishing and Hunting (11), Ming, Quarrying, and Oil and Gas Extraction (21), Utility (22), Construction (23), Manufacturing (31-33), Wholesale Trade (42), Transportation and Warehousing (48-49), Information (51), Finance and Insurance (52), Real Estate and Rental and Leasing (53), Professional, Scientific, and Technical Service (54), Management of Companies and Enterprises (55), Administrative and Support and Waste Management and Remediation Service (56),Education Service (61), Health Care and Social Assistance (62), Arts, Entertainment, and Reaction (71), Accommodation and Food Service (72), Other (81).

Regarding the market context factors, the average number of potential minority population that a business can access with a 5 km service range is 57.26 thousand, with a standard deviation of 29.85. The average amount of median household income from areas that a business can cover with a 5 km service range is 80.38 thousand, with a standard deviation of 23.53. The average number of total housing units that a business can cover with a 5 km service range is 65.84 thousand, with a standard deviation of 31.62.

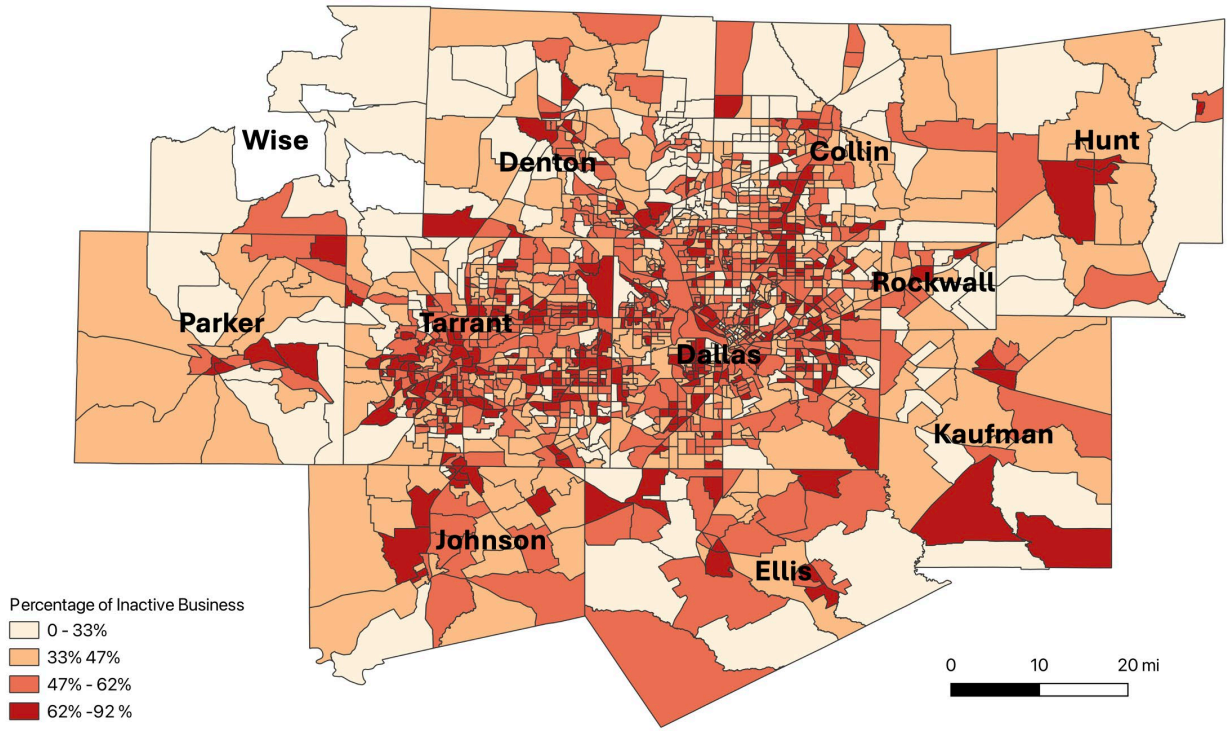


Figure 4. Percentage of Inactive Business at Census Tract Level

Figure 4 shows the map of business inactive rate in DFW at the census tract level. Areas in red from light to dark indicate the percentage of inactive businesses from low to high. As indicated in Figure 4, dark red areas tend to occur in urban areas, which suggests that compared with rural areas, census tracts in urban areas tend to have a higher percentage of businesses inactive since Dec 2019.

Figure 5 shows the map of the percentage of business access to any type of public assistance program in DFW at the census tract level. Areas in blue from light to dark indicate the percentage of business access to any type of public assistance program from low to high. As indicated in Figure 5, dark blue areas tend to occur in relatively rural areas, which suggests that assistance distribution agencies tend to distribute public assistance programs to relatively rural areas instead of urban areas.

