HEC MONTRÉAL
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Essays in Household Finance: Entrepreneurship, Tax Enforcement, and Income Shocks

par
Frank-Olivier Yatoa Garané

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Présentée par :

Frank-Olivier Yatoa Garané

a été évaluée par un jury composé des personnes suivantes :

Directeur de recherche
Philippe d'Astous
HEC Montréal

Membre du comité
Martin Boyer
HEC Montréal

Membre du comité
Barry Scholnick
University of Alberta

Président-rapporteur
Jakub Hajda
HEC Montréal

Examinateur externe
Xavier St-Denis
Institut national de la recherche scientifique

Représentant du directeur de HEC Montréal
Sébastien Arcand
HEC Montréal

Résumé

Cette thèse doctorale est composée de trois essais qui étudient comment les individus et les entreprises ajustent leur comportement en réponse aux chocs économiques et aux frictions institutionnelles. En utilisant des données administratives, ces trois chapitres explorent des enjeux situés à l'intersection de la finance des ménages, de l'économie du travail et des politiques publiques.

Le premier chapitre, co-écrit avec Philippe d'Astous et Barry Scholnick, examine comment les travailleurs touchés par un licenciement massif s'ajustent en se lançant dans le travail autonome et en créant de nouvelles entreprises. Il examine également comment le choix de la forme juridique incorporée ou non incorporée influence la performance subséquente de ces entreprises. À partir de données fiscales appariées entre employeurs et employés au Canada, nous montrons que les travailleurs licenciés qui créent des entreprises non incorporées obtiennent de meilleures performances que leurs homologues n'ayant pas été congédiés, tandis que ceux qui choisissent l'incorporation affichent des résultats inférieurs. Ces constats soulignent l'importance d'un alignement entre les trajectoires entrepreneuriales et les contraintes en capital humain et financier.

Le deuxième chapitre co-écrit avec Philippe d'Astous et Martin Boyer étudie les effets de l'intensification de la transparence fiscale sur le marché du travail, en exploitant l'introduction des modules d'enregistrement des ventes (MEV) dans le secteur de la restauration au Québec. Nous montrons que la réforme a entraîné une formalisation accrue de la main-d'œuvre, avec une hausse des salaires

déclarés et une plus grande participation aux régimes d'épargne-retraite. Si les travailleurs immigrants et natifs ont tous deux bénéficié de cette formalisation, les natifs ont connu une progression plus marquée de leurs revenus et une meilleure intégration financière.

Le troisième chapitre étudie la réaction des individus face à des chocs de revenu, à partir de données bancaires issues d'une grande institution financière nord-américaine. Nous montrons que les individus n'anticipent pas les variations de revenu, mais ajustent leur épargne, leur recours au crédit et leurs décisions d'investissement après la survenue du choc. Ces résultats mettent en lumière le rôle des contraintes de liquidité et des frictions comportementales dans la prise de décision financière.

Ces trois essais contribuent à une meilleure compréhension des mécanismes d'ajustement des individus et des entreprises face aux contraintes économiques et institutionnelles, et offrent des pistes de réflexion utiles à la conception de politiques du travail, fiscales et financières.

Mots-clés

Finance des ménages, travail autonome, incorporation, informalité, conformité fiscale, frictions financières, chocs de revenu.

Méthodes de recherche

Économétrie

Abstract

This doctoral thesis consists of three essays that examine how individuals and firms adjust their behavior in response to economic shocks and institutional frictions. Combining large-scale administrative data with quasi-experimental research designs, the essays explore themes at the intersection of household finance, labor economics, and public policy.

The first chapter (co-authored with Philippe d'Astous and Barry Scholnick) investigates how displaced workers respond to mass layoffs by doing self-employment activities, and how the choice of business structure incorporated versus unincorporated affects subsequent firm performance. Using matched employer-employee tax data from Canada, we study find that laid-off workers who start unincorporated businesses outperform their voluntary counterparts, while those who incorporate perform worse. These patterns show the importance of aligning entrepreneurial pathways with financial and human capital constraints.

The second chapter (co-authored with Philippe d'Astous and Martin Boyer) analyzes the labor market implications of tax enforcement, leveraging on the roll-out of Sales Recording Modules (SRMs) in Québec's restaurant industry. The study shows that the reform led to increased formalization of the workforce, with higher reported wages and greater take-up of retirement savings plans. While both immigrants and native-born workers experienced improved outcomes, native-born individuals exhibited stronger earnings growth and financial

integration.

The third chapter focus on household responses to income shocks using financial account data from a North American bank. We find that individuals do not anticipate income changes but adjust their savings, credit usage, and investment behavior after the shock occurs. These results underscore the role of liquidity constraints and behavioral frictions in shaping financial decision-making.

Together, the three essays contribute to our understanding of how households and firms navigate economic and institutional constraints, offering insights for the design of labor market, tax, and financial policies.

Keywords

Household finance, self-employment, incorporation, informality, tax compliance, financial frictions, income shocks.

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To Papa and Mama,

To all my family and friends.

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To my family and friends, thank you for being my anchor through the highs and lows. Your belief in me and constant support made this possible.

General Introduction

This thesis consists of three independent yet thematically connected papers in household finance, with a particular focus on the intersection of labor markets, entrepreneurship, and public policy. The first two chapters leverage both rich administrative data and exogenous variation to explore how individuals and firms adjust to institutional constraints, regulatory changes, and labor market shocks. The third chapter focuses on household financial management, using detailed banking data to analyze how individuals react to income shocks. Across all three essays, a common thread is to study real-world adjustments to frictions whether regulatory, fiscal, or financial that impact economic decision-making. The papers are self-contained and each written with the purpose of being published as a separate article in academic journals.

The first chapter, titled *"Aiming Low: Necessity Entrepreneurs and the Choice to Incorporate"*, coauthored with Barry Scholnick, and Philippe d'Astous, investigates how displaced workers respond to mass layoffs by entering self-employment, and how their choice of legal business structure incorporated or unincorporated shapes the outcomes of their new ventures. Using a large administrative Canadian matched employer-employee tax dataset and a mass layoff design, we compare necessity entrepreneurs to a matched group of voluntary founders. we find that necessity entrepreneurs who choose to "aim low" by starting unincorporated firms outperform their voluntary counterparts in terms of profitability, despite operating smaller businesses. In contrast, necessity en-

trepreneurs who opt to open an incorporated business tend to underperform relative to incorporated voluntary entrepreneurs. These patterns suggest that unincorporated businesses better match the skill and financial profiles of displaced individuals. Notably, immigrant entrepreneurs emerge as an exception, successfully starting larger incorporated firms even after layoffs. The findings highlight the importance of aligning entrepreneurial pathways with individual constraints and motivations.

The second chapter, coauthored with Martin Boyer and Philippe d'Astous, is titled *"Labor Market Implications of Tax Enforcement Measures"*. we study how firms and workers respond to increased tax monitoring using the introduction of Sales Recording Modules (SRMs) in Québec's restaurant sector. Leveraging matched employer-employee tax records and a difference-in-differences design comparing Québec to other provinces, we find that firms respond not only by increasing reported revenues, but also by formalizing their labor force. This includes substantial increases in reported payroll for incumbent workers and the onboarding of previously unregistered employees. The reform improves declared wages and reduces reliance on social assistance, with some evidence of increased use of retirement savings plans. While both immigrant and native-born workers benefit from formalization, native-born individuals exhibit stronger income growth and greater financial integration post-reform. These findings underscore that tax enforcement tools, often seen through the lens of firm compliance, can have important downstream effects on workers particularly in low-wage, cash-heavy sectors.

The third chapter, *"Are income shocks predictable? an empirical test using bank data"*, focus on individual financial decision-making in response to income fluctuations. Using administrative data from a large North American financial institution, the chapter examines how individuals adjust savings, borrowing, and financial product usage following permanent income changes. The analysis distinguishes between anticipated and unanticipated shocks, and between constrained and unconstrained households. i find little evidence that individuals anticipate

income changes. Instead, adjustments in financial behavior occur after the fact: unconstrained households reduce savings following income losses and increase investment and credit use after income gains. The chapter contributes to the literature on consumption smoothing and liquidity constraints by offering new evidence on the role of behavioral and financial frictions in shaping household responses to income dynamics.

Chapter 1

Aiming Low: Necessity Entrepreneurs and the Choice to Incorporate

Co-authored with Philippe d'Astous [1] & Barry Scholnick [2]

Abstract

Wage employees who are laid-off may turn to entrepreneurship to generate income. Conventional wisdom suggests that these necessity entrepreneurs perform poorly because they lack entrepreneurial skills and financing. In this paper we challenge this view, using data from matched employee-employer tax records that cover incorporated and unincorporated firms. We find that employees subject to mass layoffs, who "aim low" and start unincorporated companies, perform better than matched voluntary entrepreneurs starting similar firms. However, necessity entrepreneurs who start incorporated companies perform worse than

[1] Associate Professor, Department of Finance, HEC Montréal

[2] Professor, Department of Marketing, Business Economics and Law, Alberta School of Business

their voluntary counterparts. This suggests a relatively smaller role for human and financial inputs on achieving success in unincorporated firms.

1.1 Introduction

Necessity entrepreneurs (also known as "forced entrepreneurs", "distress-driven entrepreneurs" or "displaced entrepreneurs") are individuals who are forced into entrepreneurship after an unexpected and unplanned negative labour market shock.[3] Because these entrepreneurs start their firms out of necessity, compared to voluntary entrepreneurs they may have lower human capital (e.g. entrepreneurial or managerial skills) and lower financial capital (e.g collateral and access to credit). For these reasons, conventional wisdom suggests that, all else equal, necessity entrepreneurs may under perform relative to voluntary entrepreneurs.

However, the literature shows mixed results regarding the performance of firms started by necessity entrepreneurs. Some papers find that firms created by necessity entrepreneurs under perform (Galindo Da Fonseca 2022), while others provide evidence of entrepreneurs finding success following negative labor shocks (Babina 2019; Hacamo and Kleiner 2022; Hou et al. 2025). In this paper, we show that these conflicting results may be reconciled by considering the type of firm created by necessity entrepreneurs. Providing evidence on this issue is important, given that individuals who have been subject to negative labor market shocks are often advised to enter entrepreneurship as an alternative way to generate income.[4]

We exploit a setting in which the propensity for entrepreneurship increases for plausibly exogenous reasons and document how the choice of legal business structure affects its subsequent performance. We use job displacement as a trigger for necessity entrepreneurship and provide new evidence that a key de-

[3]Examples of negative labour market shocks generating entrepreneurial outcomes include job layoff (e.g. Von Greiff 2009; Røed and Skogstrøm 2014; Nyström 2020; Galindo Da Fonseca 2022), financial distress of an employer (Babina 2019), or graduating into a recession (Hacamo and Kleiner 2022).

[4]Examples are common in the financial press, such as this recent Forbes article focusing on a wave of tech layoffs: https://www.forbes.com/sites/bernhardschroeder/2023/04/03/layoffs-are-fueling-a-new-wave-of-entrepreneurs-heres-how-you-can-join-them/.

terminant of firm performance is the initial choice between "aiming high" with an incorporated legal structure or "aiming low" with an unincorporated one. A large literature (e.g. Levine and Rubinstein 2017; Rubinstein and Levine 2020) has emphasized the importance of a firm's legal structure for its future performance. The main contribution of our paper is to extend this understanding to necessity entrepreneurs by providing novel evidence on how their choice of business structure impacts their success. In doing so, we reconcile the mixed findings previously document in the literature.

Our data consists of matched employee-employer tax records covering the universe of Canadian taxpayers from 2001 to 2021. The matched employer-employee nature of the data allows us to link all individual tax filings to corporate tax filings and ownership structure of all businesses in Canada (including incorporated businesses, unincorporated businesses, and gig activity). In addition, the data includes a "Record of employment" in which the employer is legally required to certify whether any employee separation is voluntary or involuntary (Birinci et al. 2023). This allows us to precisely identify layoffs and therefore construct the universe of mass lay off events in Canada during the sample we study. Using these data we first identify all employees who are displaced in mass layoff events, second, we track these specific individuals as they start various kinds of entrepreneurial activity, and then third, we compare the performance of these necessity entrepreneurs to a matched group of voluntary entrepreneurs.

Our main findings are that necessity entrepreneurs subject to a mass layoff event, who select into an unincorporated legal structure, perform better than a matched control group of voluntary entrepreneurs. On the other hand, we also find that those subject to a mass layoff event, who select into an incorporated legal structure, perform worse than a control group of voluntary entrepreneurs. Taken together, these findings imply that it is more appropriate for necessity entrepreneurs (i.e. displaced workers) to "aim low" and select into the less complicated and demanding unincorporated legal structure, rather than to "aim high"

and select into the more complex and demanding incorporated legal structure.

Our main explanation for these findings relates to the model proposed by Rubinstein and Levine 2020 to explain selection into incorporated and unincorporated business forms. According to Rubinstein and Levine 2020, incorporation "demands entrepreneurial ability, physical capital, and liquidity," while unincorporation "demands none (or little) of these inputs and is driven primarily by the non-pecuniary benefits of self-employment, such as being one's own boss" (page 4). The setting of displaced workers following a mass layoff event is ideal to test these predictions for necessity entrepreneurs.

Given that the employees in our setting have been unexpectedly laid off, it is likely that they do not have the levels of "entrepreneurial ability, physical capital, and liquidity" required for successful performance in an incorporated firm. This is consistent with our first empirical finding: laid-off employees who start incorporated businesses perform worse than a matched group of voluntary entrepreneurs. On the other hand, even though the individuals in our study have been laid off and thus can be assumed to have relatively low levels of "entrepreneurial ability, physical capital, and liquidity," the key argument of Rubinstein and Levine 2020 is that such criteria are *not* prerequisites for successful performance in an unincorporated firm. This aligns with our second finding: laid-off employees who start unincorporated businesses perform relatively well.

The main difference between our paper and the model proposed by Rubinstein and Levine 2020, is that in their setting, individuals enter unincorporated firms for the "non-pecuniary benefits of self-employment, such as being one's own boss." In our study, the motivation for entry into an unincorporated business is directly linked to being laid off (i.e., out of necessity). Our finding that laid-off necessity entrepreneurs who start unincorporated businesses perform better than a matched group of voluntary entrepreneurs may be because the laid-off employees are motivated by necessity to maximize profitability; they have no alternative source of income, which drives them to focus on making their businesses suc-

cessful. In contrast, the matched control group of voluntary entrepreneurs may have a lower incentive to maximize profitability if, as argued by Rubinstein and Levine 2020, they are primarily motivated by non-pecuniary benefits.

Our identification assumption follows the large literature arguing that in mass layoff events, where a large fraction of a company is laid off simultaneously, whether one specific worker is laid off can be considered plausibly exogenous (e.g. Jacobson, LaLonde, and Sullivan 1993; Couch and Placzek 2010; Lachowska, Mas, and Woodbury 2020). We use a difference-in-differences specification to provide evidence that the mass layoff event can be considered plausibly exogenous. We follow recent advances in the DID literature on staggered treatment and estimate a stacked regression model (A. C. Baker, Larcker, and C. C. Wang 2022), using only never-treated individuals in our control group. Using the mass layoff as the event date, we document parallel pre-trends for our treated group of mass layoff employees compared to a matched control group of employees who are not laid off. In the post period, we document a significant reduction in wage earnings for our treated group (laid-off workers) and a significant increase in various kinds of entrepreneurship income. We conclude that the mass layoff event had a causal impact on entry into entrepreneurship by these necessity entrepreneurs.

We evaluate the performance of new firms started by necessity entrepreneurs by analyzing laid-off employees who start either unincorporated or incorporated firms. We compare their firm performance to that of a control group of matched voluntary entrepreneurs, who also started a their firm in the same year, but who were not subject to a mass layoff event. Using business tax record data (e.g., profitability, sales, assets), we provide ex post evidence on the performance of these firms based on their chosen business structure (either incorporated or unincorporated).

We find that laid-off employees who choose incorporation create firms that are significantly smaller and less profitable compared to voluntary entrepreneurs who incorporate in the same year. On the other hand, while laid-off employees

who select unincorporation also create smaller firms than matched voluntary entrepreneurs, they are actually more profitable than their voluntary counterparts. Taken together, these findings suggest that both kinds of necessity entrepreneurs (incorporated and unincorporated) create smaller firms than matched voluntary entrepreneurs, possibly due to financial constraints. However, necessity entrepreneurs who select unincorporation are able to overcome these constraints and achieve higher profitability by "aiming low" and remaining small.

The depth of our data allows us to examine various sub groups of the population, including immigrants. A large recent literature (e.g. Azoulay et al. 2022; Fairlie and Lofstrom 2015; S. P. Kerr and W. Kerr 2020) has documented the success of immigrants as entrepreneurs. The main conclusion of Azoulay et al. 2022 is that "immigrants do not simply start small firms. Rather, they tend to start more firms at every size, compared to US-born individuals" (page 72). While Azoulay et al. 2022 does not specifically compare between incorporated and unincorporated firms, their main findings showing that there are more immigrant-entrepreneurs per capita than US born entrepreneurs per capita across all firm sizes, implies that immigrant entrepreneurs are successfully entering larger firms including incorporated firms.

Our main new finding regarding immigrant entrepreneurs, is that immigrants subject to a mass layoff event who select to enter an incorporated firm, have no significant difference in performance compared to the matched control group of voluntary entrepreneurs. This finding is thus different from our main finding (described above) which shows worse performance for the general population of laid-off employees who enter incorporation. These immigrant necessity entrepreneurs are also significantly larger than a matched group of voluntary entrepreneurs. In other words, immigrants appear to be the one group who are able to overcome the constraints associated with being laid off to successfully enter into incorporated businesses. This new finding is thus consistent with the recent literature on immigrant entrepreneurs (e.g. Azoulay et al. 2022; Fairlie and Lof-

strom 2015; S. P. Kerr and W. Kerr 2020) which has documented that immigrants are typically more successful than domestic born individuals, across all types of entrepreneurial businesses.

The basic framework proposed in this paper (that the success of necessity entrepreneurs depends on the matching of the pre-existing skills of those individuals with an appropriate business structure that matches those skills) is quite general and can also explain the results of recent studies of necessity entrepreneurs by Babina 2019 and Hacamo and Kleiner 2022, whose main results are quite different from ours. Babina 2019, examines high skill and high wage individuals, who leave wage employment for entrepreneurship when their wage employer experiences financial distress, while Hacamo and Kleiner 2022 examines university graduates of elite US colleges, who graduate into a recession. Both of these other studies thus focus on necessity entrepreneurs who can be argued to have high levels of pre-existing entrepreneurial capabilities, and/or high ability to raise the required funds to start a new venture, and in both studies these individuals select into complex and sophisticated businesses, that subsequently perform well.

The key similarity between Babina 2019, Hacamo and Kleiner 2022 and our study, is that in all three studies the necessity entrepreneur will have successful ex post performance if the characteristics of the necessity entrepreneur are appropriately matched to the business structure that the necessity entrepreneur selects into. In both these other two studies necessity entrepreneurs with high levels of pre-existing skills successfully select into complex and sophisticated businesses, whereas in our study, laid-off workers with lower levels of pre-existing skills successfully select into unincorporated businesses. The key difference between our paper and these other two studies is that our setting also allows us to examine other necessity entrepreneurs (in our case laid-off workers who unsuccessfully select into incorporated business), where the matching between the characteristics of the necessity entrepreneur and the choice of business structure is less

appropriate.

Our study also differs from Galindo Da Fonseca 2022 who finds that the performance of laid-off workers, who select into incorporation, is poor. However, Galindo Da Fonseca 2022 only examines individuals who selected into incorporated, but not unincorporated, businesses, whereas the main contribution of our study is to compare across these two business forms.

1.2 Data

1.2.1 Matched Employer-Employee Tax Data

We use longitudinal linked employer-employee tax data from the Canadian Employer-Employee Dynamic Database (CEEDD), a comprehensive data set covering the universe of tax filers in Canada from 2001–2021. In this section, we document the different sources of data used in the analysis. Appendix Table 2.1 lists all the variables used in the analysis, their definition, and the source of data used to construct them. To minimize the influence of outliers, we winsorize all observations at the 5th and 95th percentiles of the distribution, adjusting values below and above these thresholds to the respective percentile values.

1.2.2 Demographics and Individual Tax Data

We use the T1 Personal Master File (T1PMF) data as the preliminary linkage file from CEEDD which allows us to match individuals' personal tax data across a range of datasets, using a unique identification number. The T1PMF is recorded at the individual level and contains the aggregate annual tax information, as well as demographics. From this dataset, we obtain age, gender and income variables.

In addition to the aggregated tax information provided in the T1PMF, the Record of Employment and Remuneration (T4ROE) provides the annual remuneration of each individual at each employer where they have worked. This al-

lows us to observe all the different employers of a given individual annually. Employers provide information on the employees, salary paid, reason for separation, contributions to national pension programs, number of days worked when there is job separation, etc. A key feature of the T4ROE is its differentiation of job separation between voluntary and involuntary separations. Following Birinci et al. 2023 we only include individuals who were involuntarily laid off, rather than those who voluntarily quit, in our definition of mass layoff events (as described in detail below).

Finally, we identify immigrants from native-born individuals through the Longitudinal Immigration Database (IMDB), a database that contains immigrant landing records with annual tax data for those arriving in Canada since 1980. The database includes immigrants who have filed at least one tax return since 1982. The landing records within the IMDB provide detailed characteristics of immigrants at the time of their arrival, including age, education, marital status, source country, official language proficiency, and admission category. We define immigrants in our study as individuals not born in Canada.

1.2.3 Unincorporated Business Data

To identify unincorporated businesses, we use consolidated data of the T1 Financial Declarations (T1FD) which are filed by taxpayers who report self-employment income, and T1 Business Declarations (T1BD) which are filed by unincorporated business owners. The data are available from 2005 onwards and cover all the unincorporated self-employed in Canada. The businesses can be either sole proprietorship or partnership. The entity in these data does not necessarily have to be registered. In Canada, registration through a business number (BN) is only mandatory for total taxable business revenues above $30,000 per year. Following Jeon, H. Liu, and Ostrovsky 2021 we define unincorporated businesses with total taxable business revenues of less than $30,000 per year, and

without business number as "gig work".

We identify ownership of unincorporated firms using the unique business registry number, which consolidates all entities registered under a singular identifier. This measure allows us to track the opening of new unincorporated firms and accurately aggregate business activities over time. The business registry number accounts for all subsidiary or affiliated businesses, including a range of unincorporated small businesses under the same umbrella. Our results for unincorporated businesses are therefore aggregated annually at the business registry number level. We define the creation of an unincorporated firm using the first year the firm appears in the dataset.

1.2.4 Incorporated Business Data

To identify incorporated entities, we use the National Accounts Longitudinal Microdata File (NALMF), which is a longitudinal administrative database of all Canadian incorporated firms. The NALMF combines different data sources including administrative tax records, surveys of employment, and business registery data. From these data, we retrieve financial information such as income statement components, balance sheet components, employee count, and NAICS of the incorporated firms.

We complement these data with a link to the Schedule 50 (T2S50) files, which contain shareholder information using the same unique individual-level identifier. It is mandatory for private Canadian-controlled corporations to file this Schedule to disclose the identities of all significant shareholders, defined as individuals holding a minimum of a 10% stake in either common or preferred shares. We can therefore attribute ownership of each incorporated business to individuals in our sample, and obtain detailed ownership shares, type of ownership (i.e., direct or chain ownership), and the number of owners.

We define the creation of an incorporated firm using the date of incorporation

recorded reported in NALMF. These administrative data allow us to accurately identify firms established in a specific year and link them with the individuals who created and/or incorporated these entities.

1.3 Identification Strategy

1.3.1 The Mass Layoff Identification Strategy

The key element of our identification strategy is to separate *involuntarily* displaced workers (i.e. layoffs) from those who endogenously choose to leave their employer (i.e., quits). We follow a large literature that has used mass layoff events of long tenured workers to identify involuntary layoffs of individual workers.[5] The main identifying assumption in this literature is that an individual's separation during a mass layoff event is *involuntarily*.

Threats to the Mass Layoff Identification Strategy

Recent literature argues that various threats exist to the identification assumption of involuntary separation when using a mass layoff strategy. The first threat is that simply observing a worker's separation during a mass layoff event may not be enough to identify it as an involuntary layoff rather than a voluntary quit; some workers may *voluntarily* quit during a mass layoff due to the employer's financial distress (as in Babina 2019, for example). It is thus critical to distinguish between voluntary quits and involuntary layoffs in the data for all employees who separated during the mass layoff event.

Birinci et al. 2023 argue that a second possible threat to identification when using the mass layoff strategy, concerns employees being erroneously classified as being laid off, when there is a change in the legal structure of the employer (e.g. resulting in a name change of the employer during a financial restructuring such

[5] see e.g. Jacobson, LaLonde, and Sullivan 1993; Couch and Placzek 2010; Lachowska, Mas, and Woodbury 2020; Schmieder, Von Wachter, and Heining 2023 and many others.

as a merger and acquisition). It is possible that a change in the legal structure of the employer (e.g. name change or M & A) will generate new employment contracts with all existing employees, even though the employees have remained in employment. Care needs to be taken therefore to ensure that such new employment contracts for the entire workforce are not mistaken for mass layoff events. The data we use in this study allows us to address both threats, which we detail below.