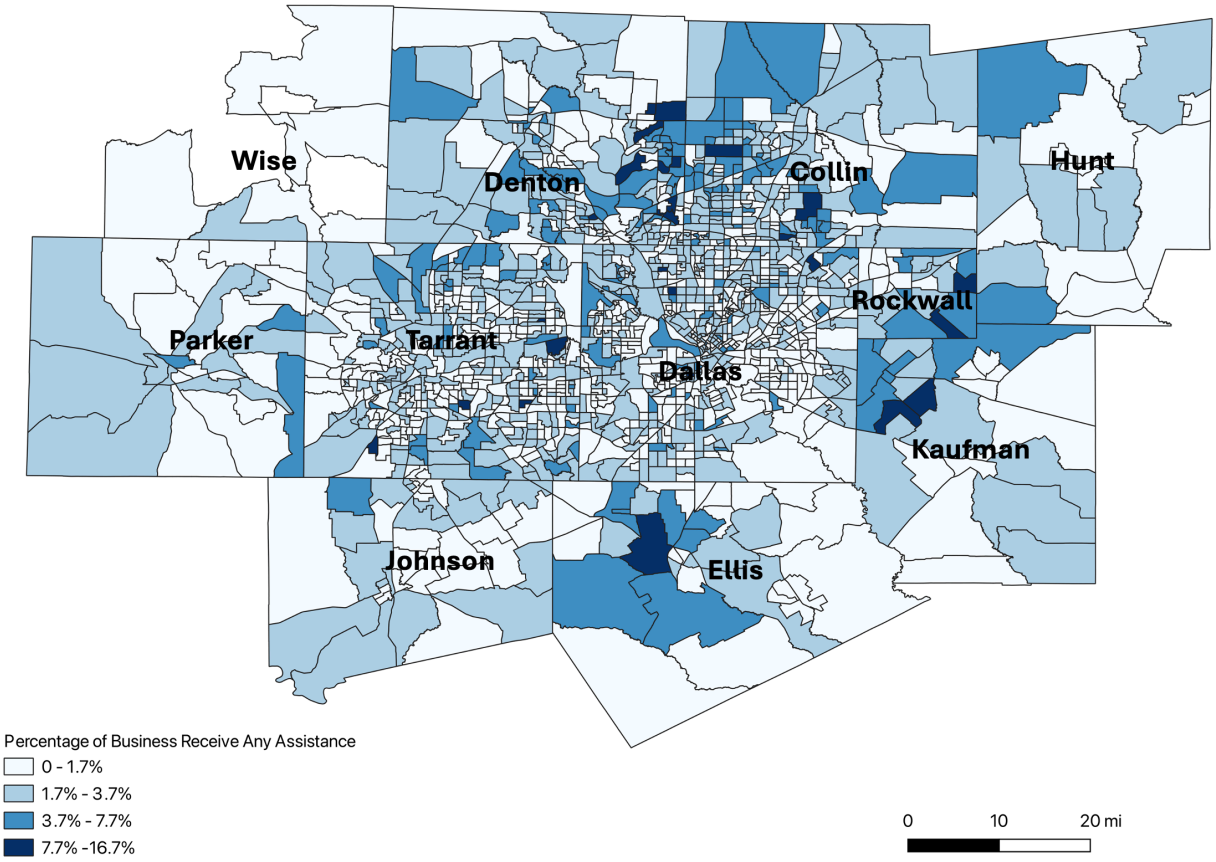


Figure 5. Percentage of Business Receive Any Assistance at Census Tract Level

5.3 The Effectiveness of Public Assistance Programs in Helping Business Recovery

5.3.1 Logistical Regression

Table 10 shows the result of logistic regression. As Table 10 indicates, different combinations of public assistance programs have different effects on business recovery. For businesses that only receive one type of assistance, either type of assistance can raise the likelihood of the outcome occurring. Specifically, receiving restricted assistance only (PPP) assistance increases the odds of staying active by about 16% (Odd Ratio=1.15, $p<0.05$) compared to businesses that do not receive any assistance, which supports Hypothesis 1. Receiving unrestricted assistance only (EIDL) increases the odds of staying active by a factor of 4.91 (Odd Ratio= 4.91, $p<0.05$) compared to businesses that do not receive any assistance, which

supports Hypothesis 2. For businesses that receive mixed types of assistance at the same time, receiving restricted (PPP) and unrestricted (EIDL) assistance increases the odds of staying active by a factor of 2 (Odd Ratio= 2, $p<0.05$) compared to businesses that do not receive any assistance, which supports Hypothesis 3.

Table 10. Factors Explaining Small Business Recovery (Logistical Regression)

	Small Business Recovery (0 = Inactive, 1= Active)		
	Estimate	***p***	**Odd Ratio**
Access to Assistance: Ref. None Assistance Received			
Restricted Assistance Only	0.15	***	1.16
Unrestricted Assistance Only	1.59	***	4.91
Mixed Assistance Received	0.69	***	2
Minority Owned	3.52	***	35.46
Sales (logged)	0.26	***	1.3
Employee size (logged.)	0.34	***	1.4
Total minority population within 5KM service range (unit:1,000)	$6*10^{-4}$	***	1.00
Average median household income within 5KM service range (unit:1,000)	$5.3*10^{-3}$	***	1.00
Total housing units within 5KM service range (unit:1,000)	$-1.5*10^{-3}$	***	1.00
Constant	-4.44	***	0.01
Also control for business sectors based on first two-digit of 2017 NACIS cod			
Pseudo R Square = 0.36			
Total N = 722,280			
* p<.05; ** p<.01; *** p<.001			

Business Sectors: Agriculture, Forestry, Fishing and Hunting (11), Ming, Quarrying, and Oil and Gas Extraction (21), Utility (22), Construction (23), Manufacturing (31-33), Wholesale Trade (42), Transportation and Warehousing (48-49), Information (51),Finance and Insurance (52), Real Estate and Rental and Leasing (53), Professional, Scientific, and Technical Service (54), Management of Companies and Enterprises (55), Administrative and Support and Waste Management and Remediation Service (56), Education Service (61), Health Care and Social Assistance (62), Arts, Entertainment, and Reaction (71), Accommodation and Food Service (72), Other (82).

The results suggest that businesses with access to public assistance programs recover more effectively than those without, as the assistance provides liquidity to sustain operations. However, when businesses apply for a mix of restricted and unrestricted assistance simultaneously, their likelihood of recovery may decrease compared to those relying solely on unrestricted assistance. This indicates that restrictions attached to programs like PPP, which

require a certain portion of funds to be spent on payroll costs, can limit the effectiveness of EIDL by reducing businesses' flexibility to adapt.

5.3.2 Cox Regression with Time-Varying Effects

This study continues to perform Cox regression with time-varying effects to further investigate the effectiveness of public assistance programs at different stages. Table 11 summarizes the results of the cox regression with time-varying effects.

As indicated in Table 11, the combination of public assistance programs has different impacts on business recovery at different stages. Specifically, at Stage 1, receiving restricted assistance only (PPP) assistance can increase the risk of a business becoming inactive by 78% (HR=1.78, $p<0.05$). Furthermore, receiving both restricted assistance (PPP) and unrestricted assistance (EIDL) simultaneously can increase the risk of business inactivity by 245% (HR=3.45, $p<0.05$).

At Stage 2, comparing with business without any assistance received, receiving restricted (PPP) assistance can decrease the risk of a business becoming inactive by 29% (HR=0.71, $p<0.05$); receiving unrestricted (EIDL) assistance can decrease the risk of a business becoming inactive by 15% (HR=0.85, $p<0.05$). Additionally, accessing both restricted (PPP) and unrestricted (EIDL) assistance can reduce the risk of business inactivity by 5% (HR=0.95, $p<0.05$).

At Stage 3, comparing with business without any assistance received, only receiving restricted (PPP) assistance decrease the risk of a business becoming inactive by 6% (HR=0.94, $p<0.05$); receiving unrestricted (EIDL) assistance reduces the risk of business inactivity by 69% (HR=0.31, $p<0.05$); and receiving restricted (PPP) and unrestricted (EIDL) at the same time decreases the risk of business inactivity by 23% (HR=0.77, $p<0.05$).

These results also show the small business recovery pattern with the aid of public assistance programs at different stages of the pandemic. At Stage 1 (Jan 2020 – Nov 2020), business mainly face challenges of decreasing demand following social distance restrictions, businesses that received restricted cash assistance faced higher risks than businesses that did not receive any assistance, which suggests that at this stage, maintaining operations with the current employee size increased the likelihood of inactivity. Business owners should use strategic adaptation methods to survive, such as reducing employees to lower operational costs.

During Stage 2 (December 2020 – January 2022) and Stage 3 (February 2022 – January 2023), businesses faced challenges from international supply chain shortages. Access to restricted assistance (PPP), unrestricted assistance (EIDL), or a combination of both helped reduce the risk of business inactivity, highlighting the importance of liquidity in sustaining operations as market demand stabilizes. In Stage 2, restricted assistance (PPP) was the most effective in reducing the risk of closure. However, accessing mixed assistance (PPP and EIDL) was less effective than relying on a single type of assistance during this period. In contrast, during Stage 3, mixed assistance became more impactful than restricted assistance alone, though it remained less effective than unrestricted assistance.

Table 11. Factors Explaining Small Business Recovery (Cox-Regression with Time Varying Effect)

	Small Business Recovery (0 = Active, 1= Inactive)					
	Stage 1 (Jan 2020 – Nov 2020)		Stage 2 (Dec 2020 – Jan 2022)		Stage 3 (Feb 2022 – Jan 2023)	
	Estimate	HR	Estimate	HR	Estimate	HR
Access to Assistance: Ref. None Assistance Received						
Restricted Assistance Only	0.58^{***}	1.78	-0.34^{***}	0.71	-0.06^{***}	0.94
Unrestricted Assistance Only	-0.02	0.98	-0.16*	0.85	-1.18^{***}	0.31
Mixed Assistance Received	1.24^{***}	3.45	$-4.71*10^{-2}$	0.95	-0.26^{**}	0.77
Minority Owned	-0.43^{*}	0.65	0.12	1.12	-3.67^{***}	0.03

Sales (logged)	$1.91*10^{-4}$	1	$7.66*10^{-3***}$	1.01	-0.14^{***}	0.87
Employee size (logged)	$2.44*10^{-2***}$	1.03	$4.29*10^{-2***}$	1.04	$-1.76*10^{-3***}$	0.84
Total minority population within 5KM service range (unit:1,000)	$3.36*10^{-3***}$	1	$5.36*10^{-3***}$	1.01	$-1.85*10^{-3***}$	1
Average median household income within 5KM service range (unit:1,000)	$3.71*10^{-3***}$	1	0.01^{***}	1	$-5.17*10^{-3***}$	1
Total housing units within 5KM service range (unit:1,000)	$2.2*10^{-3***}$	1	$-7.69*10^{-4***}$	1	$-1.22*10^{-3***}$	1
Also control for business sectors based on first two-digit of 2017 NACIS code						
Pseudo R Square = 0.78						
Wald $Chi^2 = 515{,}801^{***}$						
Total N = 722,280						
* p<.05; ** p<.01; *** p<.001						
Business Sectors: Agriculture, Forestry, Fishing and Hunting (11), Ming, Quarrying, and Oil and Gas Extraction (21), Utility (22), Construction (23), Manufacturing (31-33), Wholesale Trade (42), Transportation and Warehousing (48-49), Information (51),Finance and Insurance (52), Real Estate and Rental and Leasing (53), Professional, Scientific, and Technical Service (54), Management of Companies and Enterprises (55), Administrative and Support and Waste Management and Remediation Service (56), Education Service (61), Health Care and Social Assistance (62), Arts, Entertainment, and Reaction (71), Accommodation and Food Service (72), Other (82).						