Using "Record of Employment" (ROE) Data to Address Threats to Identification

In this section, we describe how Canadian employment data allows us to address these identification threats by exploiting unique Canadian data and intuitions. We closely follow the procedures suggested by Birinci et al. 2023, who also study mass layoffs using the same data, but do not study entrepreneurship as we do. A key element of Canadian employment law, is that all employers are legally obligated to describe the reasons for the separation for all employees who separate. In particular, the employer is required to certify whether the separation is a voluntary quit or an involuntary layoff. This data is known as "Record of Employment" (ROE) and is available to us as part of the matched employer-employee database. We are thus able to use this data to accurately differentiate between voluntary quits and involuntary layoffs for all separations in our data. Using this data we are also able to distinguish between a mass layoff event and a change to the legal structure of the employer (where the employees do not separate from the employer but rather where the employer issues new employment contracts reflecting its new legal structure).[6]

Using this ROE data, Birinci et al. 2023 document that examining mass layoff

[6]The key use of this ROE information in practice is that it is used to determine whether the separated employee is eligible for Employment Insurance. Birinci et al. 2023 argue that various elements of Canadian employment law ensure that the data reported by ROE is accurate because both employers and employees have incentives to ensure accuracy.

events in the Canadian data, *without* using ROE data, would result in very distorted conclusions. For example, they document that only a quarter of workers who would otherwise be classified as being part of a mass layoff should indeed be classified as an involuntary layoff. More than 45% of the mistaken classifications are caused by legal changes of the employer (e.g. name change or M and A), and the rest are voluntary quits that occurred at the same time as the mass layoff event.

Defining Mass Layoff Events

In constructing our sample, we start with the universe Canadian firms available in the National Accounts Longitudinal Microdata File (NALMF) between 2001 and 2021. We follow previous studies in defining mass layoffs as a year-to-year reduction of at least 30% of the workforce, and at least 5 employee layoffs (Bertheau et al. 2023; Couch and Placzek 2010; Schmieder, Von Wachter, and Heining 2023). We only consider employees who have been explicitly fired by the employer, as indicated in the administrative records. We restrict the sample to employers who conducted only one mass layoff between 2001 and 2021. This definition identifies a significant number of employers with a single mass layoff event, where an average number of at least 10 employees have been laid off per incident.

1.3.2 Treatment and Control Groups

Individual Level: Mass Layoff as Treatment and Non Mass Layoff as Control

Our treatment group consists of displaced workers, identified as those laid off in a mass layoff event. To be included in our study, employees are required to have been employed for at least 3 years at the time of the mass layoff, and have been part of a single mass lay off between 2001 and 2021. Because we observe all employment links and reasons for separation, we can exclude individuals who leave voluntarily, were terminated by any firm in any year in the sample, or were

part of more than one mass layoff. The precise identification of workers part of a mass layoff is possible using our detailed employer-employee tax data.

The control group consists of individuals who are never part of a mass layoff at any point in the sample and represents a never-treated counterfactual group, similar to the methodology employed by Greenstone et al. 2022. To form a well-matched control group, for each mass layoff year, we perform a one-to-one propensity score matching method without replacement, as employed in Bertheau et al. 2023 and Schmieder, Von Wachter, and Heining 2023. This approach creates a counterfactual group of workers with characteristics as close as possible to the treatment group in terms of earnings trends and employment trajectories pre-layoff. We match workers based on the following variables: the year of the mass layoff event, average earnings in the two and three years prior to the layoff, the worker's age at the time of layoff, the number of year employed at the firm, the size of the firm measured by the number of employees one year before the lay-off event, and the industry they were working in, as indicated by the 2-digit NAICS code. This ensures that both groups have similar pre-displacement characteristics. Below, we verify the validity of the parallel trend assumptions in this context.

Finally, to capture the dynamics surrounding mass layoffs, we analyze a balanced panel of individuals observed in the data for six years before and after the mass layoff event. This limits the occurrence of mass layoffs in our study to the period between 2007 and 2015, given the dataset's coverage from 2001 to 2021. This results in 118,745 individuals being affected by a single mass-layoff in our sample, matched one-to-one with 118,745 individuals in the control group.

Firm Level: Necessity Founders as Treatment and Voluntary Founders as Control

The second stage in our analysis is to compare the performance of firms started by displaced workers with firms started by non-displaced workers. In our sample of

displaced workers (described above), we can observe that laid-off workers who start new incorporated and unincorporated firms. Our aim is to examine the performance of these specific firms, relative to an appropriate control group of similar firms founded by non-displaced individuals.

To account for macroeconomic conditions and trends, we separately match new incorporated and unincorporated firms based on the year of mass layoff. We first identify all firms started in a given year, by both displaced and non-displaced workers. We then match treated-group founders to control-group founders using one-to-one propensity score matching without replacement, based on their earnings history, age at creation, number of years employed at their prior firm as well as the size of that firm, and with the 2-digit NAICS industry code (sector), as outlined in our individual-level matching procedure (Bertheau et al. 2023; Schmieder, Von Wachter, and Heining 2023).

This matching strategy at individual and mass-layoff-year levels ensures that each displaced founder's firm is directly compared to one non-displaced founder's firm. We validate this approach by verifying the parallel trend assumption, confirming the similarity of pre-displacement characteristics between the matched pairs of firm founders.

1.4 Model and Estimation

1.4.1 Staggered Difference-in-Differences

The first stage of our analysis is to document that the mass layoff event has a causal impact on subsequent entry into entrepreneurship (both incorporated and unincorporated). Our main identification strategy to document this causal relationship compares the treated group of necessity entrepreneurs with the control group of voluntary entrepreneurs, where we argue that because the necessity entrepreneur was subject to a mass layoff, the lay off event can be considered

involuntary and plausibly exogenous.

Our identification strategy uses mass layoffs as an instrument for job separation. The frequency and large scale of these layoffs provide a basis for examining their impact on employees, allowing us to analyze changes in employment patterns, income earnings, and transitions into entrepreneurship or self-employment. We follow the recent advances in the literature to measure dynamic treatment effects in a staggered difference-in-differences methodology (Goodman-Bacon 2021; De Chaisemartin and D'Haultfœuille 2020; Callaway and Sant'Anna 2021; Sun and Abraham 2021; A. C. Baker, Larcker, and C. C. Wang 2022; Wing et al. 2024) and adopt a stacked-regression model (e.g. Deshpande and Y. Li 2019; Cengiz et al. 2019).

We use never-treated individuals as control groups, to ensure that we construct and analyze clean subsets of experiments (A. C. Baker, Larcker, and C. C. Wang 2022). This addresses potential biases from staggered treatments by maintaining the critical assumption of parallel trends more reliably than if the control group were subject to varying treatment timings. Moreover, this method helps to avoid spillover effects, as our control group's outcomes remain uninfluenced by the treatment, providing a clearer estimation of the treatment effect.

Specifically, we estimate the following equation :

$$Y_{it} = \sum_{\substack{\tau=-6 \\ \tau\neq-1}}^{6} \mathbb{1}(\text{Period}_{i\tau}) \times (\beta_{0\tau} + \beta_{1\tau}\text{Treated}_i) + \gamma_j + \lambda_t + \theta_{c\tau} + \mu_i + \varepsilon_{it}, \tag{1.1}$$

where Y_{it} is the dependent variable for individual i in calendar year t (for example, labour earnings, firm creation indicators, or firm outcomes), Treated_i is a dummy variable indicating whether individual i is in the treatment group, and $\mathbb{1}(\text{Period}_{i\tau})$ is an indicator variable equal to one if the event time is equal to τ, and 0 otherwise, λ_t captures calendar-year fixed effects, γ_j represents the firm fixed effect, $\theta_{c\tau}$ is the interaction of the cohort year with the event time, where c indexes different cohort year, distinguishing among groups of individuals based

on the year of the mass layoff. μ_i represents individual fixed effects, and ε_{it} is the error term. In all our results, we cluster standard errors at the individual level and cohort level.

Because we use individuals who are part of a mass-layoff only once and we match to never-fired individuals without replacement in the cohort-year, the individual fixed effects capture time-invariant individual characteristics. We also saturate the model by including cohort-specific event-study-time fixed effects. Such a comprehensive fixed effects structure helps to isolate the impact of mass layoffs.

Our main coefficients of interest are the series of $\beta_{1\tau}$, which measure the effect of mass layoffs relative to event time $\tau = -1$ (the last year in which individuals are still employed by the firm which experienced the mass layoff).

1.4.2 Choice Between Incorporated and Unincorporated Firms

The second stage of our analysis is to document the choice of necessity entrepreneurs to select into either incorporated or unincorporated businesses. As we describe above, our main sample contains 118,745 displaced workers, matched one to one to undisplaced workers. In this section we examine on the fraction of this combined group (both displaced and matched undisplaced), who in the year t=0 select into either incorporated or unincorporated businesses. We examine this choice in the year of the displacement, to focus on laid-off individuals who selected into necessity entrepreneurship within one year.

To analyze this choice, we use the following probit model:

$$\text{Firmchoice}_{it} = \alpha + \beta \text{Treated}_i + \lambda_t + \theta_c + \delta_s + \epsilon_{it}. \tag{1.2}$$

In the model, Firmchoice_{it} represents a binary variable equal to one if the new firm is incorporated, and 0 if the new firm is unincorporated. The variable Treated_i is as a dummy variable indicating whether the individual was displaced in calendar-year t. To account for time-specific influences that could affect the

decision to incorporate or not, λ_t captures calendar-year fixed effects, since we are observing the firm that have been opened the year of the mass layoff.

Our main coefficient of interest is β, which captures the impact of displacement on the choice of firm type. Lastly, ϵ_{it} represents the error term, capturing unobserved factors that might influence the incorporation choice.

1.4.3 Firm Performance Regression

The third part of our empirical analysis examines the performance of firms started by a necessity entrepreneur, relative to a matched control group of voluntary entrepreneurs. We run separate specifications for incorporated and unincorporated firms (i.e. the first specification compares displaced vs. undisplaced employees who then start incorporated firms, while the second specification compares displaced vs. undisplaced employees who then start unincorporated firms).

To analyze the firm performance in our context, we employ the following regression:

$$Y_{it} = \alpha + \beta_{1j}\text{Treated}_{ij} + \gamma_r + \lambda_t + \delta_s + \epsilon_{it}, \tag{1.3}$$

where the Y_{it} serves as the dependent variable for firm i at time t, capturing outcomes such as profitability, growth, employment etc. The variable Treated_i is a dummy variable indicating whether a displaced worker founded the firm. The model includes γ_r to represent region fixed effects, controlling for geographic influence on firm performance, while λ_t accounts for the year fixed effects. Additionally, δ_s represents industry fixed effects using the 2-digit NAICS code to account for industry-specific trends that could affect firm performance.

In some specifications, we introduce an interaction term between the treated variable and a dummy variable, which represents the specificity or characteristic (demographics) of the founder. Our objective is to capture the heterogeneity of effects that could emerge among firms. This approach allows us to identify the

differential impacts and insights into how various baseline characteristics interact with the treatment effect on firm outcomes.

In terms of the event window, we run two alternative specifications, the first examining performance in the year of the firm creation, and the second examining average annual performance in the first five years after firm creation.

1.5 Results

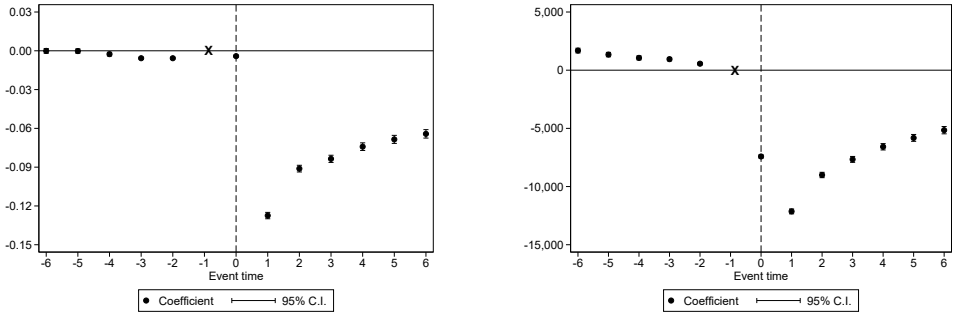
Our first set of results examine DID event studies, where displaced workers are the treated group, and non-displaced workers are the control group. We first document the significant negative effects of a mass-layoff on worker employment, earnings and withdrawals in existing pension plans (known as Registered Retirement Savings Plans or RRSPs in Canada). We then document how the mass layoff event causes these displaced workers to become necessity entrepreneurs, by selecting into either incorporated or unincorporated businesses.

The main conclusion of the event study DID results in this section is to provide strong evidence that the mass layoff event has a causal impact on necessity entrepreneurship (of both incorporated as well as unincorporated types). In all of the event study DID results we report, we show insignificant pre-trends before the event date (the date of the mass layoff event), and then significant changes after the event date. We argue that the evidence presented here is thus consistent with our key identification assumption that the mass layoff event will cause workers subject to a mass layoff to become necessity entrepreneurs and select into entrepreneurship.

1.5.1 Employment, Earnings and Savings Withdrawal

Figure 1.1 (a) exhibits the impact of mass layoffs on the probability of subsequent employment. The trends for both treated and control groups align consistently

Figure 1.1 – Effect of mass layoff on employment and earnings



(a) Employment

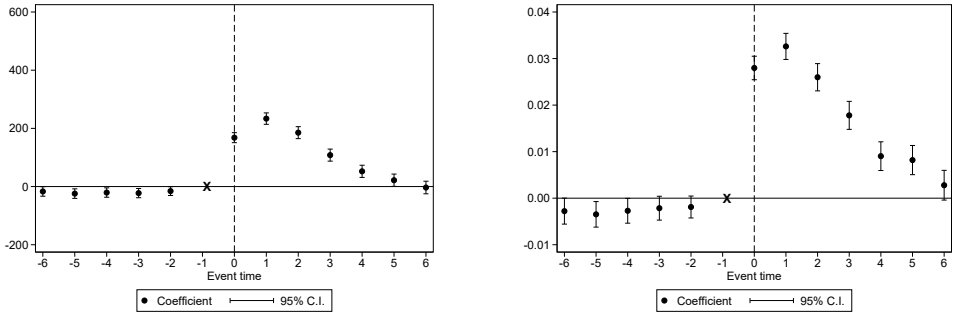
(b) Employment income ($)

Note: This figure presents employment activity (a) and employment income (b) around the mass-layoff event. $t = 0$ represents the year of the mass layoff. We use the sample of 118,745 individuals part of a mass-layoff between 2007 and 2015 matched to a control group of 118,745 individuals who were not affected by the mass-layoff event. Employment (a) is defined as a dummy variable equal to one if the individual received employment income (i.e. some T4 earnings) from a firm in the current year, and 0 otherwise. Earnings are calculated from the T1 Personal Master File (T1PMF) and are defined as the total employment income reported on T4 slips, before any deductions. We report 95% confidence intervals based on standard errors clustered at the individual level.

until the event of the layoffs. At this point, a pronounced dip in employment likelihood for the treated group is evident, showing a decline of almost 15 percentage points. Recovery is gradual over time; however, even several years post-layoff, employment probabilities have not returned to pre-layoff levels, suggesting a lasting effect of mass layoffs on job prospects. Figure 1.1 (b) portrays the trajectory of wage employment earnings following mass layoffs. Aligning with the employment probabilities trend, the earnings of the treated group mirror those of the control group until the event of the layoffs. The layoff event marks a significant inflection point, with earnings for the treated group declining sharply by close to $15,000. The subsequent period demonstrates a partial recovery, yet earnings remain noticeably below the pre-layoff benchmark, reflecting the enduring financial impact of mass layoffs.

Figure 1.2 portrays the trend in withdrawals from Registered Retirement Sav-

Figure 1.2 – Pension savings withdrawals



(a) Amount ($)

(b) Extensive margin

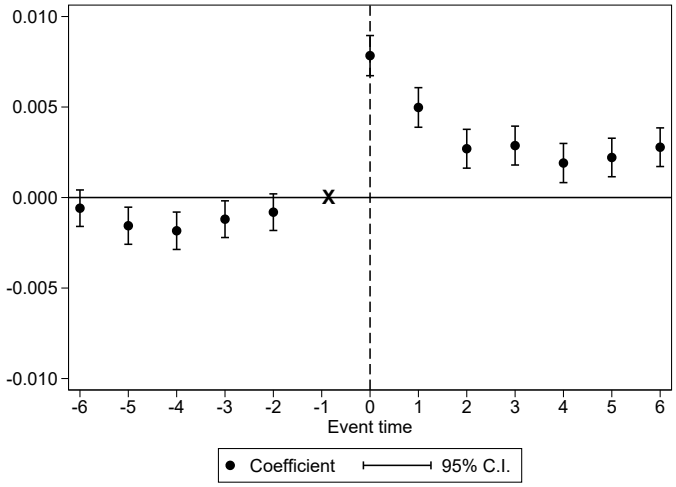
Note: this figure presents RRSP income (withdrawal) dynamic around the mass-layoff event (Amount withdrawal (a) and extensive margin (b)). $t = 0$ represents the year of the mass-layoff. We use the sample of 118,745 individuals part of a mass-layoff between 2007 and 2015 matched to a control group of 118,745 individuals who were not affected by the mass-layoff event. RRSP-income is calculated from the T1 Personal Master File (T1PMF). We report 95% confidence intervals based on standard errors clustered at the individual level.

ings Plan (RRSP) before and after mass layoffs. Because individuals who are subject to a mass layoff event have a sudden and significant drop in wage income (as documented above), they face an incentive to withdraw money from their retirement savings plans (RRSPs). The timeline prior to the layoffs demonstrates a relatively low and steady amount of RRSP withdrawals. However, coinciding with the layoffs, there is a notable increase in withdrawals (4%), indicating that individuals are tapping into their retirement savings as a response to job loss. This provide one mechanism used by displaced workers to adjust to the lay-off.

1.5.2 New Incorporated Firms

We then observe the dynamic of incorporation for the displaced workers after the displacement. Figure 1.3 (a) indicates a discernible increase in the opening of an incorporated business following mass layoffs. The baseline trend before the layoffs shows little change in the rate of new business creation. However, con-

Figure 1.3 – Incorporated business



(a) Opening an incorporated business

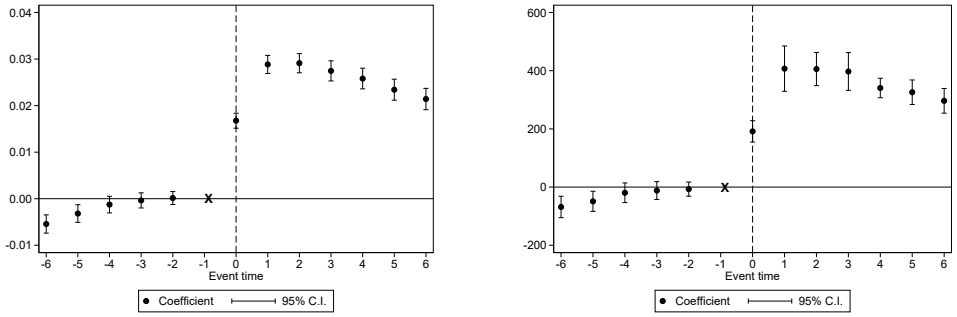
Note: This figure presents the opening dynamics of incorporated businesses around the mass-layoff event. $t = 0$ represents the year of the mass layoff. We use the sample of 118,745 individuals part of a mass layoff between 2007 and 2015 matched to a control group of 118,745 individuals who were not affected by the mass layoff event. "Opening an incorporated business" is defined as the businesses created and incorporated within the year, we identify these openings using a binary indicator. This indicator is derived from combining data from the T2 Corporation Income Tax Return (T2SR50) and the National Accounts Longitudinal Microdata File (NALMF), with '1' indicating the presence of a new business, and '0' indicating the absence of such activity. We report 95% confidence intervals based on standard errors which are clustered at the individual level.

current with the layoffs, there is a noticeable increase, with the rate of individuals starting new incorporated businesses rising by close to one percentage point in the year of the lay-off.

1.5.3 New Unincorporated Firms

Figure 1.4 examines total self employment income from unincorporated firms. Panel (a) of Figure 1.4 examines the extensive margin of entry into self-employment following the mass layoff event. This figure reveals a marked shift toward self-employment in response to mass layoffs. Prior to the layoffs,

Figure 1.4 – Effect of mass layoff on self-employment and self-employment income



(a) Self-employment extensive margin (b) Self-employment income($)

Note: This figure presents self-employment extensive margin (a) and self-employment income (b) around the mass-layoff event. $t = 0$ represents the year of the mass-layoff. We use the sample of 118,745 individuals part of a mass-layoff between 2007 and 2015 matched to a control group of 118,745 individuals who were not affected by the mass-layoff event. Self-employment income is the sum of business, commission, and professional income, calculated from the T1 Personal Master File (T1PMF). We report 95% confidence intervals based on standard errors clustered at the individual level.

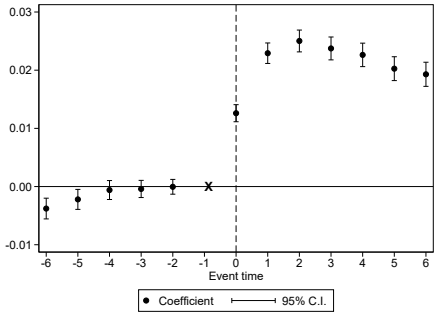
the prevalence of self-employment was similar between the treated and control groups. Following the layoffs, however, there is a pronounced increase in self-employment for those impacted, peaking at a 5% increase. Figure 1.4 (b) documents very similar patterns for the dollar magnitudes of total self-employment income.

Unregistered Business, Commission, and Professional Incomes

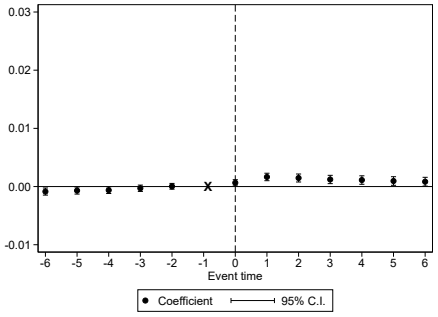
Our tax return data allows us to observe various categories of unincorporated business activity. We focus on three main categories of self-employment income (1) unincorporated business income, (2) professional income and (3) commission income.[7] Figure 1.5 presents the extensive margin of these three components, and show that the impact of mass layoffs on commission income and on professional income is very small. The vast majority of the effect of a mass layoff event is on

[7]Because they consist of small amounts, we exclude farming, fishing, and rental income.

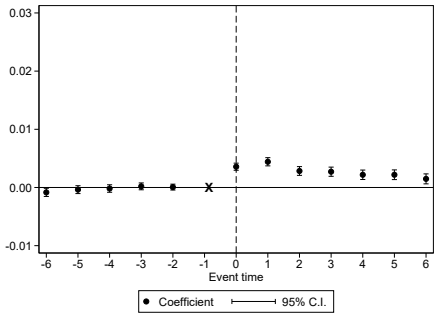
Figure 1.5 – Self-employment income (extensive margin)



(a) Unincorporated business income



(b) Commission income



(c) Professional income

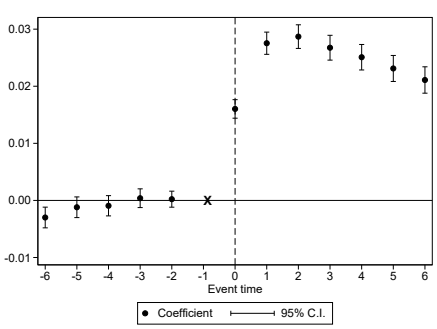
Note: This figure presents the business unincorporated (a), commission unincorporated (b), and professional unincorporated extensive margin activity around the mass-layoff event. $t = 0$ represents the year of the mass layoff. We use the sample of 118,745 individuals' part of a mass layoff between 2007 and 2015 matched to a control group of 118,745 individuals who were not affected by the mass layoff event. We report 95% confidence intervals based on standard errors clustered at the individual level.

unincorporated business income. Appendix Figure 1.7 shows that this result also holds when looking at the amount earned in each component.

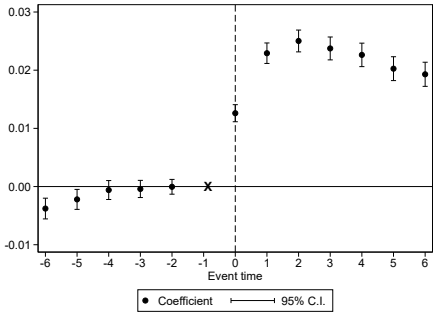
Unregistered and Unincorporated Firms (Gig Work)

Another useful distinction, described above, concerns the cutoff of firm annual income above and below $30 000 in the Canadian tax code. Firms with income below this cutoff do not have to report and file Canadian Sales Tax. These firms are thus very small (as measured by income) and can be labelled as unincorpo-

Figure 1.6 – Gig Income and Unincorporated Business extensive margin



(a) Gig-work extensive margin



(b) Unincorporated business extensive margin

Note: This figure presents the dynamics of gig and business activity around the mass-layoff event. $t = 0$ represents the year of the mass layoff. We analyze a sample of 118,745 individuals who were part of a mass layoff between 2007 and 2015, matched to a control group of 118,745 individuals who were not affected by the mass-layoff event. Gig-income is defined following the Jeon, H. Liu, and Ostrovsky 2021.It is derived from combining the T1PMF and the T1FDB. We report 95% confidence intervals based on standard errors clustered at the individual level.

rated unregistered, or as Gig work.