5.3.3 The Relationship Between Business Characteristics and Business Recovery

Table 10 also summarizes the results that explain the relationship between business characteristics and business recovery. As indicated in Table 10, being a minority-owned business can increase the odds of staying active by a factor of 35.46 (Odds Ratio=35.46, $p<0.05$) compared with non-minority-owned businesses, which supports Hypothesis 6. Further, every unit increase in the natural log of sales volume can increase the odds of staying active by a factor of 1.3 (Odds Ratio=1.3, $p<0.05$), which supports Hypothesis 5. Also, every one-unit increase in the natural log of employee size can increase the odds of staying active by a factor of 1.4 (Odds Ratio=1.4, $p<0.05$), which support Hypothesis 4.

Table 11 displays the outcome of Cox regression with time-varying effects. According to Table 11, controlling for other variables, being a minority-owned business can lower the risk of being inactive by 35% (HR=0.65, $p<0.05$) and 97% (HR=0.03, $p<0.05$) at Stage 1 and Stage 3, respectively, compared to non-minority owned businesses. Moreover, every one unit increase in

the natural log of sales volume can decrease the risk by 13% (HR=0.87, $p<0.05$) at Stage 3. Additionally, each one-unit increase in the natural log of employee size was associated with a 3% increase in the risk of business inactivity at Stage 1 (HR=1.03, $p<0.05$) and a 4% increase at Stage 2 (HR=1.04, $p<0.05$). However, at Stage 3, the relationship reversed, with a one-unit increase reducing the risk of business inactivity by 16% (HR=0.84, $p<0.05$).

These findings indicate that during the COVID-19 pandemic, businesses with more employees are more prone to becoming inactive in the first two years, which conflicts with previous studies (M. A. U. Khan & Sayem, 2013; Marshall et al., 2015). This is due to the fact that during the COVID-19 pandemic, the labor cost rose, which harmed the profitability of businesses, especially those in labor-intensive sectors (Dvořák et al., 2020). However, from the results of both logistic regression and Cox regression analysis, the values of the odds ratio and hazard ratio are close to or equal to 1, suggesting that the impact of employee size is relatively small in our sample.

Businesses with higher sales volume have a better chance of recovery, which is consistent with previous studies (Han & Nigg, 2011; Marshall & Schrank, 2014). Business sales volume reflects business financial resources that can be utilized to responding disasters; higher sales volume suggests a better capability to absorb impacts from disasters, which helps business recovery. However, at Stage 2, the increase of the natural log of sales volume slightly increases the risk of becoming inactive. This is likely due to the disruption of international supply chains during this stage, which challenges business profitability, especially for businesses with higher sales volumes. High sales volume is normally associated with high dependencies on the functioning of supply chains; this interruption can lead to an increased risk of being inactive (Craighead et al., 2007).

Moreover, minority-owned businesses show resilience during the COVID-19 pandemic, as being a minority-owned business can significantly facilitate recovery, which conflicts with previous studies (Andrew et al., 2022; Atkins et al., 2022). One possible reason for this is that minority-owned businesses can receive support from local communities, especially if they offer products that are locally demanded (Ram, 1998). As more people work remotely after the COVID-19 pandemic, the demand for household goods rises (Devereux et al., 2020), which can benefit the businesses that supply local demand goods.

5.3.4 The Relationship Between Market Context and Business Recovery

Even though the three variables used to capture market context achieve statistical significance in both logistical regression and cox-regression analysis, the value of odds ratio and hazards ratio are close to 1 or equal to 1, which suggests that these three variables do not have a significant impact on risk of business inactive, which reject Hypotheses 7 and 8. This conflicts with previous studies (Alesch et al., 2001; Chang et al., 2022; Corey & Deitch, 2011). One possible explanation for the low influence of the variables that capture the market context in this study on small business recovery is that the DFW metropolitan area did not experience a significant population shift during the COVID-19 pandemic, which can maintain a consistent demand baseline for business (Chatzinikolaou & Vlados, 2021; Wang & Kang, 2021).

5.3.5 The Relationship Between Geographic Location and Business Recovery

Table 12 summarizes the result of spatial autocorrelation (bivariate Moran's I). Specifically, Moran's I value for receiving restricted (PPP) assistance (Moran's I = -0.13, p<0.05), unrestricted (EIDL) assistance (Moran's I = -0.11, p<0.05) are negative associate with business active rate, which reject Hypothesis 9 and 10.

Table 12. Result of Spatial Autocorrelation

Variables	Moran's I	Sig.	z-value
Restricted Assistance Only Rate	-0.13	0.001	-10.23
Unrestricted Assistance Only Rate	-0.11	0.001	-9.28
Mixed Assistance Received Rate	0.07	0.001	5.96

As indicated in Table 12, at the census tract level, the percentage of business access to restricted (PPP) and unrestricted (EIDL) assistances at the same time positively associated with the percentage of business kept active (*Moran's I =0.07, p<0.05*), which supports Hypothesis 11.

These results suggest that combinations of types of assistance significantly help small businesses in the DFW area recover. This effect can be due to the increased cash flow in the DFW area, which promotes purchasing behavior and, consequently, overall business recovery in the region. However, this does not necessarily imply the recovery of individual businesses.

Figure 6 to Figure 12 presents the result of bivariate local Moran's I analysis. Areas represented in red and blue indicate that, in those areas, the percentage of businesses accessing public assistance programs is positively associated with the percentage of active businesses. Areas represented in orange and light blue indicate that, in those areas, the percentage of businesses assessing public assistance programs is negatively associated with the percentage of active businesses.