Figure 1.6 tracks the trajectory of gig economy activity following mass layoffs. In the aftermath of the layoffs, there is a discernible uptick in gig economy engagement among the treated group, with an increase of close to 3 percentage points. This shift highlights the layoffs' role in driving individuals towards alternative forms of employment within the gig economy.

In summary therefore, the previous analysis has shown that those subject to a mass layoff event select into both incorporated as well as unincorporated new businesses. Within the group of unincorporated firms many are very small gig type enterprises that are unregistered and without a formal business number. However selection into partnerships and commission income type enterprises are very limited.

1.6 The Choice Between Incorporated and Unincorporated Firms

Before we document our main results on firm performance, based on the identification strategy described above, we first, analyze the choice between opening an incorporated entity versus an unincorporated entity in the year of displacement (t=0) using equation (1.2).

Our finding presents a clear pattern, with individuals who have experienced a job displacement being more likely to start an unincorporated business rather than an incorporated one. We notice that they are 9.7 percentage points more likely to open an unincorporated business (Table 1.2). The results show a discernible inclination towards unincorporated entities, signifying a potential strategic preference for paths with potentially lower initial investment and complexity.

We then turn our analysis, to identify if there are demographic and economic factors of the founders which could nuanced dynamics across this entrepreneurial decision the year of their displacement.

First, we found that the gender of the entrepreneur could significantly influence incorporation choices. Men are more likely to open an incorporated business compared to women. This gender difference could represent the varied perceived opportunities and access to funding between men and women when navigating the decision to launch a business and to incorporate them. However, we also found that among the displaced workers, there is no significant difference among the genders. The interaction between job displacement and gender is statistically non-significant, suggesting that the impact of job loss on incorporation decisions does not change significantly across men and women.

Second, we also observe that immigrant status plays a role in our findings. While being an immigrant does not directly affect the likelihood of choosing to open an incorporated entity rather than an unincorporated entity, we notice that there is a distinct pattern among the displaced. Displaced immigrants (interac-

tion terms between immigrant and displaced) are more inclined towards opening incorporated entities compared to their non-immigrant counterparts. The significance of this interaction between job displacement and immigrant status could reveal the challenges and opportunities faced by immigrants in their entrepreneurial adventures, especially when job loss is a factor.

1.7 Firm Performance of Necessity vs. Voluntary Entrepreneurs

In the previous sections we used event study DIDs to document that a mass layoff event has a causal effect on the starting of necessity entrepreneurship of different kinds (including unincorporated, incorporated, gig etc.). Our aim in this section is to compare the performance of these exact same necessity entrepreneurs, with the performance of propensity matched voluntary entrepreneurs (i.e. non laid-off individuals who started similar firms).

We classify an individual founder as a necessity entrepreneur based on our causal DID results above, linking the formation of that firm to the founder being subject to a mass lay-off event. For this reason we are able to use these founders who were subject to the mass layoff event (i.e. necessity entrepreneurs), as our treatment group in these regressions. Our control group consists of propensity score matched founders who were not subject to a mass layoff event, who we can thus designate as voluntary entrepreneurs.

In this section we use firm level performance data (e.g. sales, assets, profits, etc) from the date of the origination of the firm. Because we start from the date of the formation of the firm, there is no pre-period, by construction.

1.7.1 Incorporated Firms

Our short run results for incorporated firms are presented in Panel A of Table 1.3, for the year of the firm creation, and our long run results are presented in panel A of Table 1.4 for the average of years 1 to 5 after the firm creation.

In these two tables, we first report our main baseline results comparing the performance for the necessity entrepreneurs against the matched group of voluntary entrepreneurs. We then examine various hetrogeneity tests for various subgroups (specifically based on gender and immigrant status) which we discuss in detail below.

Baseline Results

Our short term (in year of firm formation) baseline results for reported in Panel A of Table 1.3 indicate that necessity entrepreneurs who select into incorporation have profits that are $13K lower than the matched sample of voluntary entrepreneurs who select into incorporation. In addition, we document that the incorporated firms of necessity entrepreneurs are significantly smaller than matched incorporated firms of firms of voluntary entrepreneurs across many measures of firm size (including sales ($68k), cost of sales ($63k), total assets ($122K), total payroll ($11K) etc.).

Our long term results (based on the average annual amounts for the first five years after the firms creation), as reported in Table 1.4 are even larger in magnitude than the short term results. In the long term case, we find that necessity entrepreneurs who select into incorporation have an annual gross profit of $53K less than the matched group of voluntary entrepreneurs who select into incorporation. Similarly, our results show that the incorporated firms started by necessity entrepreneurs are significantly smaller across all of these measures, relative to voluntary entrepreneurs (including sales ($177k), cost of sales ($151k), total assets ($218K), total payroll ($34K) etc.)

These results, showing that necessity entrepreneurs who select into incorporation are both significantly less profitable as well as significantly smaller, compared to voluntary entrepreneurs, is consistent with the main new hypothesis proposed in this paper. Our new hypothesis combines the model of Rubinstein and Levine 2020 (that financial and human capital are important inputs required for success as incorporated firms), as well as the argument that necessity entrepreneurs typically lack both human as well as financial capital. Our results that necessity entrepreneurs who select into incorporation are both significantly less profitable as well as significantly smaller than the matched group of voluntary entrepreneurs, is consistent with necessity entrepreneurs not having access to either (or both) of the human capital and financial capital that are prerequisites for success and growth as an incorporated firm.

In panel B of these two tables we show hetrogeneity results based on gender, but our main conclusion here is that we find no significant effects based on gender.

Immigrant Status

In Panel C of Table 1.3 and Panel C of Table 1.4 we show heterogeneity results based on immigrant status. As we describe above, a large recent literature has documented the relative success of immigrant entrepreneurs across firms of all sizes. Our main conclusion from these results is that the gross profits of immigrant necessity entrepreneurs who select into incorporation is not significantly different than voluntary entrepreneurs who select into incorporation. In addition, we show that incorporated firms started by laid-off immigrants are significantly larger then similar firms started by voluntary entrepreneurs.

Taken together, these results for immigrants are very different from similar results for the general population (as seen in Panel A of these two Tables), where necessity entrepreneurs are both smaller as well as less profitable. We argue that these new results are consistent with the recent literature documenting that

immigrants have achieved entrepreneurial success across all kinds of firms (e.g. Azoulay et al. 2022; S. P. Kerr and W. Kerr 2020; Fairlie and Lofstrom 2015. Put differently, immigrants seem to be the one category of necessity entrepreneurs who are able to overcome the liabilities imposed by being laid off (typically thought of as the lack of human capital and the lack of financial capital) in order to start incorporated firms that have similar levels of profitability compared to similar firms started by voluntary entrepreneurs.

1.7.2 Unincorporated Firms

Baseline Results

Our baseline results for comparing necessity entrepreneurs selecting into unincorporated firms with matched voluntary entrepreneurs selecting into unincorporated forms are presented in Panel A of Table 1.5 for short run results in the year of the firm formation, and Panel A of Table 1.6 for long run results for the average annual effect of the first five years after the firm's formation.

Our main finding from Panel A of Table 1.5 and Panel A of Table 1.6 is that the gross profits of necessity entrepreneurs in unincorporated firms are significantly larger than matched results for voluntary entrepreneurs, in both the short run ($2.8K per year) as well as the long run ($5.5K per year).

In addition, we also find that necessity entrepreneurs are small than matched voluntary across a variety of measures, in both the first year (e.g. total revenue $10K, total expenses $6K, total payroll $0.6K), as well as the first five years ((e.g. total revenue $10K, total expenses $6K, total payroll $0.7K).

One interpretation of these results is that even within the group of unincorporated firms, necessity entrepreneurs are significantly smaller than matched voluntary entrepreneurs. However, in spite of the small size of the firms, the necessity entrepreneurs are still significantly more profitable than matched voluntary entrepreneurs. In other words, even within the group of unincorporated firms,

the necessity entrepreneurs still "aim low", in that they are smaller but still more profitable.

In Panel B and Panel C of these tables, we examine hetrogeneity tests for gender and immigrant status, but do not find significant evidence across multiple different measures.

1.8 Conclusion

The literature has found conflicting results regarding the performance of firms started by necessity entrepreneurs. Some papers have found that firms created by necessity entrepreneurs under perform (Galindo Da Fonseca 2022), while others provide evidence of entrepreneurs founding successful firms following negative labor shocks (Babina 2019; Hacamo and Kleiner 2022). This paper argues that these differing results can be reconciled by considering the type of firm created by necessity entrepreneurs, particularly in terms of the decision to incorporate or not.

We use administrative tax record data to track both incorporated and unincorporated businesses in Canada and we study the performance of displaced workers who start each type of firm. 0ur analysis suggests that the type of firm created by displaced workers significantly affects their entrepreneurial success. Displaced workers who start unincorporated firms perform better than a non-displaced control group, whereas those who create incorporated firms under perform. These results challenge the traditional narrative that displaced workers are less likely to succeed in entrepreneurial ventures. Instead, we show that displaced workers can find success, particularly when they choose to open unincorporated businesses or engage in gig work, which we define as “aiming low.”

The success of displaced workers in less complex entrepreneurial activities (unincorporated business and gig work) demonstrates the importance of lower entry costs in entrepreneurship (Levine and Rubinstein 2017). This suggests that

success in entrepreneurship, particularly for displaced workers, may be easier to achieve in less formal structures. These findings have broader implications for understanding entrepreneurship in the face of adversity, considering the common rhetoric that portrays entrepreneurship as an alternative path out of unemployment following job displacement. While our analysis supports the idea that entrepreneurship can help recover from negative labor shocks, it highlights that success largely depends on the type of entrepreneurial firms created. Given the distinct challenges and opportunities that laid-off workers face, policy frameworks should support realistic entrepreneurial pathways, particularly those requiring lower initial investments, such as unincorporated businesses and gig work.

Tables

Table 1.1 – Descriptive Statistics

	Mean	SD	N
Panel A. Demographics			
Year of layoff	x	x	x
Age	x	x	x
Male indicator	x	x	x
Immigrant indicator	x	x	x
Panel B. Employment data			
Employment income	x	x	x
Nb of employers	x	x	x
RRSP withdrawals	x	x	x
Panel C. Unincorporated business data			
Unincorp. bus. owner	x	x	x
Self-employment income	x	x	x
Total revenues	x	x	x
Total expenses	x	x	x
Gross profits	x	x	x
Capital cost	x	x	x
Number of employees	x	x	x
Total payroll	x	x	x
Panel D. Incorporated business data			
Incorp. bus. owner	x	x	x
Sales, goods and services	x	x	x
Cost of sales	x	x	x
Gross profits	x	x	x
Total assets	x	x	x
Intangible assets	x	x	x
Tangibility ratio	x	x	x
Number of employees	x	x	x
Total payroll	x	x	x

Note: This table presents the descriptive statistics for the main variables used in the analysis, and is currently pending disclosure review.

Table 1.2 – Choosing between incorporated and unincorporated businesses

	(1) Incorporation
A. Baseline result	
Displaced worker	-0.097***
	(0.014)
B. Gender	
Displaced worker × Male	0.068**
	(0.030)
Male	0.08***
	(0.016)
Displaced worker	-0.102***
	(0.014)
C. Immigrant	
Displaced worker × Immigrant	0.11***
	(0.035)
Immigrant	0.00002
	(0.018)
Displaced worker	-0.097***
	(0.014)
Cohort FE	YES
Year FE	YES
Treated FE	YES
Treated x Cohort FE	YES

Note: This table summarizes the findings from a probit model analysis on the choice between starting an incorporated versus an unincorporated business in the event year of displacement (T=0). Our model controls for individual displacement status, gender, and immigration status. The coefficients indicate the likelihood of choosing incorporation over unincorporation, with positive values suggesting a higher propensity towards incorporated businesses. Standard errors are clustered at the individual level to account for within-individual correlation across time. Significance levels are denoted by asterisks, with *** p<0.01, ** p<0.05, * p<0.1.

Table 1.3 – Incorporated business performance (in year of firm creation)

	Income and profits			Balance sheet and labor				
	(1) Sales	(2) Cost of sales	(3) Gross profits	(4) Total assets	(5) Intangible assets	(6) Tangibility ratio	(7) Number of employees	(8) Total payroll
A. Baseline result								
Displaced worker	-68,951***	-63,439***	-13,077**	-122,961***	-6,139**	-0.02**	-0.848***	-11,100***
	(16,970)	(16,283)	(5,403)	(20,977)	(2,546)	(0.009)	(0.232)	(3,452)
B. Gender								
Displaced worker × Male	-2,138	-1,217	5,348	-46,408	-4,077	0.009	-0.839*	-11,131*
	(36,335)	(34,945)	(11,380)	(44,204)	(4,825)	(0.019)	(0.503)	(6,737)
Male	5,689	4,548	-207	42,306	6,471	0.025*	0.622	9,422*
	(31,346)	(31,067)	(8,800)	(37,545)	(4,439)	(0.013)	(0.381)	(5,342)
Displaced worker	-67,638**	-62,754**	-17,030*	-90,593**	-3,427	-0.028*	-0.256	-3,301
	(30,695)	(29,335)	(9,317)	(35,822)	(3,699)	(0.016)	(0.419)	(4,921)
C. Immigrant								
Displaced worker × Immigrant	91,355***	86,636***	18,369*	95,127**	11,382***	0.014	0.967**	21,814***
	(34,231)	(31,691)	(10,219)	(40,411)	(4,384)	(0.020)	(0.464)	(6,092)
Immigrant	-127,698***	-104,340***	-40,285***	-125,109***	-12,481***	-0.004	-1.837***	-25,499***
	(30,166)	(29,168)	(7,856)	(35,821)	(3,937)	(0.015)	(0.368)	(4,522)
Displaced worker	-88,496***	-82,481***	-16,565**	-143,551***	-8,678***	-0.023**	-1.041***	-15,918***
	(20,952)	(20,745)	(6,612)	(26,231)	(3,296)	(0.010)	(0.283)	(4,421)
Cohort FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Treated FE	YES	YES	YES	YES	YES	YES	YES	YES
Treated x Cohort FE	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table illustrates the influence of various factors on the operational outcomes of incorporated firms, considering asset values, profitability, and sales of goods. The analysis uses a sample of firms established by displaced workers, comparing their performance against non-displaced founders across different demographic and economic dimensions. 'Displaced x Sex' indicates the interaction effect of displacement and the founder's gender, while 'Displaced x Immigrant' analyzes the relation of job loss with immigration status, respectively. Standard errors are clustered at the firm level to account for within-individual correlation across time. Significance levels are denoted by asterisks, with *** p<0.01, ** p<0.05, * p<0.1.

Table 1.4 – Incorporated business performance (Averaged one to five years after firm creation)

	Income and profits			Balance sheet and labor				
	(1) Sales	(2) Cost of sales	(3) Gross profits	(4) Total assets	(5) Intangible assets	(6) Tangibility ratio	(7) Number of employees	(8) Total payroll
A. Baseline result								
Displaced worker	-177,912***	-151,400***	-52,693***	-218,720***	-8,775***	-0.002	-1.508***	-33,759***
	(24,845)	(23,571)	(8,878)	(25,542)	(2,679)	(0.009)	(0.259)	(6,009)
B. Gender								
Displaced worker × Male	-52,950	-84,990*	9,057	-58,868	-390	0.018	-0.134	-5,793
	(48,011)	(44,963)	(17,847)	(53,944)	(5,505)	(0.019)	(0.534)	(11,370)
Male	89,562**	93,097**	19,238	94,591**	2,935	0.02	0.591	20,396**
	(38,509)	(37,031)	(14,326)	(44,504)	(4,688)	(0.013)	(0.419)	(8,994)
Displaced worker	-141,896***	-92,025**	-59,922***	-178,525***	-8,580*	-0.016	-1.428***	-30,146***
	(38,747)	(35,898)	(14,826)	(44,508)	(4,694)	(0.016)	(0.445)	(8,918)
C. Immigrant								
Displaced worker × Immigrant	83,261	88,023*	4,842	170,804***	8,101*	-0.017	0.598	36,744***
	(52,614)	(49,956)	(18,324)	(51,288)	(4,538)	(0.020)	(0.547)	(11,030)
Immigrant	-166,936***	-124,257***	-60,088***	-195,295***	-10,987***	-0.016	-1.925***	-59,909***
	(43,696)	(43,579)	(14,959)	(41,522)	(4,201)	(0.015)	(0.442)	(8,473)
Displaced worker	-193,875***	-169,754***	-52,196***	-255,630***	-10,477***	0.003	-1.602***	-41,193***
	(28,837)	(27,498)	(10,393)	(30,774)	(3,320)	(0.010)	(0.301)	(7,175)
Cohort FE	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Treated FE	YES	YES	YES	YES	YES	YES	YES	YES
Treated x Cohort FE	YES	YES	YES	YES	YES	YES	YES	YES

Note: This table illustrates the influence of various factors on the operational outcomes of incorporated firms, considering asset values, profitability, and sales of goods. The analysis uses a sample of firms established by displaced workers, comparing their performance against non-displaced founders across different demographic and economic dimensions. 'Displaced x Sex' indicates the interaction effect of displacement and the founder's gender, while 'Displaced x Immigrant' analyzes the interplay of job loss with immigration status, respectively. Standard errors are clustered at the firm level to account for within-firm correlation across time. Significance levels are denoted by asterisks, with *** p<0.01, ** p<0.05, * p<0.1.

Table 1.5 – Unincorporated business performance (in year of firm creation)

	Income and profits			Balance sheet and labor		
	(1) Total revenues	(2) Total expenses	(3) Gross profits	(4) Capital cost	(5) Number of employees	(6) Total payroll
A. Baseline result						
Displaced worker	-10,469***	-6,165***	2,846***	1,400**	-0.063***	-651***
	(2,304)	(1,018)	(911)	(713)	(0.023)	(206)
B. Gender						
Displaced worker × Male	7,342	2,740	2,829	2,333	-0.025	101
	(4,719)	(2,099)	(1,808)	(1,470)	(0.049)	(430)
Male	2,110	-199	627	755	-0.031	-213
	(3,880)	(1,716)	(1,293)	(1,121)	(0.036)	(332)
Displaced worker	-15,400***	-7,979***	951	-170	-0.045	-713**
	(3,765)	(1,706)	(1,444)	(1,183)	(0.040)	(349)
C. Immigrant						
Displaced worker × Immigrant	5,343	1,657	-912	48	-0.071	-723
	(4,835)	(2,189)	(2,057)	(1,594)	(0.050)	(458)
Immigrant	-18,467***	-6,866***	-2,740*	-2,904**	-0.027	-52
	(4,045)	(1,836)	(1,452)	(1,211)	(0.040)	(380)
Displaced worker	-11,598***	-6,511***	3,061***	1,400*	-0.046*	-489**
	(2,724)	(1,198)	(1,047)	(830)	(0.027)	(241)
Cohort FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Treated FE	YES	YES	YES	YES	YES	YES
Treated x Cohort FE	YES	YES	YES	YES	YES	YES

Note: This table illustrates the influence of various factors on the operational outcomes of unincorporated firms, considering profit, expense, and revenue. The analysis uses a sample of firms established by displaced workers, comparing their performance against non-displaced founders across different demographic and economic dimensions. 'Displaced x Sex' indicates the interaction effect of displacement and the founder's gender, while 'Displaced x Immigrant' examine the interplay of job loss with immigration. Standard errors are clustered at the firm level to account for within-firm correlation across time. Significance levels are denoted by asterisks, with *** p<0.01, ** p<0.05, * p<0.1.

Table 1.6 – Unincorporated business performance (Averaged one to five years after firm creation)

	Income and profits			Balance sheet and labor		
	(1) Total revenues	(2) Total expenses	(3) Gross profits	(4) Capital cost	(5) Number of employees	(6) Total payroll
A. Baseline result						
Displaced worker	-9,752***	-6,488***	5,506***	1,805*	-0.062**	-704**
	(3,415)	(1,435)	(1,400)	(992)	(0.030)	(310)
B. Gender						
Displaced worker × Male	11,244	6,205**	-321	174	0.015	353
	(7,057)	(2,975)	(2,815)	(2,016)	(0.066)	(666)
Male	4,389	-283	2,774	2,623*	-0.066	-525
	(5,608)	(2,351)	(1,897)	(1,441)	(0.049)	(494)
Displaced worker	-17,146***	-10,552***	5,699**	1,675	-0.071	-932*
	(5,691)	(2,404)	(2,272)	(1,643)	(0.055)	(548)
C. Immigrant						
Displaced worker × Immigrant	8,573	6,424**	-1,249	-881	0.02	332
	(7,257)	(3,159)	(3,169)	(2,167)	(0.068)	(703)
Immigrant	-27,284***	-11,070***	-5,421**	-5,144***	-0.09*	-881*
	(5,875)	(2,486)	(2,266)	(1,639)	(0.051)	(532)
Displaced worker	-11,898***	-8,012***	5,735***	1,955*	-0.067*	-785**
	(4,040)	(1,691)	(1,599)	(1,151)	(0.035)	(362)
Cohort FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Treated FE	YES	YES	YES	YES	YES	YES
Treated x Cohort FE	YES	YES	YES	YES	YES	YES

Note: This table illustrates the influence of various factors on the operational outcomes of unincorporated firms, considering profit, expense, and revenue. The analysis uses a sample of firms established by displaced workers, comparing their performance against non-displaced founders across different demographic and economic dimensions. 'Displaced x Sex' indicates the interaction effect of displacement and the founder's gender, while 'Displaced x Immigrant' examines the relation between job loss with immigration status. Standard errors are clustered at the firms level to account for within-firm correlation across time. Significance levels are denoted by asterisks, with *** p<0.01, ** p<0.05, * p<0.1.

1.9 Appendix

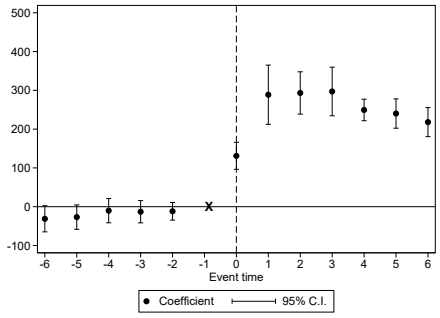
Table 1.7 – Definitions of Variables

Variable	Definition	Source
A. Demographic variables		
casenum2019	Unique identifier for individuals	T1PMF
prov of residence	Province or territory of residence	T1PMF
year	Year of tax records	T1PMF
birth year	Birth year of the individual	T1PMF
death year	Death year of the individual	T1PMF
sex	Sex	T1PMF
age	Age of the individual	T1PMF
Immigrant	Indicator representing whether the individual is an immigrant or not	IMBD
B. Income variables		
Business income net	Net business unincorporated income	T1PMF
Commission income net	Net commission unincorporated income	T1PMF
Professional inc net	Net professional unincorporated income	T1PMF
Earnings	Total employment income from T4 slips, before deductions	T1PMF
RSP Income	Income from RRSP withdrawals	T1PMF
Gig income total	Revenue from Gig- Income activities	T1PMF
Self-employment income	Self-employment income	T1PMF
C. Incorporated firm variables		
Nbr worker laidoff	Number of worker who were laidoff by the firm	NALFM
Nbr worker	Number of worker who worked for the firm	NALFM
Year of mass layoff	Year of mass-layoff	NALFM
entid syn	Business entity ID	NALFM
reason	Reason of separation from employment	NALFM
naics	NAICS - in detail	NALFM
T4 Payroll	Payroll for the enteprise	NALFM
Net income	Net income or loss for income tax purposes	NALFM
total assets	All current, capital, long-term assets, and assets held in trust	NALFM
total liabilities	All current and long-term liabilities	NALFM
total shareholder equity	All shareholder equity amount	NALFM
total current assets	All current assets	NALFM
total tangible assets	All tangible capital asset	NALFM
total intangible assets	All intangible capital asset	NALFM
total long term assets	All long term assets	NALFM
total current liabilities	All current liabilities	NALFM

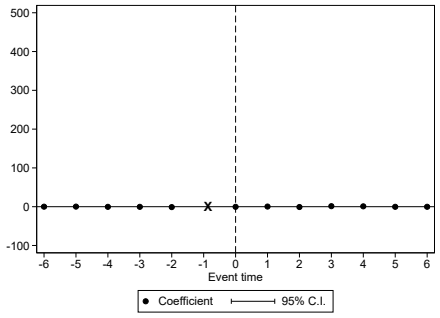
Table 1.7 continued from previous page

Variable	Definition	Source
D. Unincorporated firm variables		
Business number	Synthetic Business Number (BN)	T1FDB
total revenue unincorporated	L8299 : Total non-farm revenue	T1FDB
total expenses unincorporated	L9368 : Total expenses	T1FDB
wages salaries unincorporated	L9060 : Non farm wages and salaries	T1FDB
material costs unincorporated	L8320 : Cost of materials	T1FDB
direct wages unincorporated	L8340 : Direct wages (commission, labour, production wages and supervision)	T1FDB
cost of goods sold unincorporated	L8518 : Cost of goods sold	T1FDB
gross profit unincorporated	L8519 : Gross Profit	T1FDB
employee beneftis unincorporated	L9794 : Employee benefits, employer contribution, insurance, etc	T1FDB
t4 bn employee count unincorporated	Number of employees in the BN who received T4	T1FDB
t4 bn payroll unincorporated	Total payroll at BN using T4	T1FDB
tot wages benefits unincorporated	Total wages and benefits	T1FDB

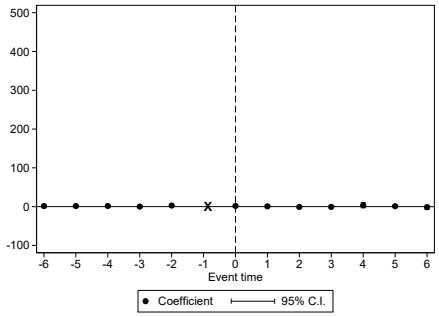
Figure 1.7 – Self-employment income (amounts)



(a) Unincorporated business income ($)



(b) Commission income ($)



(c) Professional income ($)

Note: This figure presents the business unincorporated income (a), commission unincorporated income (b), and professional unincorporated income (c) the mass-layoff event. $t = 0$ represents the year of the mass layoff. We use the sample of 118,745 individuals' part of a mass layoff between 2007 and 2015 matched to a control group of 118,745 individuals who were not affected by the mass layoff event. Business income, professional income, and commission income are calculated from the T1 Personal Master File (T1PMF). We report 95% confidence intervals based on standard errors clustered at the individual level.

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Chapter 2

Labor Market Implications of Tax Enforcement Measures

Co-authored with Philippe d'Astous [1] & Martin Boyer [2]

Abstract

Tax enforcement is challenging for governments because firms routinely offset implemented measures using different margins of adjustment. When governments enforce stricter revenue monitoring, firms respond by increasing reported expenses, which can hamper tax collection efforts.

In this paper, we examine a novel margin of adjustment used by firms: changes in workforce composition. We show that in response to increased revenue monitoring firms increase reported wages paid to incumbent workers and reported new hires, consistent with a formalization effect. Importantly, immigrants constitute a significant portion of the workforce increase. We find no effects on worker earnings from other sources, suggesting that our results represent

[1] Associate Professor, Department of Finance, HEC Montréal
[2] Professor, Department of Finance, HEC Montréal

an increase in reported earnings rather than an increase in actual work activity. Accordingly, we find that workers collect less social assistance benefits.

2.1 Introduction

Firms remit a variety of taxes to governments, including corporate income, payroll, and property taxes. In addition to these obligations, businesses often act as tax collectors on behalf of authorities, notably through sales taxes or value-added taxes (VAT) (Kopczuk and Slemrod 2006; Kleven, Kreiner, and Saez 2016). This creates incentives for firms in cash-heavy industries to under-report sales and therefore reduce both sales tax and income tax liabilities (Yaniv 1992; OECD 2017). While many developing countries have adopted registration reforms aimed at reducing administrative costs of formality, evidence suggests that such reforms alone may have limited effects unless accompanied by meaningful enforcement (KhaMis 2014).

In response, governments have implemented technological tools to combat tax evasion and improve the accuracy of reporting (Ainsworth and Chicoine 2018; OECD 2017). One such tool is the Sales Recording Module (SRM), a tamper-proof device designed to digitally record point-of-sale transactions in real time and transmit them to tax authorities.

In 2008, the province of Québec announced the introduction of a progressive implementation of SRMs in its restaurant sector. Restaurants were required to generate receipts and monthly sales summaries using these modules, with enforcement delegated to Revenu Québec.[3]

Previous work by M Martin Boyer and d'Astous (2023) documents firm-level responses to the SRM policy, including increases in reported sales and payroll expenditures. However, little is known about how such tax enforcement tools affect

[3]See detailed documentation from Revenu Québec: `https://www.ceic.gouv.qc.ca/fileadmin/Fichiers_client/centre_documentaire/CEIC-R-3572.pdf`, and `http://www.finances.gouv.qc.ca/documents/EEFB/en/eefb_vol1_no1a.pdf`.

workers, particularly in developed economies where informality is often less visible compared to developing countries. Understanding worker-level adjustment is especially relevant in sectors like food service, where informal employment, while less visible, may still be present..

This paper studies how restaurant workers responded to the introduction of SRMs in Québec, using matched employer-employee tax records from 2001 to 2021. We compare outcomes in Québec to those in similar provinces that did not adopt SRMs, exploiting the policy's sector-specific roll-out and timing of the policy for identification.

Our analysis focuses on changes in reported earnings, social program participation, and access to tax-advantaged financial instruments such as Registered Retirement Savings Plans (RRSP). We distinguish between long-tenured workers (incumbents) and individuals who appear on formal payrolls for the first time during the reform period (newly formalized). This distinction gives us the opportunity to identify different margins of adjustment: compliance-driven reporting among existing employees versus onboarding of previously unregistered workers.

We find that the implementation of SRMs creates a substantial change in the composition and reporting of the restaurant workforce. First, we observe a significant increase in the number of restaurant workers and new hires reported, consistent with a formalization effect. Workers who were previously compensated informally began to appear on formal payrolls. Second, we document a rise in reported restaurant wages among long-tenured workers(Incumbent), reflecting an improvement in the income reporting rather than increased labor supply. When we exclude restaurant and bar earnings, total reported income remains unchanged, confirming that SRMs induced formalization of preexisting earnings, rather than stimulating additional labor market activity.

Importantly, we document systematic heterogeneity by immigration status. Among incumbent workers, both immigrants and native-born individuals show

rising declared wages, increased participation in retirement savings, and lower social assistance reliance. These effects are broadly parallel, though slightly larger for native-born workers in savings behavior. Among newly formalized workers, however, native-born workers exhibit stronger earnings growth and greater financial integration post-formalization. Immigrant workers, by contrast, experience flatter income trajectories and limited take-up of tax-advantaged savings financials instrument , despite comparable reductions in social assistance participation.

Our study contributes to the literature on the labor market effects of tax compliance tools by providing new evidence from a high-income setting. Rather than treating compliance as a firm-side issue, we show how enforcement can influence income stability, benefit reliance, and long-term financial outcomes among workers in low-wage sectors.

2.2 Institutional Details

To address the potential underreporting in the restaurant industry, the Government of Québec introduced a mandatory electronic sales recording system. While the Canadian federal and provincial tax systems rely on firms to remit consumption taxes such as the GST and QST, enforcement remains challenging in cash-heavy sectors. In these contexts, under-the-table transactions can reduce both tax remittances and payroll reporting, and then impact the revenue collected by the government.

In 2010, Québec became the first and only province in Canada to mandate the use of tamper-proof Sales Recording Modules (SRMs) in restaurants. These devices automatically log point-of-sale transactions and generate monthly summaries, which must be transmitted to Revenu Québec, the provincial tax authority. Unlike traditional invoice-based controls, SRMs directly integrate with billing systems, providing real-time records of taxable activity. Restaurants were

required to provide customers with receipts produced by SRMs and to submit standardized reports to authorities. The rollout was accompanied by inspections, penalties for noncompliance, and a strong information campaign to encourage consumer participation. This paper examines how this enforcement initiative affected the labor market, particularly the formalization of employment relationships and worker-level financial outcomes.

2.2.1 The “Mandatory Billing" Policy

The policy was announced in 2008 and implemented in phases between 2010 and 2011. It applied to restaurants that sell prepared meals for consumption on-site or for take-out. Establishments were required to install an approved SRM device, issue receipts for each transaction using the SRM, and transmit monthly sales summaries to Revenu Québec.

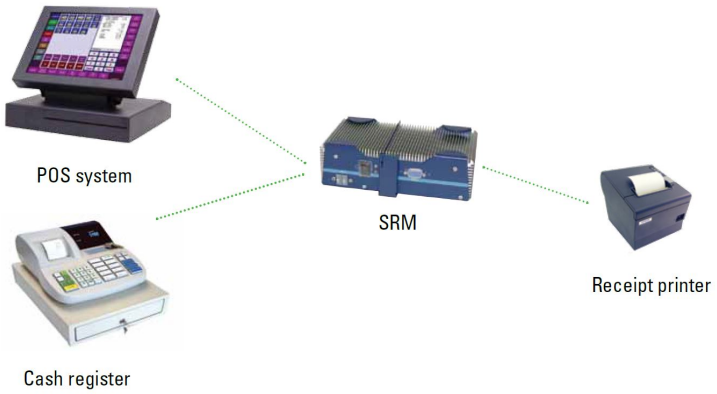
The intervention focused on a sector identified by tax authorities as being at high risk of underreporting. Official estimates from the Ministry of Finance indicated that up to 16% of sales in restaurants were not declared, corresponding to hundreds of millions of dollars in lost revenue annually.

By 2011, over 19,000 establishments had installed SRMs. Enforcement was strict: inspections, fines, and legal actions were undertaken to ensure compliance. Customers were also encouraged to demand receipts, creating social pressure alongside regulatory enforcement. While the policy was limited to Québec, other provinces like Ontario considered similar programs in subsequent years.

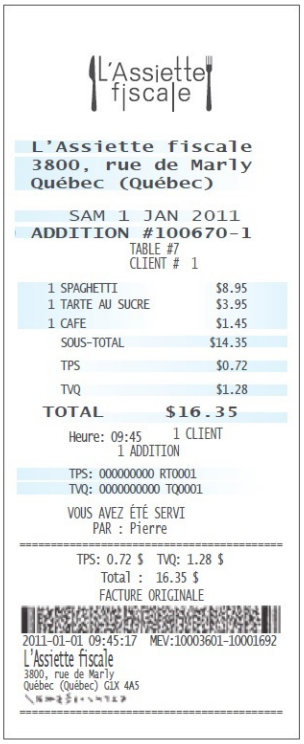
Certain businesses were exempt, such as bars where more than 90% of sales came from alcohol or venues like theatres and sports arenas. Grocery stores, bakeries, and butcher shops were also excluded, unless they sold prepared meals for immediate consumption.

Panel (a) of Figure 2.1 presents a picture of an SRM and how it fits between

Figure 2.1 – Mandatory Billing



(a) Sales Recording Module


L'Assiette fiscale

L'Assiette fiscale
3800, rue de Marly
Québec (Québec)

SAM 1 JAN 2011
ADDITION #100670-1
TABLE #7
CLIENT # 1

1 SPAGHETTI	$8.95
1 TARTE AU SUCRE	$3.95
1 CAFE	$1.45
SOUS-TOTAL	$14.35
TPS	$0.72
TVQ	$1.28
TOTAL	$16.35

Heure: 09:45 1 CLIENT
1 ADDITION

TPS: 000000000 RT0001
TVQ: 0000000000 TQ0001

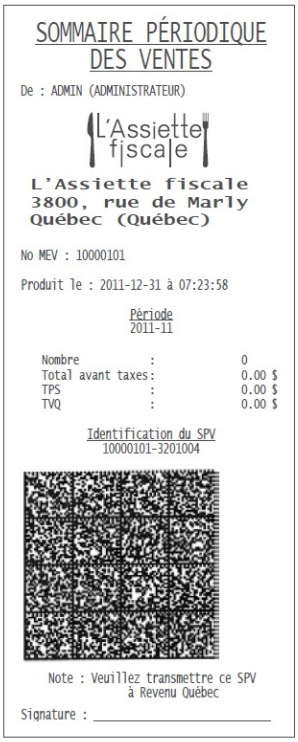
VOUS AVEZ ÉTÉ SERVI
PAR : Pierre

TPS: 0.72 $ TVQ: 1.28 $
Total : 16.35 $
FACTURE ORIGINALE

2011-01-01 09:45:17 MEV:10003601-10001692

L'Assiette fiscale
3800, rue de Marly
Québec (Québec) G1X 4A5

(b) Bill Produced by an SRM


SOMMAIRE PÉRIODIQUE DES VENTES

De : ADMIN (ADMINISTRATEUR)

L'Assiette fiscale

L'Assiette fiscale
3800, rue de Marly
Québec (Québec)

No MEV : 10000101

Produit le : 2011-12-31 à 07:23:58

Période
2011-11

Nombre	:	0
Total avant taxes	:	0.00 $
TPS	:	0.00 $
TVQ	:	0.00 $

Identification du SPV
10000101-3201004

Note : Veuillez transmettre ce SPV à Revenu Québec

Signature : _____

(c) Monthly Sales Report Produced by an SRM

Source: Revenu Québec 2013.

the point-of-sale system (POS) and the receipt printer. As microcomputers[4] connected to the restaurant's sales recording system, SRMs are designed to record transaction data from bills and receipts, and to allow for secure data extraction. SRM are protected with a security seal that prevents the device from being opened, and each device has its own unique identifier provided by the tax authorities. They are used to produce bills on which a pre-determined set of information is displayed. Panel (b) of Figure 2.1 presents an example for such bill. The receipt includes the name and address of the restaurant, the date at which the bill was produced and a unique number assigned to the bill. It also includes a description of the items ordered as well as their price. It provides the subtotal of purchases before taxes, as well as the information on the amount and registration numbers of GST and QST. Finally, the total amount of the bill is included along with a bar code that records the unique information for the bill.

Restaurant operators are required to send a monthly report of sales summary to Revenu Québec using their uniquely-identified SRM device. Panel (c) of Figure 2.1 presents an example of such a monthly report. It includes data on the transactions recorded by the SRM in a given month and are presented in the form of bar codes. The summary has to be completed on paper or electronically every month, and sent to Revenu Québec no later than the last day of the following month.

2.3 Theoretical & Motivation

2.3.1 Conceptual Framework

Recently (Kleven, Knudsen, et al. 2011; Kleven, Kreiner, and Saez 2016; Carrillo, Pomeranz, and Singhal 2017; Slemrod et al. 2017) we have seen new advances

[4]At the time of the policy implementation, SRMs used by Revenu Québec are AAEON microcomputers, model AEC-6822, and modified by IBM Canada for the sake of the intended use (Revenu Québec 2013). The reported cost of such devices in 2012 was $1000; in 2019, the cost of new SRM is $1500, which is one-third of the total cost of setting up the display shown in Panel (a) of Figure 2.1. A used five year-old SRM is priced at $350 in 2019.

and refinements of the basic model of tax evasion presented in Allingham and Sandmo 1972, which itself is a reinterpretation of the crime model of Becker 1968. However, we will heed the "old" warning of Graetz and Wilde (1985) who write that these models are defective.

> "only consider the actions of taxpayers and ignore the variety of other agents involved in the revenue collection process – in particular, they fail to take into account the interrelationhsips (sic) between flexible IRS policy instruments and noncompliance behavior." (p. 357)

For that reason, we will rather examine the situation pioneered by Townsend (1979), and better described for the case of tax fraud in Graetz, Reinganum, and Wilde (1986), whereby taxpayers (in our case restaurants) and the government are each offering best responses to the action of the other party. Mookherjee and Png (1989) and Picard (1996), M. M. Boyer (2004), and Bourgeon and Picard (2014) use the same modeling framework to study the special case of insurance fraud.

Restaurants, which are endowed with fixed characteristics Ω (such as location, type of cuisine, number of tables), earn revenue from sales of $\tilde{R}$, a random variable distributed according to pdf $g(R;\Omega)$ in the domain $[\underline{R},\overline{R}]$, which is common knowledge. For some collected sales of R, restaurants are supposed to remit tR to the government in the collected sales tax. In order to generate those sales, restaurants must incur operational costs C, which we will suppose are fully observable even if Carrillo, Pomeranz, and Singhal (2017) finds some under-reporting in costs (i.e., 26% of firms report costs below third-party amounts), and pay wages $W(1+\omega)$ (ω is the payroll tax rate applied to total wages W). Although operating costs are easily verifiable, revenues are private information to the firm and wages are private information to the firm and the workers.

Firms report revenues of R' and wages paid of W' to the government, who then decides whether to verify these reports knowing C and Ω. The marginal cost to verify a single agent is assumed to be fixed and equal to ψ. The government's

tax compliance technology is common knowledge. A firm's true earnings before corporate income taxes are paid is given by $R(1-t) - C - W(1+\omega)$, but the reported earnings are $R'(1-t) - C - W'(1+\omega)$. Restaurants are therefore responsible for paying or remitting three types of tax to the tax authorities. The collected sales tax tR, the payroll tax $W\omega$, and the profit tax $(R(1-t) - C - W(1+\omega))\tau$. The same three types of firm taxation are also presented in Kopczuk and Slemrod (2006) and Almunia and Lopez-Rodriguez (2018). The following summarizes the game that restaurants and tax authorities are playing.

- All players are risk neutral.
- Agents (i.e., restaurant owners) know R and W privately.
- Each agent individually chooses the probability p with which to file a false report.
- Simultaneously, the government chooses an auditing strategy conditional on the agents' report such that any report is audited with probability ρ.
- If the government does not verify (with probability $1-\rho$), then the firm must pay taxes based on its *reported* earnings at some rate τ such that its after-tax income available to shareholders becomes $(R - C - W) - (R'(1-t) - C - W'(1+\omega))\tau$.
- If the government verifies (say with probability ρ), then not only are *actual* earnings taxed at a rate of τ, the agent must also pay a penalty $\kappa > 0$ if he reports the wrong R or W; we model κ as a dead weight cost to society, which can be proportional to the amount defrauded or some arbitrary amount. The after-tax income of the firm available to shareholders is then $(R(1-t) - C - W(1+\omega))(1-\tau) - \kappa$.

- Conditional on submitting a false report, an agent reports revenues $R' \leq R$ according[5] to some distribution $f(R';R)$ on the support $[\underline{R},R]$, and wages paid W' according to some distribution $h(W';W)$ on the support $[\underline{W},\overline{W}]$. The choice of the support is of course arbitrary, but tell us that any report outside of the support is surely fraudulent and therefore should be audited immediately (Phillips 2014; Slemrod et al. 2017; Almunia and Lopez-Rodriguez 2018).

Given the timing of the game (choosing simultaneously the probability of cheating and the probability of auditing, then the agents deciding what to report to the government), we will solve the game using backward induction starting with the choice of R' and W'. In the last stage of the game, the agent choose R' and W' to maximize the following program, taking as fixed p and ρ, respectively the probability of filing a false report and the probability of audit

$$\begin{aligned}\max_{R',W'} EU = {} & p\rho\left[R(1-t) - W(1+\omega) - C\right](1-\tau) - k \\ & + p(1-\rho)\left[R'(1-t) - W'(1+\omega) - C\right](1-\tau) \\ & + p(1-\rho)\left[(R-R') - (W-W')\right] \\ & + (1-p)\left[R(1-t) - W(1+\omega) - C\right](1-\tau) \end{aligned} \tag{2.1}$$

Under the constraints $R' \in [\underline{R},R]$ and $W' \in [\underline{W},\overline{W}]$ The first order conditions are

$$\begin{aligned}\frac{\partial EU}{\partial R'} &= p(1-\rho)[(1-t)(1-\tau) - 1] - \lambda_R = 0 \\ \frac{\partial EU}{\partial W'} &= -p(1-\rho)[(1+\omega)(1-\tau) + 1] + \lambda_W = 0\end{aligned} \tag{2.2}$$

We have a clear corner solution with respect to reported revenues, $R^\star = \underline{R}$, so that, conditional on misreporting income an agent will report the lowest possible income that does not change the government's probability of auditing. This

[5]For simplicity, and most likely without loss of generality, we suppose that firms do not over-report their revenues.

corner solution is similar to the ”bunching" of tax reports found in the model of Almunia and Lopez-Rodriguez (2018).[6] With respect to reported wages, we will still have a corner solution, but the question is whether $W^\star = \underline{W}$ or $W^\star = \overline{W}$? Which of the two corner solution is chosen in the end will depend on the agent's overall tax liability when she reports $\underline{W}$, say $T(\underline{W})$, compared to her tax liability when she reports $\overline{W}$, say $T(\overline{W})$. We have, respectively,

$$\begin{aligned} T(\underline{W}) =& \underline{W}\omega - \underline{W}(1+\omega)\tau \\ T(\overline{W}) =& \overline{W}\omega\overline{W}(1+\omega)\tau \end{aligned} \tag{2.3}$$

We then have that $T(\overline{W}) \geq T(\underline{W})$ (meaning that it is profit maximizing to hide wages paid) if and only if

$$\tau \leq \frac{\omega}{1+\omega} \tag{2.4}$$

As the risk of jumping ahead, note that in the case of restaurants in the province of Québec, payroll tax ω is approximately 16.5%, whereas the profit tax, τ is 14%. And because $\tau = 0.14 < \frac{0.165}{1.165} = \frac{\omega}{1+\omega}$, we do have that restaurants who misreport their income to the government would prefer to under-report wages in addition to under-reporting revenues.

Knowing what agents will report conditional on misreporting their income, we can now move to the first stage of the game to determine the strategies of agents and the government with respect to the probability of misreporting income, p, and auditing an agent's report ρ. Under a Perfect Bayesian Nash Equilibrium solution concept, agents under report their revenues with a probability p such that the government is indifferent between auditing at cost ψ (the subtracted term in Equation 2.5) and not auditing (the first two terms in Equation 2.5). This probability is such that

$$\begin{aligned} 0 =& (1-p)\{[R(1-t) - C - W(1+\omega)]\tau + Rt + W\omega\} \\ &+ p\{[\underline{R}(1-t) - C - \underline{W}(1+\omega)]\tau + \underline{R}t + \underline{W}\omega\} \\ &- \{[R(1-t) - C - W(1+\omega)]\tau + Rt + W\omega - \psi\}, \end{aligned} \tag{2.5}$$

[6] See also Best et al. (2015) and Kopczuk and Munroe (2015)

where the first term is the tax collected if there is no misreport (with probability $1-p$) and there is no audit, the second term is the tax collected if there is misreport and no audit, and the third term is the tax collected in the case of an audit (whether the report is truthful or not) minus the marginal cost of conducting the audit. Letting L represent the total tax lost if misreporting remains undetected,[7] the solution to this problem is then to have

$$p^{\star} = \frac{\psi}{L} \tag{2.6}$$

From this simple model,[8] we can surely predict that fraud is more likely when the government's marginal cost of auditing (ψ) is large. The technology we examine in this paper to fight electronic sales suppression devices essentially drops the government's cost of auditing (ψ) to almost zero. The model's prediction is then that the agents' probability of misreporting income will also drop to zero.

2.3.2 Wage Underreporting and Informality in the Restaurant Sector

Most of the existing literature on labor market formalization focuses on developing countries, where informality is widespread and formal employment remains limited (e.g., Bazdresch (2018), Berens (2020), and Maurizio and Vásquez (2019)). These studies document how changes in labor regulation, enforcement, or access to financial services influence transitions into formal employment. In contrast, evidence on worker formalization in developed economies is rare. Our study contributes to filling this gap by analyzing a large-scale formalization episode created by tax enforcement reforms in Canada's restaurant sector.

[7] That is, L is the sum of the lost profit tax (given rate τ), the lost sales tax (given rate t), and the lost payroll tax (given rate ω), so that $L = [(R-\underline{R})(1-t) - (W-\underline{W})(1+\omega)]\tau + (R-\underline{R})t + (W-\underline{W})\omega$.

[8] For the sake of completeness, the government's auditing strategy (auditing with probability ρ) must be such that an agent is indifferent between telling the truth and lying. This occurs when $\rho^{\star} = \frac{G}{G+\kappa} < 1$, where G is an agent's potential gain associated with misreporting income: $G = (R-\underline{R})[1-(1+\omega)(1-\tau)] - (W-\underline{W})[1-(1-t)(1-\tau)]$.

We build on the model in Section 2.3.1 to interpret how increased enforcement through SRMs may affect worker-level outcomes. While the framework focuses on firm incentives to misreport revenues and wages, the same logic can clarify how employment and income reporting evolve when informal arrangements become less feasible.

Informality is widespread in the restaurant sector , partly because compensation often includes cash and tips. In many cases, compensation and reporting practices resulted in underreporting: firms reduced payroll and sales tax liabilities, while workers' reported contributions to social insurance programs and eligibility for income-tested benefits were affected. These arrangements created conditions under which earnings were not fully reflected in official records.

Prior to the SRM reform, the perceived costs of formality such as higher payroll taxes and reduced eligibility for income-based programs likely outweighed the benefits for many low-wage workers. Compensation was often paid off the books, which limited recorded contributions to the Canada Pension Plan (CPP), Employment Insurance (EI), and other formal systems. At the same time, firms could underreport both revenues and payroll with limited risk of detection.

2.3.3 SRMs and the Enforcement Shock

The rollout of Sales Recording Modules (SRMs) corresponds to an important discontinuity in the enforcement environment. SRMs reduced firms' ability to suppress reported revenues and, by extension, underreport wages. Although the reform targets firm-level behavior, its implications extend to workers. As firms began reporting revenue more accurately, they also had incentives to report costs including labor compensation more precisely in order to minimize taxable profits. Therefore, by extension, their wages were more fully reflected in official records, and workers' reported earnings became visible to public institutions, which in turn affected eligibility for means-tested programs and triggered mandatory con-

tributions to formal systems such as the Canada Pension Plan (CPP), Employment Insurance (EI), and registered savings plans.

2.3.4 Expected Worker-Level Adjustments

On the worker side, this SRMs introduction reshapes the incentives associated with formal participation in the labor market. We expect the following behavioral responses:

Prediction 1 (Formalization of Income). The introduction of SRMs increases the likelihood that workers' earnings are formally reported. That is, observed wages increase as compensation previously outside of payroll systems becomes reflected in official records. This increases taxable income and alters eligibility for government programs.