As shown in Figures 6 to 8, at the census tract level, a similar pattern emerges: businesses in areas that farther from each county center have higher activity rates, which consistent with current studies (Chrisman et al., 1987; Craig et al., 2008). This pattern may be due to two factors. First, compared to urban centers, businesses in rural areas often lack alternative funding options beyond public assistance programs. This limitation creates pressure to make full use of the assistance they receive, which in turn is more likely to encourage business innovation (Mann et

al., 2021). Secondly, the financial ecosystem of business in rural area are less likely to relay on centralized economic hubs, assistance to key business in this area can lead broader economic recovery (Craig et al., 2008). Small businesses in rural areas are often central to local networks, with their scale and profitability determined by the local consumer base (Miller & Soyoung, 1999). Unlike businesses in urban centers, rural consumer demand and purchasing power tend to be more stable (Grube & Storr, 2018). Temporary assistance to help these businesses resume operations can therefore be highly effective for community recovery.

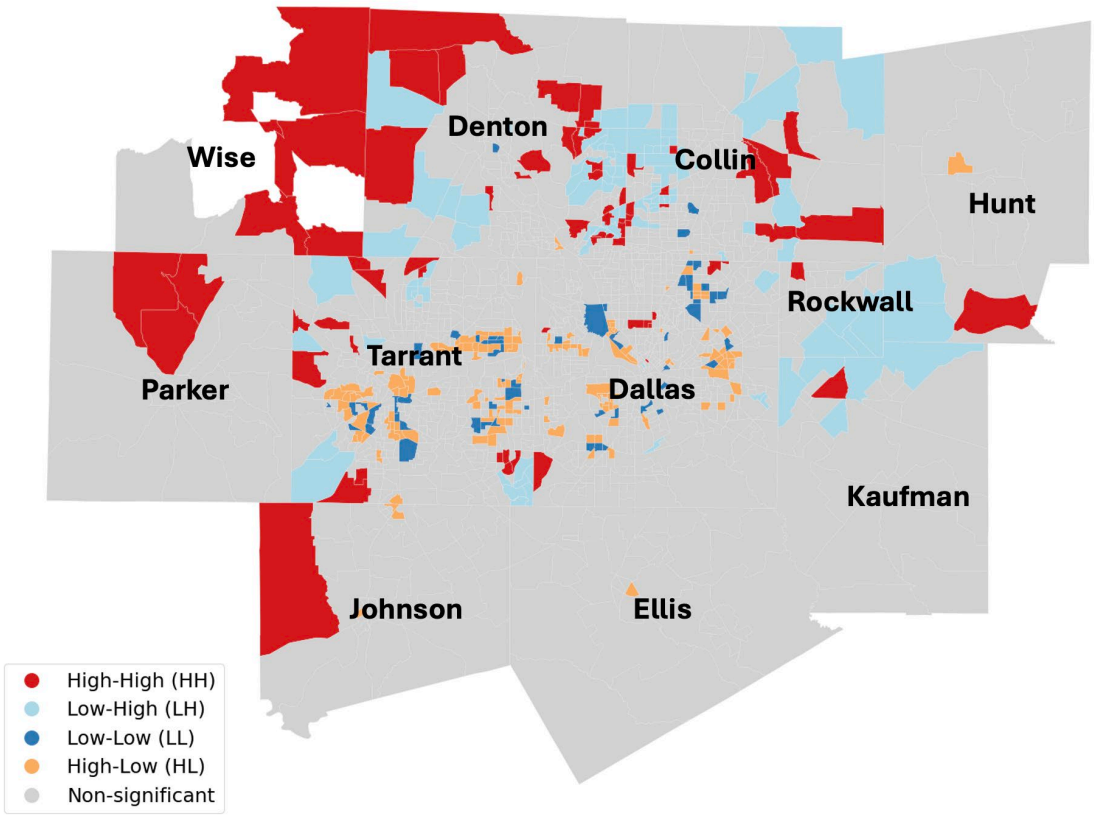


Figure 6. Percentage of Business Access to Restricted (PPP) Assistance Only and Business Active

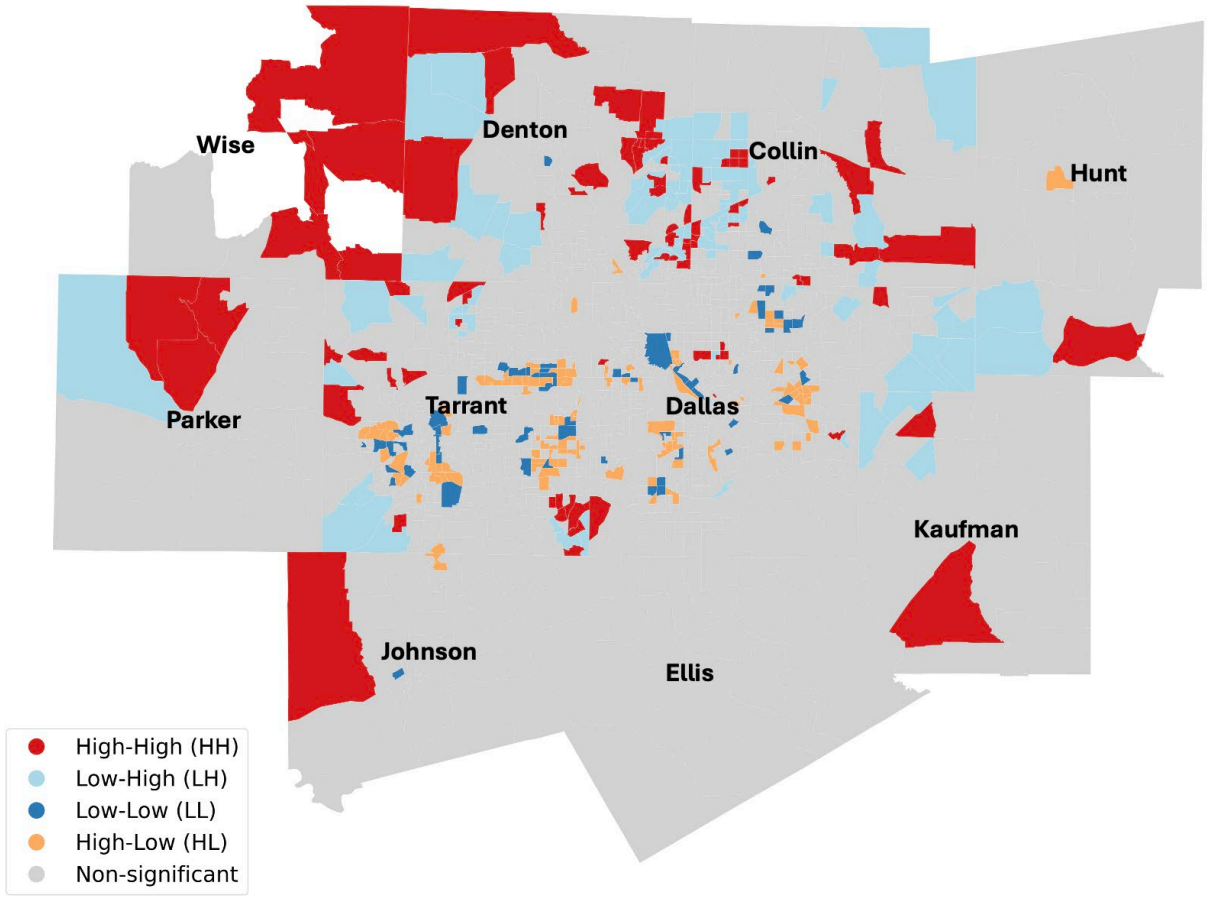


Figure 7. Percentage of Business Access to Unrestricted (EIDL) Assistance Only and Business Active

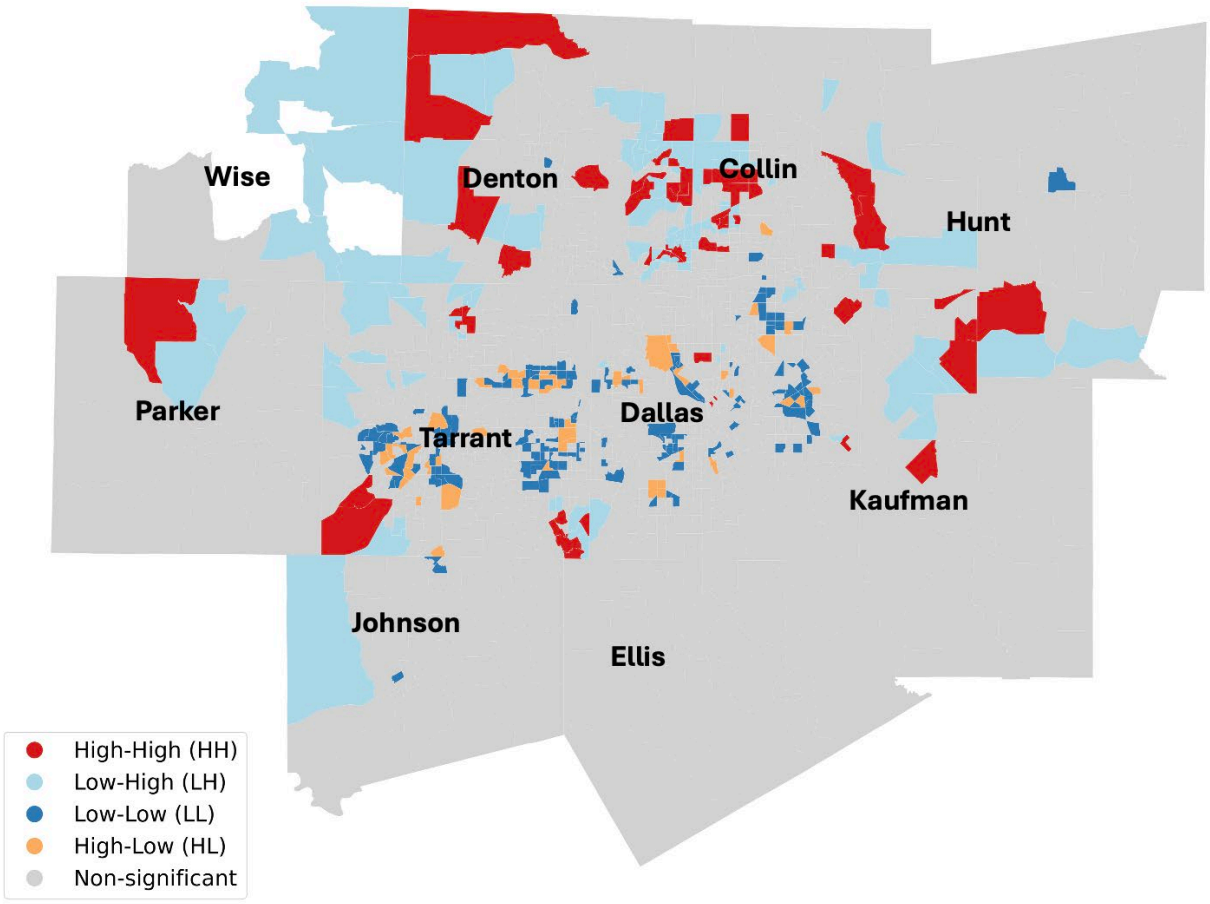


Figure 8. Percentage of Business Access to Mixed Assistance (PPP and EIDL) and Business Active

The following chapter covers the implications and conclusions of this study. Chapter 6 examines how this study contributes to the field and practices. It also outlines the limitations of this dissertation and the suggestions for future research.