Prediction 2 (Spillover to Worker Behavior). As wages become formally reported, workers become more visible to public institutions. From one side this will improve their eligibility for social insurance programs (e.g., pension adjustments, RRSP contributions), on the other side this will reduced their accessibility to means-tested social assistance programs due to increased declared income. Reported income may also shift across categories, including self-employment or other sources, reflecting adjustments in how earnings are recorded in response to higher reported wages. These dynamics depend on both pre-policy attachment and the characteristics of prior reporting arrangements. In order to perfectly identify those trends, we distinguish two groups:

- **Incumbent workers**: Individuals with a history of restaurant employment before SRMs (Those for who we observed a T4 from the restaurant industry befoe the SRMs implementation). For these workers, we expect a shift from partially to fully reported wages, with limited change in total observed

earnings. The rise in reported income should reduce reliance on social assistance and increase formal program contributions.

- **Newly formalized workers**: Individuals with no prior T4 earnings in restaurants who appear on payroll post-SRM. These workers likely transitioned from fully informal arrangements. We expect sharper declines in social assistance take-up and more pronounced entry into contributory programs (RRSPs, employer pensions).

These mechanisms imply that SRMs influence not only firm behavior but also reshape the economic footprint of workers, particularly in sectors with historically high levels of informality.

2.4 Data

We use the administrative dataset from the Canadian Employer-Employee Dynamics Database (CEEDD), a longitudinal dataset covering the universe of tax filers in Canada from 2001 to 2021. The CEEDD gives the opportunity to link individual tax files with employer records over time, allowing for a detailed analysis of employment, earnings, and firm-level characteristics. Appendix Table 2.1 provides definitions of the variables used in this study and their sources. All income related continuous variables are winsorized at the 99th percentile to reduce the influence of outliers.

2.4.1 Matched Employer-Employee Tax Data

Employment and earnings measures are extracted from the T4 Statement of Remuneration (T4ROE), which reports employer-specific earnings, separation events, and social contributions for each employee on an annual basis. The T4ROE provides a detailed record of each worker's employment in multiple companies and captures detailed compensation information including pension plan

contributions, social insurance payments, and other components of taxable income.

We restricted our sample to workers employed in the restaurant industry, defined using four-digit NAICS codes under classification 7225. This gives us the opportunity to observe individual labor market histories within the sector and to identify the implications of the 2008 introduction of SRMs in Quebec. The T4ROE data further allow us to observe transitions out of the restaurant sector and subsequent employment patterns.

We use financial and payroll information to measure changes in employment, total wages paid, and revenues at the firm level. To identify those informations, we rely on the National Accounts Longitudinal Microdata File (NALMF), a longitudinal dataset of all incorporated businesses in Canada. The NALMF consolidates tax return filings, business registry data, and employer surveys, and includes information on firm size, revenues, balance sheet items, industry sector classification and geographic location.

2.4.2 Demographics and Individual Tax Data

Demographic characteristics and aggregate personal income data are sourced from the T1 Personal Master File (T1PMF), which serves as the primary linkage file in CEEDD. The T1PMF includes individual-level information on age, sex, marital status, and aggregate income. These data are used to characterize the composition of the workforce and to analyze heterogeneity in responses between demographic groups.

To measure access to social programs and social security mechanisms, we observe government transfer payments and contributions through administrative tax forms. These include contributions to unemployment insurance (EI), participation in the pension plan, and reported social assistance benefits. This allows us to assess whether formalization following the SRM policy led to increased partic-

ipation in social insurance programs or reductions in public assistance receipt.

We identify immigrant workers using the Longitudinal Immigration Database (IMDB), which links immigration landing records with tax data for individuals who arrived in Canada since 1980 and subsequently filed taxes. The IMDB provides information on the age of immigrants at arrival, official language proficiency, country of origin, and admission category. In our analysis, we classify individuals as immigrants if they are not born in Canada.

2.5 Empirical Strategy and Identification

We measure the impact of sales recording modules (SRM) using a difference-in-differences framework that takes advantage of the targeted implementation of the policy in the Quebec restaurant sector. The absence of comparable reforms in neighboring provinces offers a credible counterfactual to evaluate labor market responses to this tax enforcement policy.

Our empirical strategy proceeds in two parts. First, we examine a sample of long-tenured restaurant workers, whom we define as individuals with at least two years of employment in the industry prior to the reform. We are using this group to estimate how the introduction of the SRMs affected earnings wages, program participation, and income composition among them. In the second part, we focus on newly formalized workers those who had no T4-reported restaurant income prior to the reform but first appeared on the payroll between 2008 and 2011.

For these 'newly formalized workers,' compensation had not previously been captured in formal payroll records. To isolate the effect of formalization, we match these workers with comparable new hires in control provinces and implement a difference-in-differences design. The treatment time is defined by the first year of formal entry into the restaurant sector, and we focus on those who have entered formally the sector between 2009 and 2011. For the long-tenured

sample, we estimate the following event-study specification:

$$Y_{it} = \sum_{\substack{\tau=-4 \\ \tau\neq-1}}^{6} \mathbb{1}(\text{Period}_{i\tau}) \times (\beta_{0\tau} + \beta_{1\tau} \cdot \text{QC}_i) + \gamma_j + \mu_i + \varepsilon_{it}, \tag{2.7}$$

where Y_{it} denotes the outcome of interest for individual i in year t. The variable QC_i is an indicator equal to one if the individual resides in Quebec. $\mathbb{1}(\text{Period}_{i\tau})$ is a set of event-time indicators centered on the year prior to SRM rollout ($\tau = -1$, omitted). We include individual fixed effects (μ_i), and firm fixed effects (γ_j). Standard errors are clustered at the individual level.

For newly formalized workers, we recenter the event time around the first T4 (tax income file) observation and use the same equation structure. Matched untreated workers in control provinces serve as the comparison group in the stacked-event setup. This two-part design allows us to separately capture the effects of formalization for incumbents and new entrants, providing a comprehensive assessment of how SRMs reshaped employment, income reporting, and program take-up in a high-informality sector.

2.6 Results

2.6.1 Firm level result

We begin by examining the firm-level response to the introduction of Sales Recording Modules (SRMs) in Québec's restaurant sector. Figure 2.2 presents the results of the impact of the SRMs implementation at the firm level.

Panel (a) shows a clear increase in reported sales following the SRM rollout. The effect becomes statistically significant in the years immediately after 2008 and continues to grow through 2015. This pattern is consistent with improved sales reporting due to the monitoring capabilities of the SRM devices, which reduce opportunities for electronic sales suppression.

Panel (b) shows a parallel increase in total reported operating costs. The timing and magnitude of the response suggest that restaurants began to report a larger share of their expenses likely reflecting both increased scrutiny from the tax authority and an effort to offset higher reported revenues by maximizing deductible inputs.

In Panel (c), we observe a gradual but persistent increase in total wages paid, further supporting the interpretation that SRMs lead to a broader formalization within the restaurant sector. Importantly, this rise in wage expenditures is aligned with the increase in reported revenues and costs, suggesting that firms adjusted both revenue and payroll reporting practices in response to the policy..

Panels (d)–(f) results corresponds to the new employment composition. The number of reported workers (Panel d) begins to rise steadily after 2008, with stronger increases from 2010 onward. Panels (e) and (f) show pronounced growth in the number of new hires, including a substantial and sustained increase in newly hired immigrant workers. These patterns point to a formalization channel operating at the extensive margin. In fact, previously unreported employment relationships were likely registered for the first time in the wake of SRM adoption.

2.6.2 Income Composition and Adjustment: Incumbent & Newly Formalized Workers

Figure 2.3 presents event study estimates comparing incumbent worker (long-tenured) restaurant workers with newly formalized workers who entered formal payroll for the first time between 2008 and 2011. Both groups are directly affected by the introduction of Sales Recording Modules (SRMs), albeit through different channels. Incumbents likely experienced a transition from compensation not previously recorded on payroll to formally declared wages, while newly formalized workers represent earnings that were not previously captured in payroll records

but became visible after the reform.

Panel (a) shows a substantial and persistent increase in reported restaurant earnings for both groups following the reform. This pattern is consistent with a reduction in payroll underreporting, particularly among incumbents whose employers were compelled to declare a greater share of compensation. The effect is slightly less pronounced for formalized workers, reflecting the shift from full informality to formal payroll inclusion.

Panel (b) displays diverging patterns in other income sources such as tips and gratuities. Incumbent workers exhibit a significant increase in this category, potentially reflecting changes in reporting practices or partial formalization of supplementary earnings.. In contrast, newly formalized workers show a decline, suggesting that tip income may have been more prevalent or more heavily underreported prior to SRMs.

In Panel (c), both groups report increases in self-employment income over time, reflecting income diversification and/or reclassification of earnings in response to greater payroll transparency. This shift is slightly stronger among Incumbent workers.

Panel (d) reveals increases in RRSP contributions across both groups, consistent with improved eligibility and integration into employer-sponsored savings mechanisms. The magnitude of the increase is larger for incumbents, reflecting higher cumulative earnings histories and stronger attachment to the sector.

Finally, Panel (e) shows a notable decline in social assistance benefits for both groups, particularly after formalization. This is consistent with reduced eligibility due to higher reported income. The timing of the decline aligns closely with SRM implementation and is indicative of a shift in workers' position relative to means-tested program thresholds.

Taken together, these results indicate that SRMs contributed to a measurable shift toward wage formalization among both incumbent and newly formalized workers. The evidence points to a broader integration of previously unreported

labor into the formal system through higher declared wages, increased participation in retirement savings, and reduced reliance (and eligibility) on government transfers. These findings are consistent with the view that formalization is not a binary or irreversible process. As Dıaz et al. 2018 emphasize, in developing economy , firms may register for tax purposes without complying with labor regulations, and transitions in and out of formality are usually frequent in those economy. Our results suggest that SRMs may have pushed business level formalization (i.e., sales reporting), but also additionally labor formalization as reflected in payroll records for incumbent and newly formalized workers.

2.6.3 Income Composition and Adjustment: Immigrant & Native-Born Incumbent Workers

Figure 2.4 presents the estimates comparing the responses of long-tenured immigrant (blue) and native-born (red) restaurant workers in Quebec to the introduction of SRMs. Both groups show strong evidence of formalization, but with distinct patterns. In panel (a), both immigrant and native-born workers experience a rise in reported restaurant earnings post-SRM, cconsistent with a shift from compensation not previously recorded on payroll to formally reported wages. The increase is slightly more pronounced for immigrant workers. For both groups, the increase in declared earnings does not coincide with a rise in income from other sectors (panel b), indicating that the effect reflects income reclassification rather than changes in overall work activity.

Panel (c) shows that other labor income including tips and gratuities rises modestly for both groups, suggesting changes in reporting practices or partial formalization of non-wage compensation. Self-employment income also increases gradually (Panel d), with slightly earlier growth for native-born workers.

Panels (e) and (f) reflect the broader behavioral implications of formalization. Both groups increase their RRSP contributions after the reform, with a larger

magnitude among native-born workers. At the same time, both groups experience reductions in social assistance take-up, reflecting income effects that likely pushed them above means-tested eligibility thresholds.

Overall, the results indicate that SRMs induced parallel formalization dynamics among incumbent immigrant and native-born workers, with differences largely in timing and magnitude rather than direction. Formalization increased declared wages, encouraged participation in retirement savings, and reduced reliance on government transfers for both groups of incumbent workers.

2.6.4 Transitions into Formal Employment: Newly Formalized Workers

Figure 2.5 compares the post-reform trajectories of newly formalized immigrant (blue) and native-born (red) restaurant workers individuals who appeared on payrolls for the first time between 2008 and 2011. These workers had not previously appeared in payroll records, making them a particularly relevant group for assessing the direct effects of the SRM-driven formalization shock.

Panel (a) shows a striking divergence in reported restaurant earnings following formalization. While native-born workers experience a sharp and sustained increase in declared wages, immigrant workers exhibit a decline. This pattern may reflect differential earnings structures, selective entry dynamics, or greater barriers to wage formalization among immigrant workers.

In Panel (b), other labor income (including tips and gratuities) declines slightly for both groups, suggesting a reclassification of total earnings into formal wage components.

In contrast, self-employment income (Panel c) rises steadily across the post-reform period, particularly for Native born workers. This may reflect income diversification or a strategic shift toward self-employment in response to reduced flexibility in formal wage arrangements.

Panel (d) shows growth in RRSP contributions for native-born workers but a flat profile for immigrants, consistent with differences in financial integration or access to employer-sponsored benefits.

Finally, Panel (e) shows a decline in social assistance take-up for both groups, though the effect is more pronounced among immigrants their stronger exposure to means-tested benefit thresholds.

In sum, these patterns confirm that SRMs induced formalization among both newly integrated immigrant and native-born workers, though immigrant responses appear more constrained. While both groups reduced benefit reliance, native-born workers experienced greater earnings and savings gains, pointing to persistent disparities in how formal labor market integration translates into financial security

2.7 Conclusion

Firms remit taxes on their own behalf and act as fiscal intermediaries by collecting taxes such as sales taxes and value-added taxes in developed economy. In this dual role, firms in cash-intensive sectors may face strong incentives to underreport sales, which therefore will reduce their tax liabilities. In order to fight these incentives, governments around the world have increasingly adopted laws and technological tools to reduce tax underreporting..

This paper investigates how workers and firms adjust to the introduction of the SRMs in the restaurant sector in Québec. We find evidence that SRMs changed firms' reporting practices. Restaurants affected by the mandate experienced at the extensive margin a change in the composition of their workforce, including increases in the number of employees and new hires.

In fact, the rise in reported hiring is associated with an increase in the number of new immigrant hires, which is aligned with the onboarding of workers who had previously been compensated informally (not appearing in the payroll).

These findings indicate that SRMs shifted firm behavior across multiple dimensions of compliance, affecting not only revenue reporting but also labor registration and payroll declaration.

On the worker side, we observe a heterogeneous adjustment patterns depending on the formalization into the sector and immigration status. Among long-term restaurant workers (incumbents), SRMs led to an increase in reported wages, a rise in retirement savings contributions, and a decline in the use of social assistance. These effects correspond to a better alignment between actual and reported earnings and also correspond to a shift in income documentation practices rather than labor supply changes.

Among newly formalized workers(those appearing officially on payroll for the first time following SRM rollout) , we observe a distinct adjustment margin. Formalization led to a rise in declared income and access to tax-advantaged savings mechanisms, particularly for native born workers. However, immigrant workers in this group exhibit weaker income gains and limited participation in RRSPs, while experiencing a comparable decline in social assistance take-up. These results suggest that while SRMs successfully brought both groups into the formal sector. Taken together, our findings provide new evidence on the broader implications of tax enforcement for labor market participation and for worker welfare analysis. SRMs facilitated a shift away from informality. By forcing firms to declare transactions more transparently, enforcement technology indirectly improved access to formal income records, social insurance eligibility, and savings instruments for workers. Our analysis contributes to the literature on enforcement and informality by showing the multiples impact of tax compliance. While most policy discussions focus on enforcement as a firm level concern, our findings show the downstream and ripple effects of firm compliance on individual workers particularly in sectors characterized by high informality .

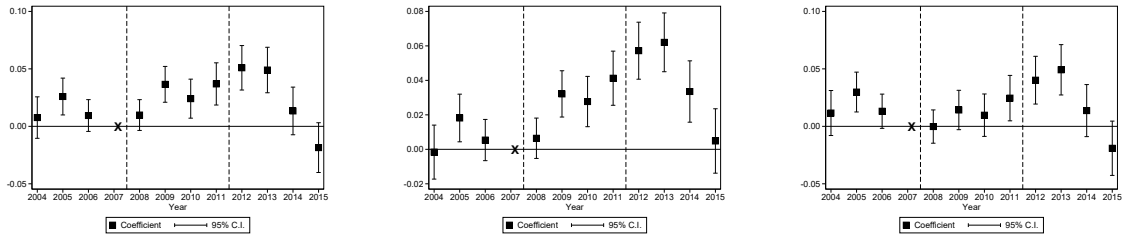
For future research, we are planning to explore different avenue that will help us better understand the restaurant industry work force. First, future work will

explore whether SRMs produced spillover effects into adjacent industries, such as bars or self employment, where regulatory reach may differ. Secondly , we will exploit the type of work permit that allow those immigrants to come to Canada and see if those play a role in the result that we found. Finally, further analysis will examine the compensation at the ownership level to see if there is a heterogeneity in the compensation of owner versus worker in the restaurant industry.

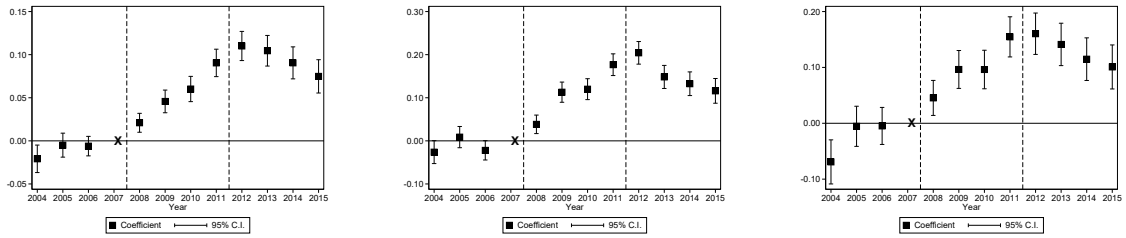
By integrating firm level enforcement with worker level outcomes, this paper helps us understand on how tax policy can shape not only fiscal capacity but also labor market inclusion in rich developed economies.

Figures

Figure 2.2 – Sales, Costs, and Labor Market Outcomes



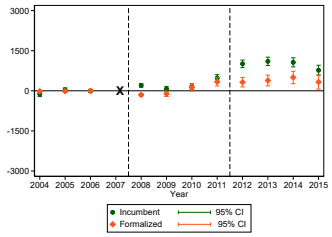
(a) Sales (b) Total Cost (c) Wages



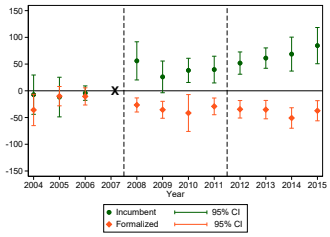
(d) Number of Workers (e) New Hires (f) New Immigrant Hires

Note: Each panel presents event study estimates from Equation (2.7), using a difference-in-differences framework with restaurant and year fixed effects. The outcome variables are measured annually at the restaurant level. The sample includes restaurants in Quebec affected by the SRM mandate and a matched control group of restaurants in other Canadian provinces that were not subject to the policy. Panel (a)–(c) display logged outcomes: total sales, operating costs, and total wages. Panel (d)–(f) report count-based labor measures: total number of employees, new hires, and new immigrant hires. The policy intervention year is $t = 2008$. Shaded areas represent 95% confidence intervals based on standard errors clustered at the restaurant level.

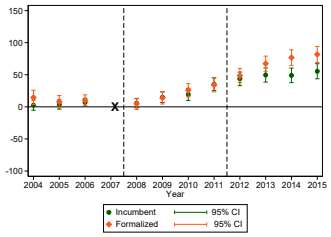
Figure 2.3 – Income Composition and Employment Adjustment — Incumbent & Newly Formalized Workers



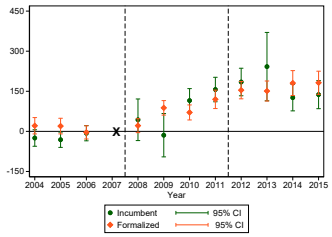
(a) Earnings from Restaurants



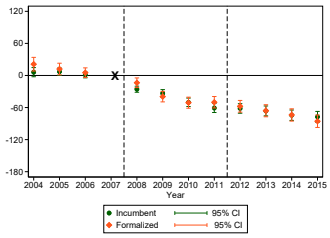
(b) Other Income (Incl. Tips, Gratuities, or Fees)



(c) Self-Employment Income



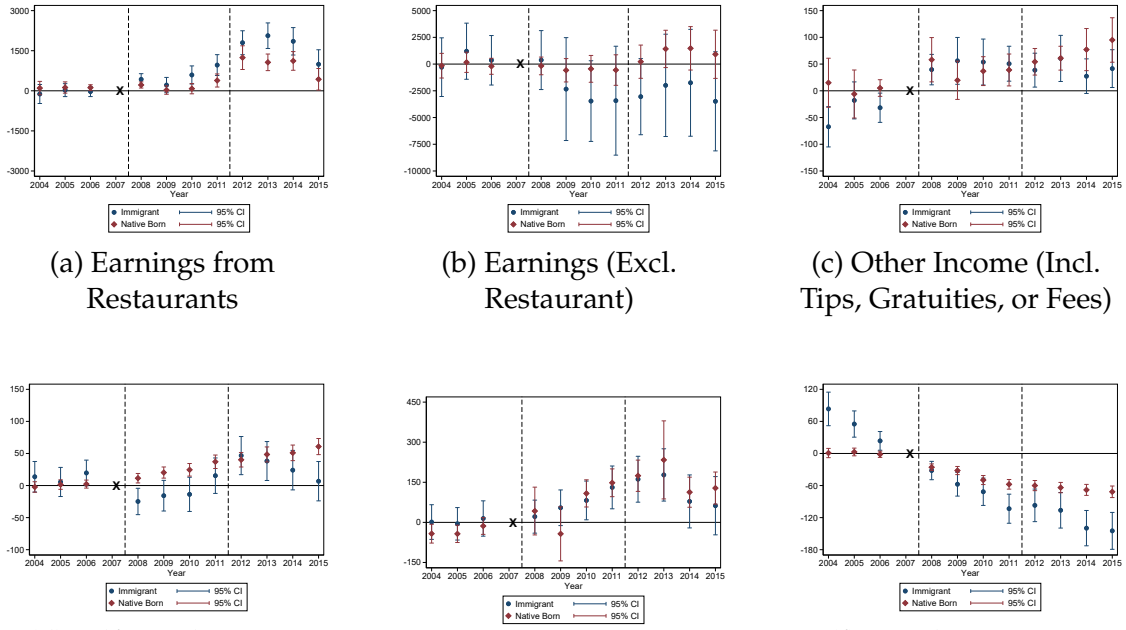
(d) RRSP Contributions



(e) Social Assistance Benefits

Note: Each panel presents event study estimates from Equation (2.7), using a difference-in-differences specification with individual and firm fixed effects. The sample includes two groups of restaurant workers in Quebec: (i) **incumbent workers** (in green), defined as individuals with at least two consecutive years of prior employment in the sector, and (ii) **newly formalized workers** (in orange), defined as individuals who appeared on formal payrolls for the first time between 2008 and 2011 following SRM implementation. The control group consists of comparable workers in provinces unaffected by SRMs. Vertical lines mark the year of SRM implementation ($t = 2008$). Outcomes are measured in Canadian dollars and plotted in levels. Shaded regions represent 95% confidence intervals, with standard errors clustered at the individual level.

Figure 2.4 – Income Composition and Employment Adjustment — Incumbent Immigrants and Native-Born Workers



(a) Earnings from Restaurants

(b) Earnings (Excl. Restaurant)

(c) Other Income (Incl. Tips, Gratuities, or Fees)

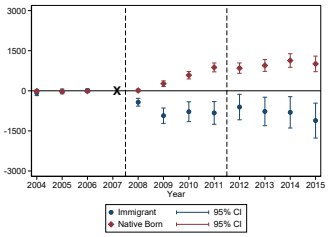
(d) Self-Employment Income

(e) RRSP Contributions

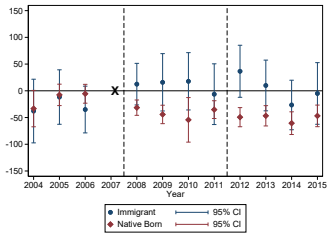
(f) Social Assistance Benefits

Note: Each panel presents event study estimates from Equation (2.7), using a difference-in-differences specification with individual, firm, and year fixed effects. The graph displays separate estimates for incumbent immigrant (blue) and native-born (red) restaurant workers in Quebec defined as individuals with at least 2 years of continuous tenure in the industry prior to SRM implementation. Each group is compared to a matched control group of workers in other provinces unaffected by SRMs. $t = 2008$ marks the year of SRM introduction. Outcomes are expressed in Canadian dollars and plotted in levels. Shaded regions indicate 95% confidence intervals, with standard errors clustered at the individual level.

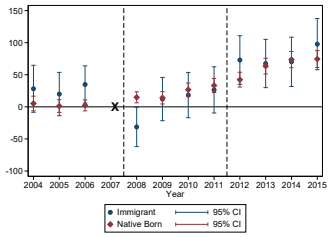
Figure 2.5 – Income Composition and Employment Adjustment — Newly Formalized Workers



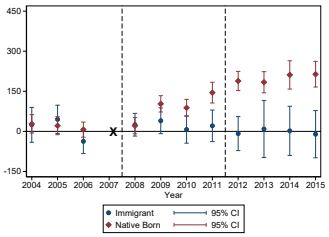
(a) Earnings from Restaurants



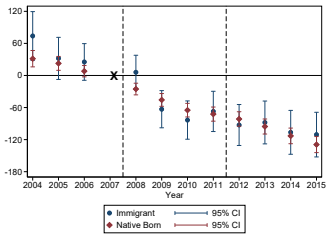
(b) Other Income (Incl. Tips, Gratuities, or Fees)



(c) Self-Employment Income



(d) RRSP Contributions



(e) Social Assistance Benefits

Note: This panel presents event study estimates from Equation (2.7), using a difference-in-differences specification with individual, firm, and year fixed effects. The graph displays separate estimates for newly formalized immigrant (blue) and native-born (red) restaurant workers in Quebec defined as individuals who appear on formal payrolls following SRM implementation after being previously unregistered. Each group is compared to a matched control group of workers with similar characteristics in other provinces unaffected by SRMs. $t = 2008$ marks the year of SRM introduction. Outcomes are expressed in Canadian dollars and plotted in levels. Shaded regions indicate 95% confidence intervals, with standard errors clustered at the individual level.