CHAPTER 6

CONCLUSION

The objective of this dissertation is to answer the overarching research question: to what extent do public assistance programs mitigate the likelihood of business closure after disasters? This research question is important because business recovery is a critical part of the disaster recovery process. In addition, as the primary source of assistance available for small businesses, the long-term effectiveness of public assistance programs in helping businesses recover remains unclear (Chang et al., 2022). Furthermore, there is a lack of studies investigating how the types and combinations of public assistance programs impact their effectiveness in aiding business recovery (Josephson & Marshall, 2016; Marshall & Schrank, 2020; Wang & Kang, 2023; Watson, 2021). Therefore, studying business recovery with the support of public assistance programs can help policymakers understand the rationality of these programs and inform small business owners on how to choose appropriate combinations of public assistance programs when multiple options are available after disasters.

This study's research questions contribute to academia by investigating the impact of different combinations of public assistance programs on business recovery post-disaster. By exploring the mechanisms behind these programs, this research addresses a gap in the literature concerning how restrictions attached to public assistance programs and the differences between loan-based and cash-based assistance affect their overall effectiveness.

Theoretically, this research question expand based on the Business Recovery framework proposed by Chang et al., (2022), which argue that restrictions attached to public assistance programs, format of assistance are critical to succeed of those programs and can affect business

recovery. Answering the overall research question can contribute the development of business recovery theory by investigating the significance of public assistance programs.

The main research question helps the practice by telling policymakers about the effect of the mechanism behind those public assistance programs. Moreover, answering main research question can guide small business owners to choose suitable assistance for them to boost recovery instead of raising operation risk after disaster. Also, the main research questions show insights on how public assistance programs allocated geographically, which can propose ways to make assistance more reachable and equitable.

A literature review was performed to investigate a preliminary question of the main research question: what factors can account for business recovery after disasters? The main factors that affect disaster recovery and business continuity were explored through a range of studies. These factors are, public assistance programs, geographic locations, business characteristics, and market context.

Public assistance programs help businesses recover by offering them liquidity to ease their financial pressure and restore their operational capacity (Josephson & Marshall, 2016). Disasters can result in physical damage, and businesses with physical damage need to buy new equipment to resume operations (Sydnor et al., 2017). Previous studies suggest that public assistance programs have a significant role in supporting business recovery after disasters (Berger et al., 2021; Marshall & Schrank, 2020; Watson, 2021). However, the effectiveness of public assistance programs depends on the rationality of the restrictions attached and the format of public assistance programs. Unreasonable restrictions can hinder businesses' ability to adapt, and loan-based assistance can add to their debt burden, which slows down the recovery process (Dahlhamer & Tierney, 1998; Graham, 2007).

Geographic location can influence the effectiveness of public assistance programs in helping small businesses recovery by influencing distribution patterns (Crass et al., 2016; McCann & Folta, 2011). Geographic locations can significantly increase the likelihood of businesses receiving public assistance because of the localized advantages, for instance, well-developed industrial chain and scale of labor market (Andersson & Larsson, 2016; Porter, 1998). Allocating public assistance to these areas can more effectively promote recovery, benefiting not only small businesses but also the regional economy (Albors-Garrigos & Collado, 2019; Skokan et al., 2012).

The degree of impact that disasters have on businesses depends on their characteristics, such as their sector and size, which decide the initial pathway of the subsequent recovery process (Altay & Ramirez, 2010). Businesses in different sectors have different levels of dependence on infrastructure to restore their functionality. Moreover, businesses with more employees have more resources and market experience to deal with the negative effects of disasters. They also have stronger networks and savings, which allow them to resume their operations faster than smaller or newer businesses (Webb et al., 2002). In addition, businesses with a larger number of employees tend to get priority when applying for public assistance, as distribution agencies also consider unemployment rates following disasters (Hartwell et al., 1996). Further, businesses with higher sales volume can support businesses' recovery after a disaster from by increasing business resilience (Marshall et al., 2015).

Market context can decide businesses' ability to stay profitable after a disaster, which is crucial for business recovery (Aghababaei et al., 2020). While some sectors, like construction, may experience a temporary increase because of reconstruction demand after a disaster, large-scale population relocation and economic losses among survivors pose challenges to business

profitability (Corey & Deitch, 2011; Kousky, 2014; Sampson et al., 2018). Empirical studies indicate that businesses that can quickly restore their customer base have a higher chance of surviving and thriving after a disaster (Marshall & Schrank, 2014). Moreover, businesses that have access to customers with higher purchasing power are more likely to recover (Xiao et al., 2022).

In summary, business recovery is influence by factors include types of public assistance programs, geographic factors, business characteristics such as sector, size, and ownership, and market context such as spending power of customer groups. This dissertation suggest that restrictions attached to public assistance programs and format of assistance can influence the effectiveness of those programs.

Why is it necessary to set retroactions to public assistance programs and set the majority of assistance in a loan-based format? Restrictions often attach to public assistance programs from concerns of effectiveness (Gu et al., 2008; Xu & Mo, 2013). Restrictions are used to ensure recipients use the assistance for activities related to business operations instead of misusing the fund. The loan-based format is critical for business recovery because it not only provides liquidity but also promotes creation and expansion with appropriate pressure (Bach, 2014; Kelly et al., 1998).