Tables

Table 2.1 – Definitions of Variables

Variable	Definition	Source
A. Demographic variables		
casenum2023	Unique identifier for individuals	T1PMF
prov of residence	Province or territory of residence	T1PMF
year	Year of tax records	T1PMF
birth year	Birth year of the individual	T1PMF
sex	Sex	T1PMF
age	Age of the individual	T1PMF
Immigrant	Indicator representing whether the individual is an immigrant or not	IMBD
B. Income variables		
Business income net	Net business unincorporated income	T1PMF
Commission income net	Net commission unincorporated income	T1PMF
Professional inc net	Net professional unincorporated income	T1PMF
Earnings	Total employment income from T4 slips, before deductions	T1PMF
Earnings from restaurant	Total employment income from T4 slips, before deductions from restaurants	T4ROE
RSP Income	Income from RRSP withdrawals	T1PMF
Gig income total	Revenue from Gig- Income activities	T1PMF
Self-Employment Income	Self-employment income (sum of Busines, commission and Professional unincorporated income)	T1PMF
Other Income	Other employment income (tips, gratuities or director's fees not reported on a T4 slip)	T1PMF
Reason	Reason of separation from employment	T4ROE
C. Social Benefit Variables		
Social Assistant Benefit	Social assistance income	T1PMF
Employment Benefit Adjustment-Credits	Pension adjustment credits, total amount sponsored by all employers	T1PMF
RRSP Contribution	Amount contributed to RRSP	T1PMF
RRSP Deduction	RRSP contributions used for tax deductions	T1PMF
D. Firm Variables		
entid syn	Business entity ID (uniqye identifier)	NALFM
Sales	Total sales of good and services	NALFM
Total Cost	All cost of sales amounts	NALFM
Number of Worker	Number of worker who worked for the firm	NALFM
Number of Worker Immigrant	Number of Immigrant workerd who worked for the firm	NALFM
New Hires	Number of new hires	NALFM
New Immigrant Hires	Number of new immigrant hires	NALFM
Wages	Salaries and wages	NALFM

Table 2.1 continued from previous page

Variable	Definition	Source
taxable income	Taxable income	NALFM
gross profits	Net of total sales of goods and services less cost of sales	NALFM
total current liabilities	All current liabilities	NALFM
total current asset	All current assets	NALFM

Table 2.2 – Descriptive Statistics

	Québec		Rest of Canada	
	Mean	Std. dev	Mean	Std. dev
I. Demographics and Firm Characteristics				
Age of worker	x	(x)	x	(x)
Share of Immigrants in restaurant	x	(x)	x	(x)
Share of Native born in restaurant	x	(x)	x	(x)
Number of employees	x	(x)	x	(x)
Firm age				
II. Earnings				
Earnings from restaurant	x	(x)	x	(x)
Earnings excluding restaurant	x	(x)	x	(x)
Overall Earnings	x	(x)	x	(x)
RRSP Contribution	x	(x)	x	(x)
RRSP Deduction	x	(x)	x	(x)
Social Assistance benefit	x	(x)	x	(x)
Self-employment income	x	(x)	x	(x)
Other Income including tips	x	(x)	x	(x)
Tenure of worker	x	(x)	x	(x)
III. Firm Financials				
Assets	x	(x)	x	(x)
Liabilities	x	(x)	x	(x)
Total earnings	x	(x)	x	(x)
Total tax paid	x	(x)	x	(x)
Total wage	x	(x)	x	(x)

Note: This table presents the descriptive statistics for the main variables used in the analysis, and is currently pending disclosure review.

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Chapter 3

Are Income Shocks Predictable? An Empirical Test Using Bank Data

Abstract

We analyze how individuals respond to a change in income using administrative account-level data provided by a large North American financial institution. The data includes records of the client's total monthly income deposits, and allows us to link month-end balances of all assets (savings and checking accounts) and liabilities (mortgages, credit lines and term loans) held by clients at this bank. Using an event-study methodology, we first test whether households in the sample can predict income changes. We then study how households use their financial products to adjust to a change in economic resources. We do not find evidence of anticipation of future income but rather an adjustment to the shock. We also document the responsiveness of mortgages, consumer term loans and credit lines to the change in economic resources.

3.1 Introduction

Consumption represents as much as 75% of GDP, and understanding its dynamic is crucial from a policy perspective.[1] In a model with complete markets, consumption can be fully insured against income changes. In reality, although there exists a host of mechanisms available to insure labor income, the hypothesis of full insurance is usually rejected (e.g. Jappelli and Pistaferri 2010) . Alternatively, the rational-expectation permanent income hypothesis (RE-PIH) with perfect credit markets assumes that saving and borrowing are the only way to smooth consumption against income changes (Friedman 1957; Modigliani and Brumberg 1954). Drawing down on savings or borrowing against future income can be used to smooth consumption from transitory income changes, but they cannot permanently hedge consumption against permanent income drops. Under the RE-PIH, permanent income changes therefore lead to permanent changes in consumption, while transitory income changes do not substantially affect consumption.

Importantly, changes in current consumption are determined by an individual's future expectations. When labor income is the main source of risk for individuals, consumption will respond to changes in expectations of future income. Under the RE-PIH, individuals adjust their consumption-saving decision when a change in income is anticipated, not when it is realized. The timing of the response of consumption to changes in income therefore depends on the predictability of the income change.

In the presence of imperfect credit markets, the inability to shift resources freely over time prevents consumers from increasing consumption early in anticipation of positive income changes (Zeldes 1989; Jappelli and Pistaferri 2006). Borrowing is only possible when individuals are not liquidity constrained. However, liquidity constraints do not prevent individuals from saving more in antici-

[1] The World Bank estimates for Canada in 2021, presented here, show that total consumption amounts to 76.2% of GDP, household to 55.6%.

pation of an income decline (Shea 1995). Recent studies have also highlighted the critical role of debt and liquidity constraints in determining the elasticity of consumption in response to income shocks. Households with higher levels of debt are found to exhibit significantly higher consumption elasticities, which can be explained almost entirely by their limited access to credit and liquid assets (S. R. Baker 2018). Therefore, the individual's availability of liquidity could affect the consumption response to income changes.

One strand of the literature assumes households do not anticipate income changes. In this group of studies, income shocks are decomposed into transitory and permanent components, and the consumption reaction to these two components is measured (e.g. Meghir and Pistaferri 2004; Jappelli and Pistaferri 2010) . Another strand of the literature analyzes events in which changes in income are known to be predictable by individuals to investigate the sensitivity of consumption to their realization.[2] Our paper attempts to bridge the gap between these two strands of literature by testing whether individuals can predict income changes, and by analyzing how they use financial products to adjust to these changes.

We build on predictions of consumption-savings models to investigate two questions. First, we test whether individuals are able to predict future income changes. According to theory, unconstrained individuals increase current consumption when they expect future income to rise, and decrease consumption when future income is expected to decline. If individuals can predict positive income changes, unconstrained individuals will increase their consumption before the change, and constrained individuals will wait for the income increase to increase consumption. In the case of negative income changes, if individuals can predict the changes, both constrained and unconstrained individuals will reduce consumption in anticipation of the change.

We derive an empirical test of income anticipation by studying whether sav-

[2]For example, changes in committed debt payments (e.g. Coulibaly and G. Li 2006; Stephens Jr 2008; Scholnick 2013; d'Astous 2019), income tax rebates (e.g. S. Agarwal, C. Liu, and Souleles 2007), or the cost of attending college (Souleles 2000), etc.

ings account balances change ahead of important income changes, as a model of buffer-stock savings would predict (Carroll 1997). To do so, we look at an individual's savings adjustment in the months before the realization of the change. If income changes are predictable, savings should have a counter effect before income realization for those individuals. We expect the result to be significant for the unconstrained individuals who experienced a future negative income change according to the literature (Carroll, Hall, and Zeldes 1992; Shea 1995; Jappelli and Pistaferri 2010). Additionally, recent research suggests that even when income changes are anticipated, the actual consumption responses can vary significantly depending on the liquidity constraints and behavioral factors at play (Gelman et al. 2014). Similarly, research on consumer responses to crises, such as the COVID-19 pandemic, suggests that consumption adjustments may also depend on the nature of the income change and the broader economic environment (Andersen et al. 2022). Carvalho, Meier, and S. W. Wang 2016 highlight how changes in financial resources at critical times, like payday, significantly influence economic decision-making, particularly among those facing economic hardships In the theoretical prediction section, we provide the theoretical framework and the motivation for using savings as a proxy for consumption In the theoretical prediction section, we provide the theoretical framework and the motivation for using savings as a proxy for consumption.

Second, we analyze how individuals use financial products to adjust to these changes. Under the RE-PIH, individuals adjust their consumption-saving decision when a change in income is anticipated, not when it is realized. We therefore test how financial product usage is sensitive to realized income changes. The income change could also influence new product subscriptions. Indeed, (S. R. Baker 2018) explains how consumption decisions are influenced by credit and liquidity restrictions in households with different debt levels. It is plausible to assume that individuals who experienced an increase in their income could now qualify for a product they could not be eligible for; they can use it to protect themselves

against a potential future income drop. For financial institutions, understanding how their clients react to an anticipated or unanticipated change in income could help them assess their client's risk and evaluate the potential profitability of certain products. Mortgage prepayment can be a result of positive income shocks, and credit utilization can be affected by negative shocks.

We find that unconstrained individuals do not predict income changes but react after the shock in income. Specifically, these individuals adjust their savings in response to a permanent decrease in income, reducing their savings the month following the shock. This behavior suggests a reactive rather than predictive adjustment, where unconstrained individuals do not build up a "buffer stock" of savings in anticipation but rather respond after the income shock occurs. In the case of a permanent increase in income, unconstrained individuals increase their investments, reflecting a shift in financial strategy in response to the additional income.

Furthermore, our analysis reveals that unconstrained individuals reduce their credit line usage following an increase in income. In addition, individuals who experience a permanent income increase are more likely to sign up for a new consumer term loan. The theoretical framework provided in the subsequent section explains the use of savings as a proxy for consumption and motivates our approach to analyzing these financial behaviors.

3.2 Conceptual framework

3.2.1 Savings framework

We use a similar approach for illustrative perspective as (Jappelli and Pistaferri 2010). The illustrative example considers an individual who can borrow and

lend at a constant rate and maximizes his expected utility over time. We follow the same assumption as (Jappelli and Pistaferri 2010); we assume that the utility is time separable. We obtain the following Euler equation.

$$u'(c_{it-1}) = \frac{E_{t-1}[(1+r_t)u'(c_{it})]}{(1+\delta)} \tag{3.1}$$

Where c is the consumption, r is the real interest rate, δ is the intertemporal discount rate. Equation (3.1) underscores a notable observation: it reveals the absence of any potential for intertemporal consumption reallocation capable of augmenting the marginal utility of consumption in equilibrium. If we assume that the interest rate is constant and equal to the intertemporal discount rate, the equation (3.1) simplify to :

$$u'(c_{it-1}) = E_{t-1}u'(c_{it}) \tag{3.2}$$

Equation (3.2) demonstrates that the current marginal utility serves as the optimal predictor for the next period's marginal utility. Post facto, changes in marginal utility only occur when expectations go unfulfilled. (Hall 1978) expounds that in his work, information from the preceding period, aside from consumption levels, fails to forecast future consumption. this implies the the concept of consumption smoothing. An individual who expects his future income to decline will start saving when he begins to form expectations about his future income. The same rationale applies to individuals who expect an income increase. Indeed they will begin to borrow against their future income. Following (Campbell 1986) , we infer the individual's consumption fluctuation through the change in savings and income, as the individual's savings reflect the total residual income on consumption. Therefore, we can infer the individual's consumption by observing the fluctuation of the individual's income and savings. This is the proxy we will use to observe if the individuals can predict their income shock and how they react to it.

3.2.2 Financial product framework

In this section, we examine how individuals adjust their use of financial products namely credit lines, mortgages, bank loans, and consumer loans following changes in economic resources. Our analysis focuses on two dimensions: prepayment behavior and the likelihood of opening new financial products. While credit line utilization has been extensively studied in the corporate finance literature (e.g., Holmström and Tirole 1998, Boot, Thakor, and Udell 1987), its role within household finance remains less understood. As noted by Tufano 2009, much of the existing work in this area emphasizes default risk and credit ratings. For instance, S. Agarwal, Ambrose, and C. Liu 2006 find that individuals often open credit lines in anticipation of deteriorating credit scores. Our context differs: the dataset contains limited variation in credit risk or delinquency, allowing us instead to focus on how individuals use credit lines in response to income shocks. Consistent with life-cycle models, we hypothesize that individuals may use financial instruments to smooth consumption across time. Credit lines and installment loans offer a means of reallocating resources either by drawing on future income to meet current needs or by paying down debt when liquidity improves. Bank term loans in our data consist of fixed borrowing amounts repaid through equal installments over time. These products typically support large purchases or longer-term financial planning. Consumer term loans, by contrast, are more flexible: they enable short-term borrowing with minimal penalties for early repayment. Understanding how households manage these financial instruments particularly their prepayment behavior is key to evaluating how income changes shape borrowing dynamics. Although the literature offers limited guidance, Z. Li et al. 2019 note the lack of empirical work on prepayments, and V. Agarwal and Taffler 2008 show that macroeconomic conditions such as rising interest rates and unemployment tend to reduce early repayment. In our setting,

these external factors are relatively stable, allowing us to isolate the role of income variation in shaping repayment patterns. Finally, we assess whether income changes affect the likelihood of opening new credit products. One might expect an increase in income to facilitate access to mortgages, credit lines, or personal loans. Alternatively, individuals may prefer to allocate additional funds toward investment or savings. By jointly studying both the prepayment and acquisition margins, we provide a comprehensive picture of how income shocks influence household financial behavior.

3.3 Data Source & Descriptive Statistics

Our empirical analysis is based on administrative data obtained from a major North American financial institution. The dataset spans the period from February 2010 to March 2017 and includes detailed account-level information for 76,382 individuals. For each client, we observe month-end balances across a range of financial products, including lines of credit, mortgages, bank term loans, and consumer loans. An important inclusion criterion is that individuals must have opened at least one account with the branch and hold an active savings account. Our dataset contains the monthly income data, recorded as the total value of direct deposits made into clients' accounts. These deposits represent a wide range of income sources, including salaries, retirement benefits, government transfers, and occasional bonuses. This income information is available between November 2013 and February 2017, during which 44,619 individuals have at least one non-missing observation. Our main analysis focuses on a smaller cohort of 1,715 individuals for whom we observe both sustained income changes and account activity around the shock window, as detailed in section 4.

For the financial products analysis, we restrict our sample to financial products that have been opened between November 2013 and January 2017. To ensure consistency in our analysis of credit utilization, we exclude individuals whose

credit line limits were adjusted during the event window. This allows us to isolate changes in usage from changes in borrowing capacity. Within this restricted sample, we identify 392 individuals with credit lines who experienced a permanent increase in income and 242 individuals who experienced a permanent decrease. For bank term loans, we focus on cases where loan origination information is matched with income records and where a clear income shock is observed. The dataset includes 12,834 bank term loans in total, of which 8,129 include origination dates and 2,294 include salary information. Among these, we identify 130 loans associated with a permanent income increase and 26 with a permanent decrease. These figures include both new and refinanced loans observed during the event window.

On the mortgage side, we observe 78 cases of permanent income increases and 56 cases of income decreases. While the number of observations is limited, these cases allow us to document patterns in mortgage behavior following income shocks, although our analysis remains largely descriptive in this segment. Due to the scarcity of consecutive observations for individuals facing income declines, our quantitative analysis emphasizes the permanent increase sample. For mortgages, consumer loans, and bank term loans, the sample size for income-decrease cases is insufficient for robust statistical inference. We plan to revisit these margins as additional data becomes available. Sample construction is discussed in detail in **section 4** , and limitations related to product-level coverage are addressed in **in the section 6**.

Table 3.1 presents descriptive statistics. The average monthly direct deposit is $1,443.05, with minimal variation across months. The average balance in the savings account is $11,606, with an average month-to-month decline of $135.04, or roughly 15%. The average balance in the investment account is $75,834, with a monthly increase of $716.39 and negligible percentage variation. The average size of a permanent income increase (Δ_{i+}) is $438.48, while the average permanent

decrease (Δ_{i-}) is \$406.53.

3.3.1 Identifying Permanent Income Shocks and Sample Construction

Our empirical analysis focuses on individuals who experience a clear and sustained change in monthly salary deposits. We classify these income shocks as either permanent increases or permanent decreases and analyze their effects using an event-study framework. We define a permanent income shock as a discrete change in income occurring at time T_{+1}, followed by a four-month period of income stability. To distinguish these changes from transitory bonuses or statistical noise, we impose a strict stability condition: income from T_{+2} to T_{+4} must remain within a 10% band of the new post-shock level observed at T_{+1}. Similarly, we require pre-shock income stability by restricting the four months prior to the shock to lie within a 5% band around the baseline value at T_0.

The following conditions are used to construct the sample (T_0 as the reference month):

$$\begin{aligned} \text{Permanent Increase:} \quad & T_{+1} \geq 1.10 \times T_0, \\ & 0.90 \times T_{+1} < T_{+2}, T_{+3}, T_{+4} < 1.10 \times T_{+1}, \\ & 0.95 \times T_0 < T_{-1}, T_{-2}, T_{-3}, T_{-4} < 1.05 \times T_0. \end{aligned} \tag{3.3}$$

$$\begin{aligned} \text{Permanent Decrease:} \quad & T_{+1} \leq 0.90 \times T_0, \\ & 0.90 \times T_{+1} < T_{+2}, T_{+3}, T_{+4} < 1.10 \times T_{+1}, \\ & 0.95 \times T_0 < T_{-1}, T_{-2}, T_{-3}, T_{-4} < 1.05 \times T_0. \end{aligned} \tag{3.4}$$

These conditions ensure that the income shock is both substantial and sustained, effectively ruling out transitory fluctuations or seasonal variation. This allows us to examine how financial behavior particularly savings accumulation, credit utilization, prepayment decisions, and product adoption responds to durable shifts in economic resources.

To quantify the magnitude of these shocks, we compute the change in income, denoted Δ_i, as the difference between the average monthly salary deposited during the four months following the shock and the average salary over the four months preceding it. This measure captures the persistent component of the income adjustment and is used as a continuous treatment variable in our regression analyses.

$$\Delta_i = \frac{1}{4} \sum_{t=+1}^{+4} T_t - \frac{1}{4} \sum_{t=-4}^{0} T_t \tag{3.5}$$

This formulation ensures that the estimated income change reflects a stable shift rather than transitory noise, and aligns with the empirical definitions used to classify individuals into treatment groups.

We can notice from the two figures (3.1 & 3.2) that our samples are not presenting any pretend before the change in economic resources. From the figure 3.1, we can observe that on average, the change is around $430, and from the figure 3.2 , we notice that on average, the change is around - $400.

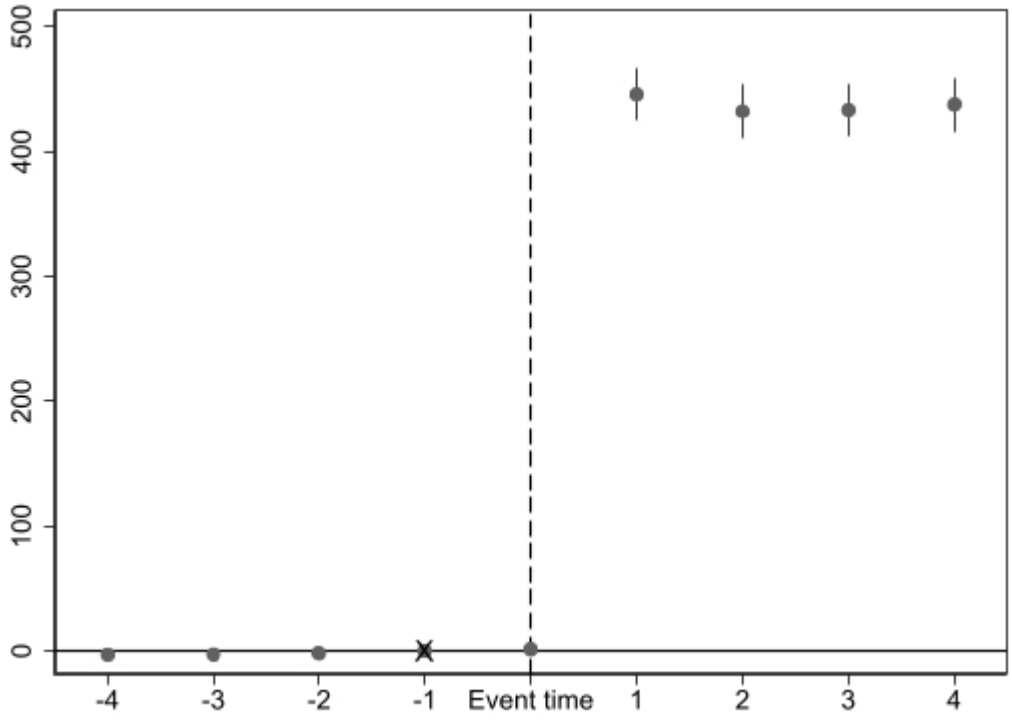
To capture heterogeneity in financial behavior, we classify individuals as liquidity constrained using an asset-based rule inspired by Zeldes 1989. An individual is defined as constrained if their total liquid savings measured as the sum of savings and invesments are less than twice their deposited income in the pre-shock period:

$$\text{Assets}_t < 2 \times \text{Income}_t \tag{3.6}$$

This test is applied over a four-month window prior to the shock (T_{-4} to T_0), using the average balance during this period. The asset-based segmentation plays a central role in our analysis: it reflects the idea that individuals with limited savings may be unable to smooth consumption through self-insurance and are therefore more sensitive to income changes.

Given that not all individuals maintain full monthly observations due to either recent product uptake or reporting gaps we restrict the analysis to those with

Figure 3.1 – Income dynamics - robustness (Permanent increase in income)



Note: We constructed the permanent increase sample using the equations (3.3). We plot the Income dynamic from T-4 to T+4 (income shock) using the equation (3.7) where our Y is the monthly income.

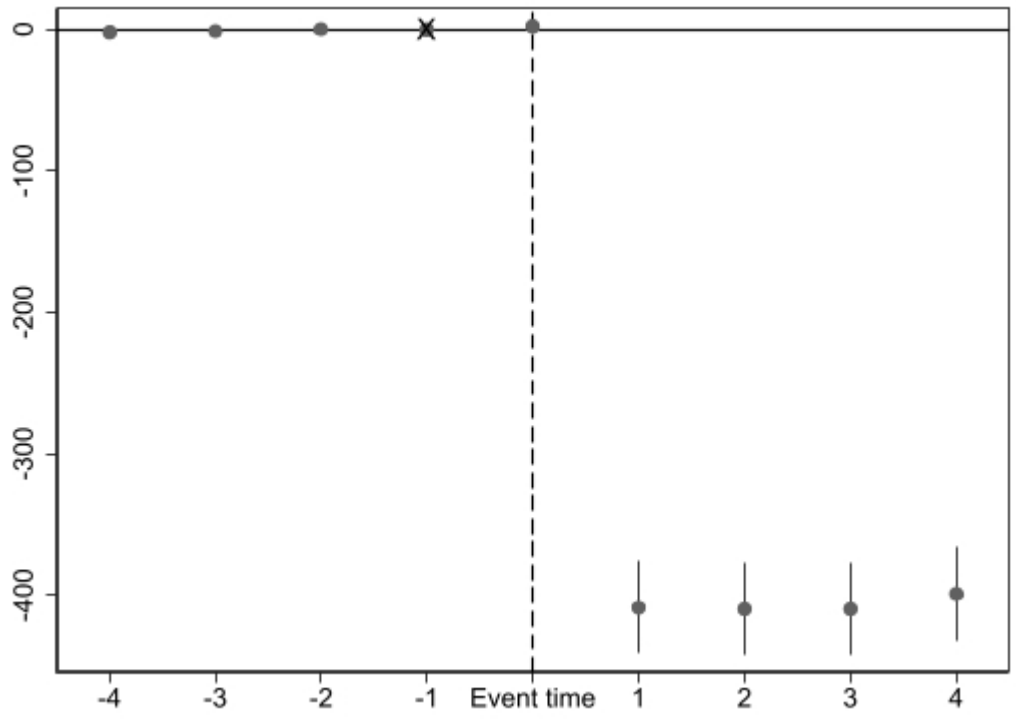
at least nine consecutive months of data, from four months before to four months after the shock. This restriction ensures consistency in tracking financial behavior over time and allows us to reliably identify constrained from unconstrained individuals.

3.4 Strategy and results

Savings and Predictability

This section explores the savings dynamics surrounding permanent income shocks, with a particular focus on the presence of anticipatory behavior. Fol-

Figure 3.2 – Income dynamics - robustness (Permanent decrease in income)



Note: We constructed the permanent decrease sample using the equations (3.4). We plot the Income dynamic from T-4 to T+4 (income shock) using the equation (3.7) where our Y is the monthly income.