This dissertation examines how various restrictions and formats of public assistance programs affect business recovery. This study uses logistic regression and cox regression with time-varying effects to analyze the data. The reason for using cox-regression as a complement to logistic regression is that it enables us to measure the varying impacts of public assistance programs at different stages. Businesses encountered different challenges at different times during the COVID-19 pandemic, such as reduced demand in the early stage, disrupted

international supply chains in the middle stage, and regulatory and policy uncertainties at the end stage (Ardekani et al., 2023; Bartik, Bertrand, et al., 2020; Trump & Linkov, 2020).

The results of the analysis reveal three findings. First, the effectiveness of public assistance programs does not have a cumulative effect on business recovery. At the individual business level, while individual public assistance programs positively impact business recovery regardless of attached restrictions and funding format, inappropriate combinations of assistance programs can negate these efforts. When businesses receive restricted (PPP) assistance and unrestricted (EIDL) assistance, this combination of assistance might require businesses to maintain their employee size and repay loan interest, which can increase operational costs and raise the risk of business inactivity. On the other hand, from a geographic perspective, in the entire DFW area, the more unrestricted cash flows in, the more likely overall business recovery is to occur.

Second, business size is not always positively associated with business recovery. Businesses with a large number of employees need to afford relatively high payroll costs. Considering the increase in labor costs following the pandemic, these increased payroll expenses can affect business profitability and raise the risk of inactivity (Dvořák et al., 2020). On the other hand, businesses with larger sales volumes can positively associate with recovery during the pandemic if they do not face supply chain disruptions.

Third, market context does not influence business recovery if there is a lack of massive population relocation because stable local residents can ensure a baseline of demand. Businesses can establish a well-developed operation pattern with customers before the pandemic; even though the social distance restriction policy limits customers' purchasing behavior, it does not decrease the demand, does not (Chatzinikolaou & Vlados, 2021; Wang & Kang, 2021). On the

other hand, the increase in household demand due to more people working from home during the pandemic can promote recovery (Devereux et al., 2020). This also explains why minority-owned businesses show more resilience than non-minority-owned businesses, as they can better provide local demand goods (Ram, 1998; Wang et al., 2021).

This study has several limitations. The first limitation is that it merges business records from Mergent Intellect and the recipient list from the SBA based on business names and addresses. This merging method can result in mismatches due to duplicate business names, such as Seven Eleven. Additionally, it does not account for businesses that relocated between the times the addresses were collected by Mergent Intellect and the SBA.

The second limitation is that this study does not filter out potential fraud cases in both PPP and EIDL recipient lists. According to Griffin et al., (2021) the adaptation of fintech lenders during the COVID-19 pandemic to distribute PPP assistance promoted fraud in PPP programs. Although merging the recipient list with business records from Mergent Intellect can indirectly filter out some fraud cases, there might still be fraudulent cases in the sample of this study. The presence of fraud cases can distort the effectiveness analysis of the assistance programs, as fraudulent recipients do not represent genuine business needs and recovery efforts.

The third limitation is that the conclusions are based on data from the DFW region. While the same public assistance programs were distributed nationwide by the SBA, local economic structures, infrastructure status, and geographic factors can limit the generalizability of this study to other areas. The unique characteristics of the DFW region, such as its economic diversity, population density, and infrastructure development, might not be representative of other regions. Therefore, the findings might not fully apply to areas with different economic and infrastructural contexts.

The fourth limitation is that this study only includes two major public assistance programs from the SBA during the COVID-19 pandemic. Other accessible assistance at the state and local levels is not included. For example, the State of Texas also provided several small business assistance programs to reboot the economy during the pandemic. This study does not cover those programs due to a lack of relevant data. Excluding these additional programs means that the analysis might not capture the full spectrum of available support and its combined impact on business recovery.

The next step of this dissertation is to conduct further studies to overcome these limitations and expand the scope of the business recovery research. The modified research framework proposed in this study will be applied to other metropolitan areas that have experienced long-term disruptive events similar to the COVID-19 pandemic. By broadening the geographic scope, the study aims to test the robustness and applicability of the framework across different contexts. Future studies will also include all available public assistance programs for small business owners at both the federal and state levels. This comprehensive approach will allow for a more detailed investigation into the effectiveness of various combinations of public assistance programs in aiding small business recovery. By analyzing a wider array of assistance options, the research can provide more nuanced insights into how different types of aid interact to support business resilience.

In future research, instead of focusing on a single metropolitan area, multiple metropolitan areas with varying infrastructure characteristics will be used as research sites. This comparative approach will enable the study to assess the impact of infrastructure development on the effectiveness of public assistance programs. By selecting metropolitan areas with diverse infrastructure profiles, the research can identify which aspects of infrastructure development

most significantly mitigate the challenges faced by businesses during recovery. This will help to understand how investments in infrastructure can enhance the effectiveness of public assistance programs and contribute to more resilient economic systems. The modified theoretical framework will be rigorously tested using data from multiple metropolitan areas, providing a broader and more comprehensive understanding of business recovery dynamics.

Lastly, since the COVID-19 pandemic did not cause physical damage to businesses, this study does not account for business damage profiles. However, when applying the proposed theoretical framework to future disaster events, it will be essential to include the damage profiles caused by these events. Future studies will investigate the interaction between the extent of physical damage caused by disasters and the combinations of public assistance programs. This will involve analyzing how different levels of damage influence the effectiveness of various aid packages and identifying the optimal combinations of assistance for different scenarios. By incorporating damage profiles, the research can offer more tailored recommendations for disaster recovery planning and policy-making, ensuring that public assistance programs are designed to address the specific needs and challenges faced by businesses in the wake of physical destruction.

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