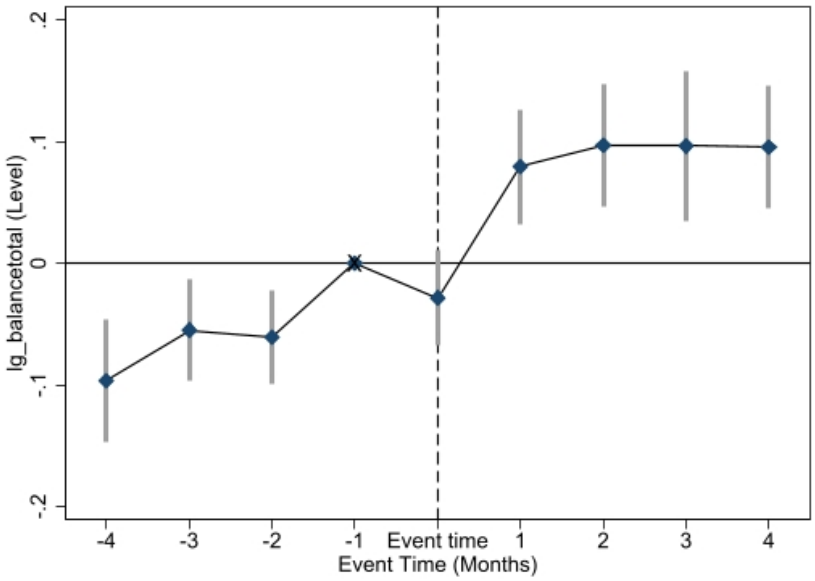
lowing the Rational Expectations-Permanent Income Hypothesis (RE-PIH), a forward-looking consumer adjusts their consumption and savings in response to changes in expected lifetime income. In this framework, counter-cyclical movement in savings prior to the shock serves as evidence of predictability that is, individuals anticipate future income changes and adjust their behavior accordingly.

To formally test for the presence of such patterns, we estimate the following equation:

$$Y_{it} = \beta_0 + \sum_{\substack{t \neq -1 \\ t=-4}}^{4} \beta_t D_{it} + \gamma_{it} + \alpha_i + \epsilon_{it} \tag{3.7}$$

where Y_{it} is the outcome of interest (e.g., log savings balance), and D_{it} is a set of event time dummies capturing months relative to the income shock, from T_{-4} to

Figure 3.3 – Total Balance Dynamics (Permanent Increase in Income)



Note: We construct the permanent increase sample using equations (3.3). The figure plots the log of total balance from T_{-4} to T_{+4} using equation (3.7), where the outcome variable Y_{it} is the total account balance.

T_{+4}, omitting T_{-1} as the reference period. The model includes individual fixed effects α_i and a vector of time-varying controls γ_{it}. Standard errors are clustered at the individual level.

We begin by analyzing the behavior of individuals who experience a permanent increase in income. Figure 3.3 plots the log of total balances from T_{-4} to T_{+4}. The trajectory reveals a modest accumulation of savings in the pre-shock period, followed by a clear upward shift in the aftermath of the income change. Indeed, we observe a slight dip in balances immediately before the shock, which may indicate anticipatory consumption a pattern consistent with intertemporal smoothing in the presence of expected income gains. The post-shock rise in balances likely reflects a combination of precautionary savings and mechanical accumulation driven by higher income inflows. Taken together, these dynamics suggest forward-looking behavior and lend support to the notion that individuals adjust their financial positions in anticipation of income improvements.

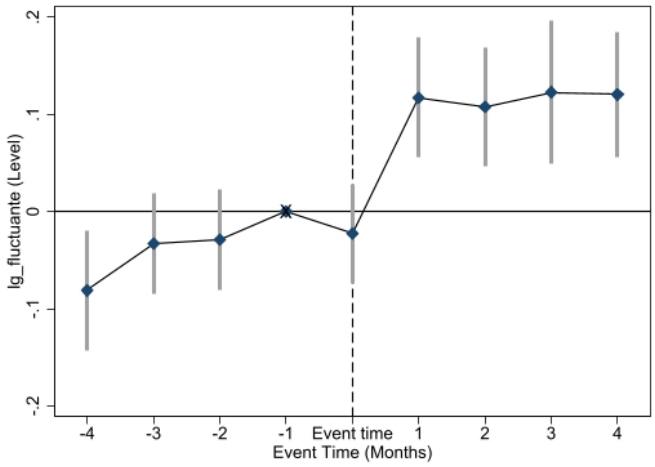
To identify the mechanisms driving this adjustment, we disaggregate total balances into two components: the *savings account* and the *investment account*. The savings account captures liquid holdings accessible for immediate use, while the investment account includes more illiquid vehicles typically associated with long-term financial planning(RSSP, TSFA). This distinction allow us to assess whether households allocate new resources differently depending on asset liquidity.

Figures 3.4 and 3.5 present the evolution of these two components for the permanent increase group from T_{-4} to T_{+4}. The results reveal a notable divergence in behavior between the two accounts.

Savings Account: Figure 3.4 plots the evolution of log savings balances around the time of the income shock. We observe a pronounced increase in liquid savings beginning at T_0, which is sustained through T_{+4}. This response is consistent with forward-looking behavior. In the fourth month preceding the shock, balances exhibit a gradual decline, suggesting that individuals may have anticipated the income gain and drawn down savings accordingly. The post-shock increase likely reflects a combination of mechanical accumulation from higher income and a precautionary response to improved financial circumstances.

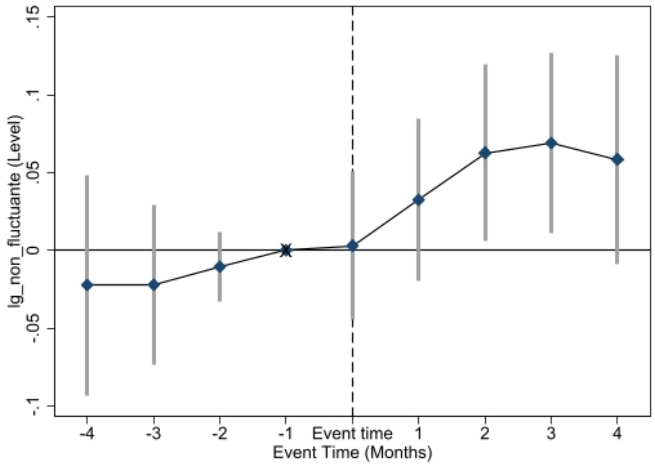
Investment Account: The pattern for investment accounts, shown in Figure 3.5, is markedly different. Balances remain relatively stable in the pre-shock period, and while there is a modest upward drift after T_0, the changes are small . These non dynamics indicate that individuals do not adjust their longer-term investment positions to the same extent as their liquid savings following an income increase. in fact, we notice that the coefficient are not statistically significant. Taken together, the evidence suggests that short-term financial instruments particularly savings accounts constitute the primary margin of adjustment. Individuals appear to respond to income gains by reinforcing their liquidity buffers rather than reallocating funds toward less accessible investment products.

Figure 3.4 – Savings Account – Permanent Increase Group



Note: We construct the permanent increase sample using equation (3.3). The figure plots the log of savings from T_{-4} to T_{+4} using equation (3.7), where the outcome variable Y_{it} is the savings account balance.

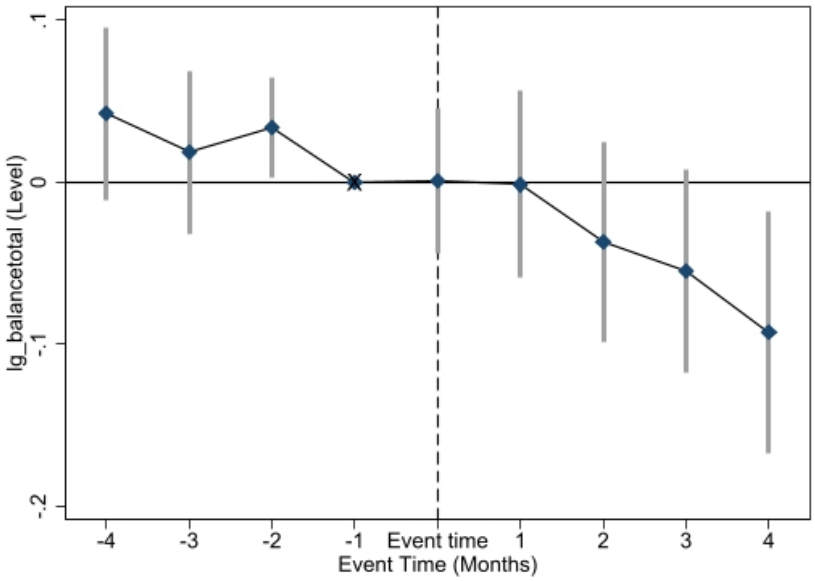
Figure 3.5 – Investment Account – Permanent Increase Group



Note: We construct the permanent increase sample using equation (3.3). The figure plots the log of investment from T_{-4} to T_{+4} using equation (3.7), where the outcome variable Y_{it} is the investment account balance.

By contrast, Figure 3.6 illustrates the dynamics of the total balance (sum of investment and savings accounts balace) for individuals who experience a permanent income decline. In this case, the trajectory diverges sharply from the pattern observed under income gains. We document an immediate and sustained drop in

Figure 3.6 – Total Balance Dynamics - Permanent Decrease Group



Note: We construct the permanent decrease sample using equations (3.4) . The figure plots the log of savings from T_{-4} to T_{+4} using equation (3.7), where the outcome variable Y_{it} is the savings account balance.

their savings beginning at T_0, with no visible buildup in the months leading up to the shock. The absence of pre-shock adjustment suggests either that the decline in income was largely unanticipated or that households lacked the financial slack to modify consumption behavior in advance. Taken together, the evidence points to limited scope for forward-looking behavior in the face of negative income shocks.

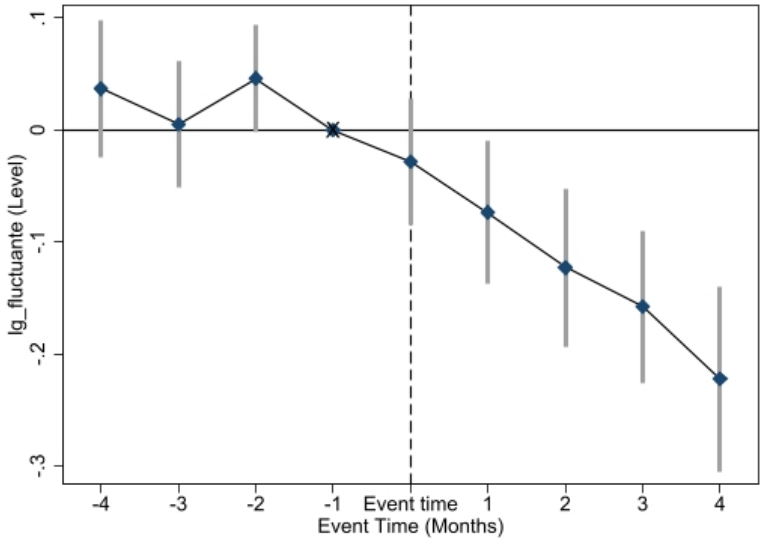
To better understand the composition of these responses, we again decompose total balances into their constituent parts. Specifically, we examine the evolution of log balances in both savings and investment accounts for individuals exposed to a permanent income decrease. This separation allows us to assess whether the adjustment is concentrated in highly liquid instruments or extends to longer-horizon assets.

Figure 3.7 documents the trajectory of balances held in saving accounts following a permanent income decline. The adjustment is both immediate and persistent: starting at T_0, savings drop sharply and continue to decline through T_{+4}.

Consistent with earlier findings, we observe no evidence of pre-shock accumulation, reinforcing the notion that individuals either did not anticipate the income loss or were constrained in their ability to smooth consumption in advance.

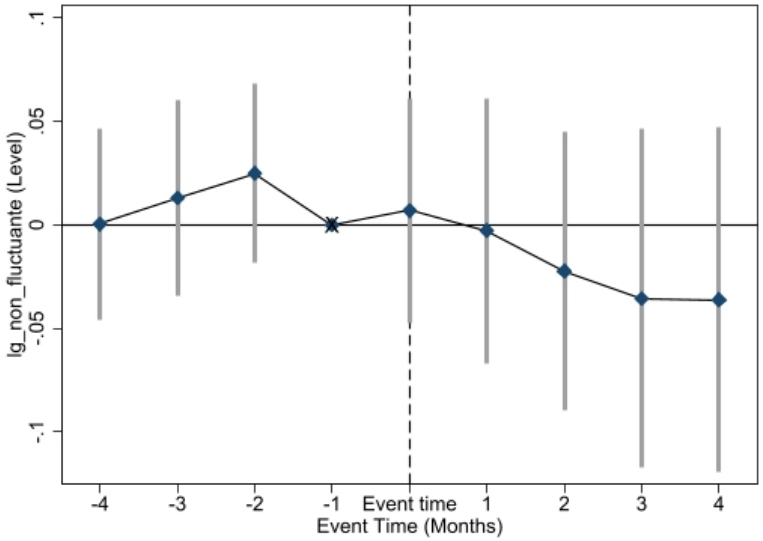
By contrast, Figure 3.8 presents the evolution of balances in the investment accounts. Here, the adjustment is limited. While there is a modest decline following T_0, the change is both smaller in magnitude and statistically not significant. As in the case of savings accounts, there is no sign of anticipatory behavior. These patterns suggest that when faced with negative income shocks, individuals primarily adjust along the liquid margin, drawing down accessible savings while leaving longer-term investments largely untouched.

Figure 3.7 – Savings Account – Permanent Decrease Group



Note: We construct the permanent decrease sample using equations (3.4). The figure plots the log of savings from T_{-4} to T_{+4} using equation (3.7), where the outcome variable Y_{it} is the savings account balance.

Figure 3.8 – Investment Account - Permanent Decrease Group



Note: We construct the permanent decrease sample using equations (3.4). The figure plots the log of Invesment account from T_{-4} to T_{+4} using equation (3.7), where the outcome variable Y_{it} is the investment account balance.

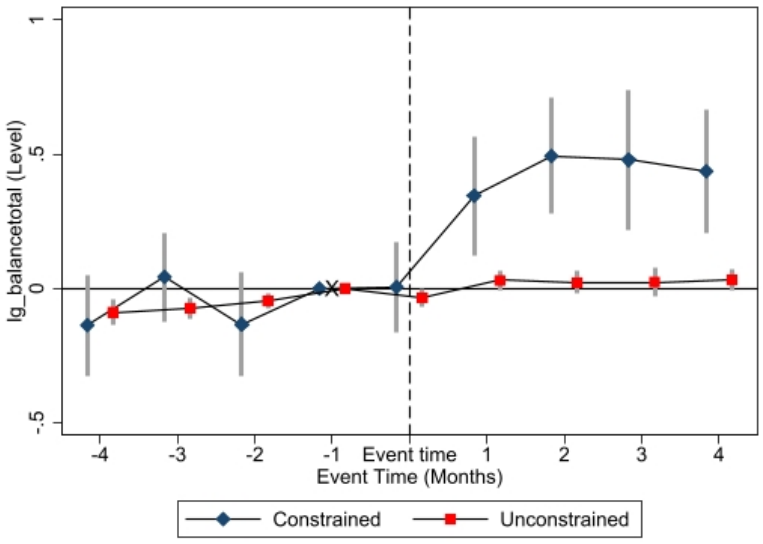
Taken together, these findings reveal a pronounced asymmetry in behavioral responses : individuals adjust more actively to income gains than to losses. This divergence likely reflects both the presence of liquidity constraints and differences in the predictability of each type of shock. Notably, these patterns arise even before conditioning on individuals' financial capacity. In the next section, we exploit variation in asset holdings to examine whether access to liquid resources shapes the ability to respond to income fluctuations.

3.4.1 Heterogeneity by Liquidity Constraints

We now observe how the savings response to permanent income gains varies by baseline liquidity status. This analysis helps identify whether individuals with limited financial buffers are able to adjust their behavior in anticipation of income changes, or whether their responses are shaped by immediate resource constraints.

Figure 3.9 plots the evolution of the log of total balances separately for constrained and unconstrained individuals. Among unconstrained individuals, we observe a clear pre-shock decline in balances, consistent with anticipatory consumption-smoothing. This pattern aligns with the permanent income hypothesis: forward-looking households reduce savings and raise consumption in anticipation of higher future income. Following the shock, balances stabilize at a higher level, suggesting that consumption has already adjusted and savings behavior returns to baseline.

Figure 3.9 – Total Balance Dynamics by Liquidity Status (Permanent Increase)



Note: We construct the permanent increase sample using equation (3.3). The figure plots the log of total balances from T_{-4} to T_{+4} using equation (3.7), where the outcome variable Y_{it} is the total balance. Results are presented separately for constrained and unconstrained individuals, based on the asset-based liquidity classification described in Section 2.2.

In contrast, constrained individuals show no evidence of anticipatory adjustment. Their balances remain flat through the pre-shock period and begin rising only after the income increase materializes. This delayed response is consistent with binding liquidity constraints: lacking access to sufficient buffers, these individuals are unable to adjust consumption or savings ahead of the shock. Instead, the post-shock accumulation likely reflects precautionary motives or a partial eas-

ing of financial constraints.

We disaggregate the total balance into its two core components: savings and investment. This breakdown offers further insight into which type of financial vehicle individuals rely on most following an income shock, and whether their ability to respond is mediated by liquidity constraints.

Figure 3.10 plots the evolution of the log of balances in savings accounts for constrained and unconstrained individuals following a permanent income increase. The two groups exhibit markedly different trajectories. For constrained individuals, balances rise sharply after T_0, suggesting a reactive adjustment once the income shock materializes. This pattern is consistent with limited liquidity, which infer that anticipatory smoothing is not feasible due to the lack of resources.

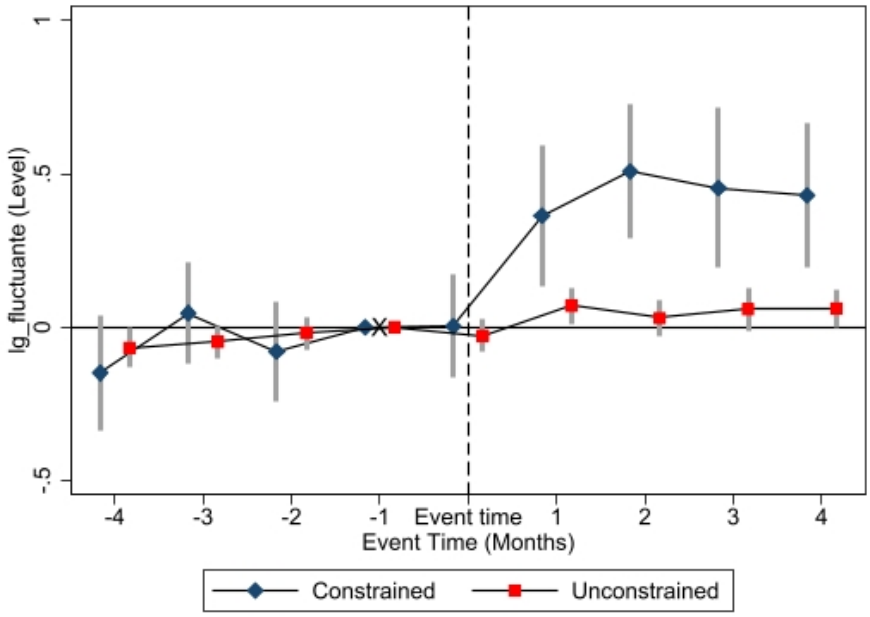
In contrast, unconstrained individuals show a modest drawdown in the months preceding the shock, indicative of forward-looking behavior. The divergence in timing reinforces the interpretation that constrained individuals respond ex post, while unconstrained individuals seem to be able adjust ex ante.

Figure 3.11 presents the corresponding dynamics for investment account. Here, balances remain largely flat for unconstrained individuals, while constrained individuals display only a mild and delayed increase. The non-response across both groups suggests that investment accounts are not the primary vehicle for absorbing income gains. Instead, individuals especially those who are liquidity constrained prefer to accumulate buffer stock through their savings account, which remains more flexible and accessible.

Taken together, these results reinforce the interpretation that liquidity-constrained individuals adjust only after the shock occurs, primarily through increased savings. In contrast, unconstrained individuals display behavior more consistent with intertemporal optimization, including some evidence of withdrawal or pre-consumption prior to the shock.

Figure 3.12 plots the log of total balances for individuals who experience a

Figure 3.10 – Savings account dynamics (Permanent increase, by liquidity status)

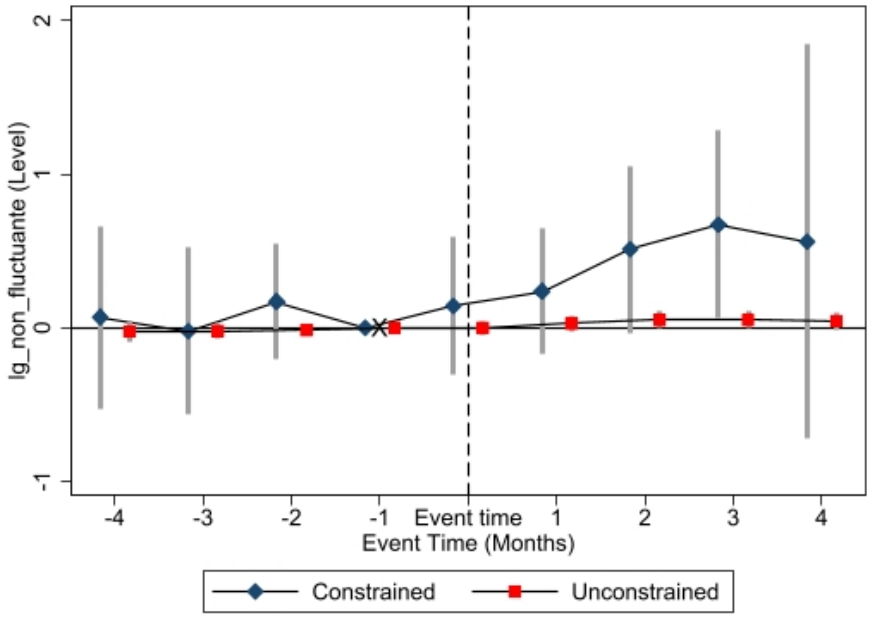


Note: We construct the permanent increase sample using equations (3.3). The figure plots the log of savings from T_{-4} to T_{+4} using equation (3.7), with separate lines for constrained and unconstrained individuals.

permanent decrease in income, separately by liquidity status. For unconstrained individuals, balances remain remarkably stable throughout the event window, with no discernible adjustment either before or after the shock. A similar pattern emerges among constrained individuals, their total balances exhibit little movement, suggesting limited scope for either anticipatory drawdowns or post-shock rebuilding.

We disaggregate total balance into its two core components to assess which margin responds more acutely and how this adjustment varies by liquidity status. Figure 3.13 illustrates the dynamics of savings accounts for constrained and unconstrained individuals from T_{-4} to T_{+4}. We observe a clear asymmetry in post-shock behavior. Among unconstrained individuals, balances decline steadily following T_0, consistent with the use of liquid buffers to absorb the income shortfall. This pattern aligns with canonical consumption-smoothing models, wherein

Figure 3.11 – Investment account dynamics (Permanent increase, by liquidity status)



Note: We construct the permanent increase sample using equations (3.4). The figure plots the log of investment from T_{-4} to T_{+4} using equation (3.7), with separate lines for constrained and unconstrained individuals.

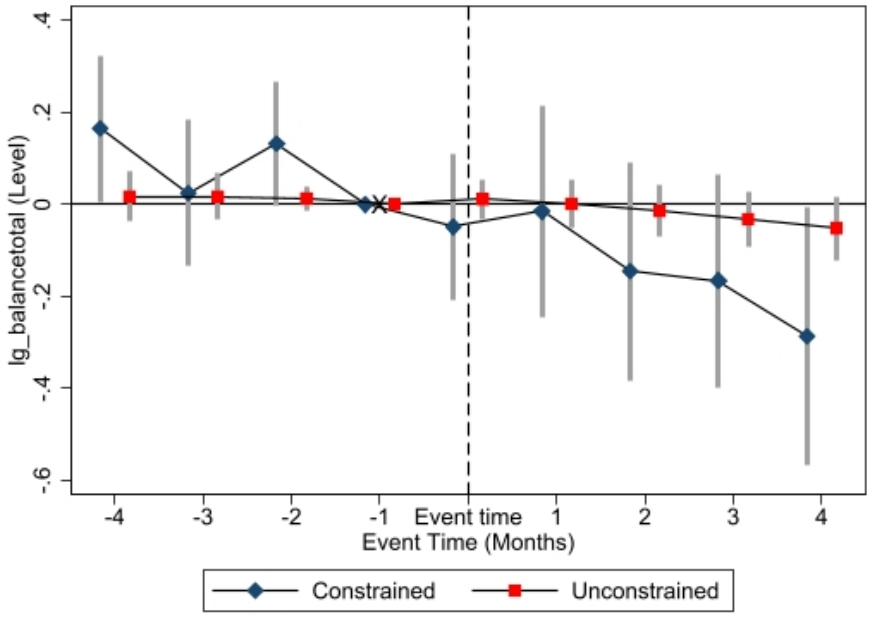
households with financial slack draw down savings in response to negative income shocks.

We next assess whether the magnitude of income changes has a differential effect on financial behavior. In particular, we test whether individuals who experience larger income shocks respond more strongly in terms of their account balances. To do so, we estimate a before-and-after specification with an interaction between the post-shock indicator and the scaled income change Δ_i:

$$Y_{it} = \beta_0 + \beta_1 \text{After}_{it} + \beta_2(\text{After}_{it} \times \Delta_i) + \beta_3 \Delta_i + \gamma_t + \alpha_i + \epsilon_{it} \tag{3.8}$$

where Y_{it} is the log of account balances (savings, investment, or total), After_{it} is a dummy equal to one for periods after the income shock, and Δ_i is the change in income for individual i (scaled in thousands of dollars). We control for individual fixed effects α_i and time fixed effects γ_t, with standard errors clustered at the

Figure 3.12 – Total balance dynamics (Permanent decrease, by liquidity status)



Note: We construct the permanent decrease sample using equations (3.4). The figure plots the log of total balances from T_{-4} to T_{+4} using equation (3.7), with separate lines for constrained and unconstrained individuals.

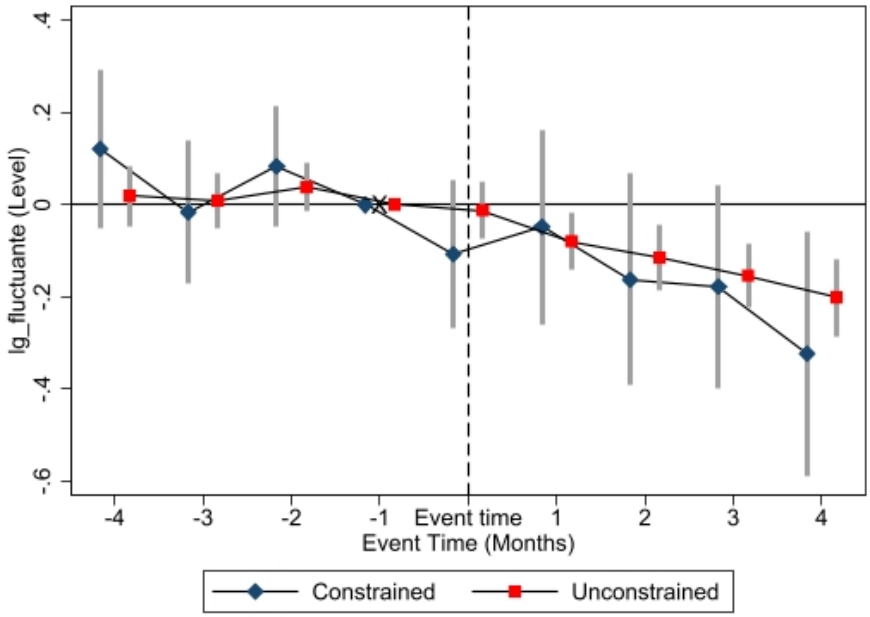
individual level.

Table 3.4 presents the results, separately for permanent income increases and decreases, and across constrained and unconstrained subsamples.

First, the coefficient of the interaction term $\text{After}_{it} \times \Delta_i$ (After x Income) is generally small and statistically insignificant for the unconstrained individual. This suggests that the size of the income change has little effect on the level of savings or investment accounts post-shock. For example, in Panel A, even large income increases do not significantly amplify the accumulation of savings for the unconstrained individuals.

However, constrained individuals show strong responses to the occurrence of the income change. In Panel A, constrained individuals experiencing a permanent income increase increase their savings account balances (column 2), while unconstrained individuals show no such adjustment. A similar pattern is found

Figure 3.13 – Savings account dynamics (Permanent decrease, by liquidity status)



Note: We construct the permanent decrease sample using equations (3.4). The figure plots the log of savings from T_{-4} to T_{+4} using equation (3.7), with separate lines for constrained and unconstrained individuals.

in total balances (Panel E), where the effect is again concentrated among constrained individuals.

Third, investment accounts appear relatively unresponsive, regardless of group or shock direction. In both Panels B and D, neither constrained nor unconstrained individuals exhibit significant post-shock changes, consistent with the earlier graphical evidence suggesting that savings accounts are the primary margin of adjustment.

These findings indicate that it is not the dollar magnitude of the income change that matters, but rather the realization of the shock itself. The binary nature of adjustment—strong for constrained individuals, muted for the unconstrained—reinforces the idea that liquidity conditions, not income levels per se, govern balance dynamics.

Note: All outcome variables are measured in logs. Income changes Δ_i are scaled by 1,000. Coefficients can be interpreted as approximate percentage changes.

Table 3.4 [about here]

3.4.2 Financial products

In this section, we examine how individuals adjust their use of financial products, specifically credit lines, mortgages, and term loans following a permanent shift in income. Our analysis focuses on two key questions: first, whether individuals allocate additional income toward debt repayment or investment; and second, whether income gains facilitate access to new credit products or expanded borrowing capacity.

To address these questions, we study both the utilization patterns of existing products and the likelihood of acquiring new financial instruments. This approach allows us to assess whether changes in economic resources translate into shifts in household balance sheet management.

However, the results, illustrated in figures (3.15 & 3.16), do not show any statistically significant changes in credit line usage for either the constrained or unconstrained groups following a permanent change in income. The lack of significant adjustments suggests that the anticipated impact of income changes on credit line usage is not evident in our sample. These findings imply that, contrary to our expectations, individuals may not be using additional income to reduce reliance on credit lines or to alter their borrowing behavior in a meaningful way.

We now turn to the role of credit lines in absorbing income shocks. In this analysis, we use the same empirical framework as outlined in equation 3.8, where the outcome variable Y_{it} is the log of the individual's credit line balance.

Table 3.5 presents the results, we find no evidence that the magnitude of the income shock Δ_i affects the evolution of credit line balances interaction terms

are statistically insignificant across all specifications. However, we do observe a significant adjustment in credit behavior following the shock itself, particularly for individuals who are liquidity-constrained.

Specifically, constrained individuals reduce their credit line balances after the income shock. Column (2) of Panel A shows that the average log balance declines in the post-shock period. The observed decline may reflect precautionary deleveraging, limited access to additional borrowing, or efforts to restore financial stability after the shock. In contrast, unconstrained individuals show no meaningful adjustment in their credit utilization.

Taken together, these results suggest that credit lines does not play an important role in income smoothing for both groups and that constrained individuals may be more focused on rebuilding their balance sheets than on expanding credit usage in response to income shocks.

Table 3.5 [about here]

For the mortgage and the consumer term loan, we construct the prepayment variable by comparing the evolution of the balance from period T to period T_{+1} to the amount agreed to be repaid by the individual in period T. We do not consider prepayment amount less than \$50 as we assume that it could be caused by interest discrepancy or it could be a record error from the bank.

$$\text{Prepayment} = (\text{Balance}_{t+1} - \text{Balance}_{t}) - \text{Amount agreed to be repay} \tag{3.9}$$

If the balance growth is greater than the amount agreed on, we have a prepayment situation. Therefore, we are interested in the pattern of those prepayments made during our event window.

Our goal is to identify if the additional income resulting from the income change is affecting the prepayment made by the individuals. To do so, we use the equation 3.8, where our outcome of interest is the observed prepayment made over the financial products.

Table 3.5 [about here]

On the mortgage side,As reported in Panel C of Table 3.5, we find no evidence that the magnitude of the income change Δ_i influences mortgage prepayment interaction terms are insignificant across all groups. However, we observe a clear shift in prepayment behavior following the shock itself for constrained individuals.

In particular, the coefficient on the "After" indicator in Column (2) shows that constrained individuals increase their prepayment by approximately $169 in the months following a permanent income gain. This finding suggests that although these individuals were previously limited in their repayment capacity, the shock provided them with sufficient liquidity to reduce outstanding mortgage balances. This response, however, is absent among unconstrained individuals, who do not exhibit any significant change in mortgage prepayment. A potential explanation is that prepayment penalties or contractual frictions may reduce the incentive to repay ahead of schedule. As discussed by Beltratti, Benetton, and Gavazza (2017), the presence of prepayment costs can partially offset the benefits of deleveraging. Overall, our findings suggest that liquidity-constrained households are more responsive to income increases when it comes to mortgage repayment, even if the effect remains moderate in absolute terms.

Regarding consumer term loans (Table 3.5), we find that additional income does not significantly affect prepayment behavior. This result is unexpected, particularly since consumer term loans do not carry penalties for early repayment. A possible explanation could be that individuals who experience a permanent increase in income may prefer to allocate their additional funds to investment accounts rather than using them to prepay these loans. This behavior could account for the lower incidence of prepayment observed for consumer term loans.

Finally, we turn our analysis on whether individuals are more likely to open new financial products after experiencing a change in economic resources. It is reasonable to hypothesize that additional income might enable individuals to qualify for new financial instruments such as term loans, mortgages, or credit

lines that they were previously unable to access. Additionally, some individuals might choose to refinance existing obligations or expand their financial toolkit to better manage their liquidity.

To test this hypothesis, we estimate the following probit specification:

$$P\left(\text{New financial product} = 1\right) = \Phi\Bigg[\beta_0 + \sum_{\substack{t\neq 0 \\ t=-3}}^{6} \beta_{1,it} D_{it} + \sum_{\substack{t\neq 0 \\ t=-3}}^{6} \beta_{2,it}(D_{it} \times \Delta_i) + \beta_{3,it}\Delta_i + \gamma_{it} + \alpha_i + \epsilon_{it}\Bigg] \tag{3.10}$$

where the outcome variable captures the probability of opening a new financial product (credit line, mortgage, or consumer loan), and the key variables of interest include the event time dummies D_{it}, the magnitude of the income change Δ_i, and their interaction.

Table 3.6 presents the results. We find no evidence that the magnitude of the income shock significantly increases the likelihood of opening a new credit line. However, we do find that individuals particularly the unconstrained are more likely to open a credit line in the months following an income shock. For unconstrained individuals, the probability of opening a credit line rises by 1.6 percentage points post-shock , while the effect is 1.5 percentage points for constrained individuals.

For mortgages, the results suggest a modest sensitivity to income magnitude. Among constrained individuals, a $1,000 increase in income raises the probability of opening a mortgage by 1.4 percentage points. However, the timing of the shock itself does not appear to drive significant changes in mortgage openings for either group.

Finally, results for consumer term loans reveal a contrasting pattern. For unconstrained individuals, a $1,000 increase in income is associated with a 0.3 percentage point increase in the likelihood of opening a consumer loan, while the

post-shock dummy itself is also positive and significant. In contrast, constrained individuals do not respond to the income shock along this margin, suggesting that liquidity may be necessary to initiate new borrowing even when the underlying demand exists. Taken together, these findings highlight important heterogeneity in financial behavior. While income shocks do not universally increase access to or demand for new financial products, unconstrained individuals appear better positioned to expand their credit options following an improvement in resources.

3.5 Discussion, Limitations and Potential Extensions

In this paper, we examine the predictability of income changes by analyzing the co-movement of savings account balances and income fluctuations. Our findings suggest that unconstrained individuals facing a permanent decrease in income do not predict the income change but react after it occurs. In cases of permanent income increases, constrained individuals show adjustments in their savings behavior before the shock, while unconstrained individuals exhibit significant changes in both their investment and savings accounts after the shock.

We also explore how additional income from these changes affects financial behaviors such as prepayment and new subscriptions to financial products. Notably, we find that unconstrained individuals with a permanent increase in income are less likely to open new financial products like mortgages and consumer term loans. Moreover, constrained individuals reduce their credit line usage following an increase in income, and this additional income also impacts mortgage and consumer term loan prepayment behaviors.

The absence of significant findings for opening new bank term loans and mortgages could be linked to the transaction costs associated with negotiating such loans, as discussed in Jappelli and Pistaferri 2010. High transaction costs may deter individuals from adjusting their financial commitments, even when

they experience an increase in income. Unfortunately, our dataset does not include detailed information on these costs, which limits our ability to fully control for this factor. Future research with more comprehensive data could explore this dimension further.

These findings hold important implications for policy, particularly in the context of emergency financial support like the Canadian Emergency Response Benefit (CERB). Understanding how households manage consumption in response to income fluctuations is crucial for assessing the effectiveness of such policies in mitigating the adverse effects of economic shocks like COVID-19.

However, our analysis is subject to several limitations. The data used originates from a single financial institution, which raises concerns about the completeness of the financial information for the individuals in our sample. It is possible that these individuals hold financial products at other institutions, leading us to underestimate their overall financial adjustments. Additionally, the data only captures end-of-month balances, limiting our ability to analyze consumption patterns at a higher frequency.

Another limitation is the inability to observe individual expectations regarding income changes. Our analysis does not account for whether individuals expected the magnitude of the income change that occurred. This gap suggests that while the magnitude of the income change may be of secondary importance, the expectation of a positive or negative shock remains a key factor driving our findings.

Looking ahead, we plan to expand this research in several ways. First, we will develop a theoretical model to refine the predictions tested in our empirical setting. Second, we intend to investigate the potential for asymmetric information between individuals and the bank. This could be explored by analyzing individuals with multiple financial products, such as a credit line and a mortgage, to infer the presence of asymmetric information by examining mortgage default probability and credit line usage simultaneously.

3.6 Results

Table 3.1 – Summary statistics

	Mean	SD	p5	p50	p95	N
Montly income Level (in $)	1443.05	1061.92	309.34	1228.8	3468.72	15454
Monthly change (in $)	9.01	196.85	-155.76	0	234.46	12345
Monthly change (in %)	0.02	0.18	-0.1	0	0.15	12345
Savings Account Level (in $)	11606.38	23361.45	66.49	5260.46	39837.84	15454
Savings change (in $)	-135.04	12942.69	-4641.6	0.08	3644.37	12269
Savings change (in %)	0.16	2.82	-0.59	0	0.84	12269
Investments Account Level (in $)	75834.67	175323.65	0	12422.62	328617.44	15454
Investments change (in $)	716.39	18983.56	-4090.67	3.6	5192.2	8142
Investments change (in %)	0.03	0.51	-0.05	0	0.04	8142
Δ_*Positive*	438.48	342.72	44.11	402.27	1077.56	1093
Δ_*Negative*	-406.53	414.76	-1033.61	-282.88	-101.86	632

Note: Descriptive statistics of the individuals included in the sample. All changes are monthly. The panel presents the mean of direct deposits, savings, and investment accounts and their monthly change in dollars and percentages.

Table 3.2 – Saving and Investment Accounts - Permanent Increase sample

	Saving Account			Investment Account		
	All	Constrained	Unconstrained	All	Constrained	Unconstrained
T-4	−0.081**	−0.150	−0.068**	−0.022	0.069	−0.025
	(0.032)	(0.094)	(0.033)	(0.036)	(0.289)	(0.036)
T-3	−0.033	0.046	−0.048*	−0.022	−0.022	−0.022
	(0.026)	(0.085)	(0.027)	(0.026)	(0.264)	(0.025)
T-2	−0.029	−0.080	−0.019	−0.010	0.171	−0.017*
	(0.026)	(0.083)	(0.027)	(0.011)	(0.181)	(0.010)
T-1	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
T-0	−0.023	0.002	−0.028	0.003	0.140	−0.001
	(0.026)	(0.085)	(0.026)	(0.024)	(0.218)	(0.024)
T+1	0.117***	0.364***	0.069**	0.032	0.237	0.026
	(0.031)	(0.116)	(0.030)	(0.027)	(0.198)	(0.027)
T+2	0.108***	0.507***	0.029	0.063**	0.510*	0.048*
	(0.031)	(0.110)	(0.030)	(0.029)	(0.264)	(0.029)
T+3	0.123***	0.454***	0.058	0.069**	0.671**	0.050*
	(0.037)	(0.131)	(0.036)	(0.029)	(0.297)	(0.029)
T+4	0.120***	0.429***	0.061**	0.059*	0.561	0.042
	(0.033)	(0.119)	(0.031)	(0.034)	(0.625)	(0.029)
Observations	9504	1557	7947	5995	200	5795

Standard errors in parentheses

Savings and Investment accounts - Permanent Decrease

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3.3 – Saving and Investment Accounts - Permanent Decrease sample

	Saving Account			Investment Account		
	All	Constrained	Unconstrained	All	Constrained	Unconstrained
T-4	0.037	0.122	0.019	0.000	0.518	−0.015
	(0.031)	(0.087)	(0.033)	(0.024)	(0.673)	(0.014)
T-3	0.005	−0.015	0.009	0.013	0.641	−0.007
	(0.029)	(0.079)	(0.031)	(0.024)	(0.700)	(0.013)
T-2	0.046*	0.084	0.038	0.025	0.728	0.003
	(0.024)	(0.067)	(0.026)	(0.022)	(0.724)	(0.006)
T-1	0.000	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)	(.)
T-0	−0.028	−0.107	−0.012	0.007	0.737	−0.015
	(0.029)	(0.081)	(0.031)	(0.028)	(0.636)	(0.021)
T+1	−0.074**	−0.048	−0.079**	−0.003	0.721	−0.024
	(0.032)	(0.107)	(0.032)	(0.033)	(0.637)	(0.027)
T+2	−0.123***	−0.163	−0.115***	−0.022	0.234	−0.031
	(0.036)	(0.116)	(0.036)	(0.034)	(0.839)	(0.027)
T+3	−0.158***	−0.177	−0.154***	−0.036	−0.451	−0.025
	(0.035)	(0.111)	(0.035)	(0.042)	(1.195)	(0.028)
T+4	−0.222***	−0.323**	−0.201***	−0.036	−0.066	−0.037
	(0.042)	(0.134)	(0.043)	(0.042)	(1.157)	(0.030)
Observations	5576	969	4607	3620	109	3511

Standard errors in parentheses

Savings and Investment accounts - Permanent Decrease

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3.4 – Savings and Investment Accounts - Permanent Increase and Decrease

	(1) All	(2) Constrained	(3) Unconstrained
A. Savings Account Perm Increase			
After × Income	0.429	1.708 ∗ ∗	0.166
	(0.275)	(0.640)	(0.190)
After	−0.274 ∗ ∗	−0.649	−0.208∗
	(0.123)	(0.397)	(0.121)
Observations	4707	731	3714
B. Invesment Account Perm Increase			
After × Income	−1.756	0.000	−1.794
	(1.300)	(.)	(1.316)
After	0.689	0.003 ∗ ∗	0.687
	(0.475)	(0.000)	(0.468)
Observations	2908	88	2693
C. Savings Account Perm Decrease			
After × Income	−0.984	0.000	−0.859
	(0.756)	(.)	(0.799)
After	−0.559∗	−0.838 ∗ ∗	−0.497
	(0.337)	(0.000)	(0.363)
Observations	2899	437	2140
D. Invesment Account Perm Decrease			
After × Income	−0.296	0.000	−0.296
	(0.586)	(.)	(0.586)
After	0.067	0.000	0.067
	(0.295)	(.)	(0.295)
Observations	1876	44	1645
E. Total Balance Perm Increase			
After × Income	0.169	1.704 ∗ ∗	−0.147
	(0.391)	(0.644)	(0.291)
After	−0.215	−0.650	−0.137
	(0.182)	(0.399)	(0.177)
Observations	4789	733	3793
E. Total Balance Perm Decrease			
After × Income	−0.399	0.000	−0.193
	(0.670)	(.)	(0.692)
After	−0.186	−0.838 ∗ ∗	−0.085
	(0.329)	(0.000)	(0.347)
Observations	2944	437	2178
Monthly FE	YES	YES	YES
Individual FE	YES	YES	YES

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3.5 – Prepayment on financial product

	(1) All	(2) Constrained	(3) Unconstrained
A. Credit Line Balance			
After × Income	−0.267	0.001	−0.259
	(0.846)	(0.002)	(0.871)
After	0.186	−0.186 ∗ ∗	0.213
	(0.578)	(0.000)	(0.604)
Observations	751	183	526
C. Prepayment Mortgage			
After × Income	236.989	0.000	−105.622
	(454.320)	(.)	(472.967)
After	−246.936	169.245 ∗ ∗	−169.346
	(335.063)	(0.000)	(292.904)
Observations	485	90	346
D. PrepaymentConsumer Term Loan			
After × Income	−6.429 ∗ ∗	0.000	−7.481∗
	(2.709)	(0.000)	(3.915)
After	12.710 ∗ ∗	0.000	14.971 ∗ ∗
	(3.210)	(0.000)	(4.024)
Observations	513	123	377
Month FE	*YES*	*YES*	*YES*
Individudual FE	*YES*	*YES*	*YES*

Table 3.6 – Opening a new financial product

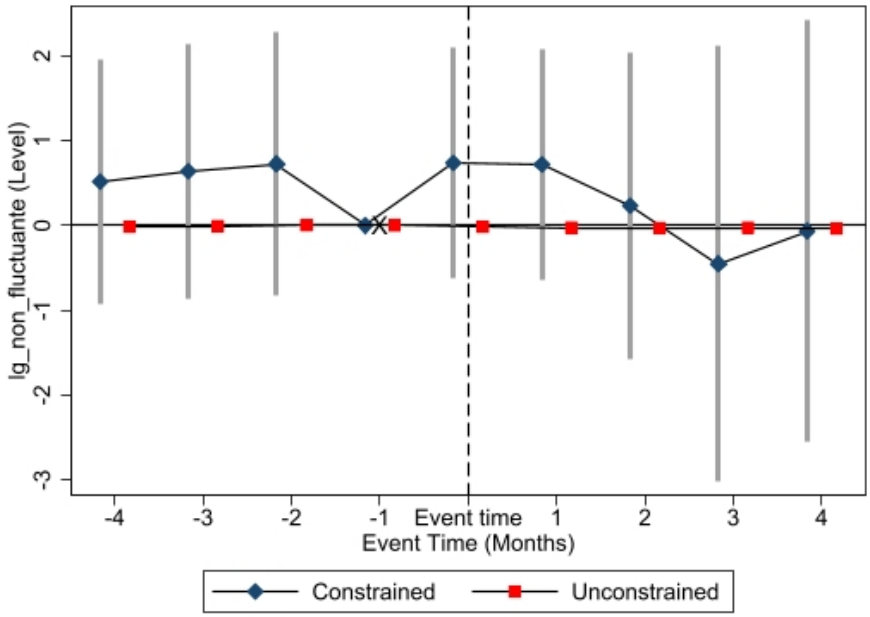
	(1) All	(2) Constrained	(3) Unconstrained
A. Opening Credit Line			
After × Income	−0.011	−0.006	−0.012
	(0.017)	(0.027)	(0.022)
After	0.014 ∗ ∗∗	0.015∗	0.016 ∗ ∗
	(0.005)	(0.008)	(0.007)
Observations	12587	5189	7395
C. Mortgage			
After × Income	0.007 ∗ ∗	0.014∗	0.005
	(0.004)	(0.008)	(0.004)
After	0.003∗	0.004	0.003
	(0.002)	(0.003)	(0.002)
Observations	12587	5189	7395
C. Consumer Term Loan			
After × Income	−0.001 ∗ ∗∗	0.000	0.003 ∗ ∗∗
	(0.000)	(.)	(0.000)
After	−0.002 ∗ ∗∗	0.000	0.001 ∗ ∗∗
	(0.000)	(.)	(0.000)
Observations	12587	5189	7395
Month FE	YES	YES	YES
Individudual FE	YES	YES	YES

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

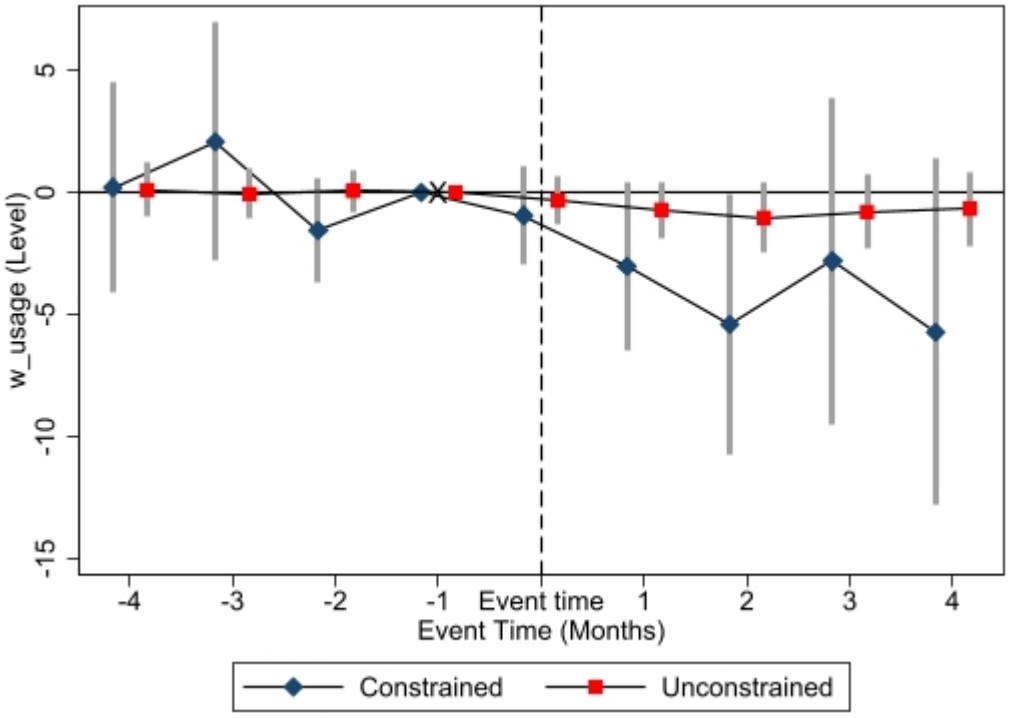
3.7 Appendix

Figure 3.14 – Investment account dynamics (Permanent decrease, by liquidity status)



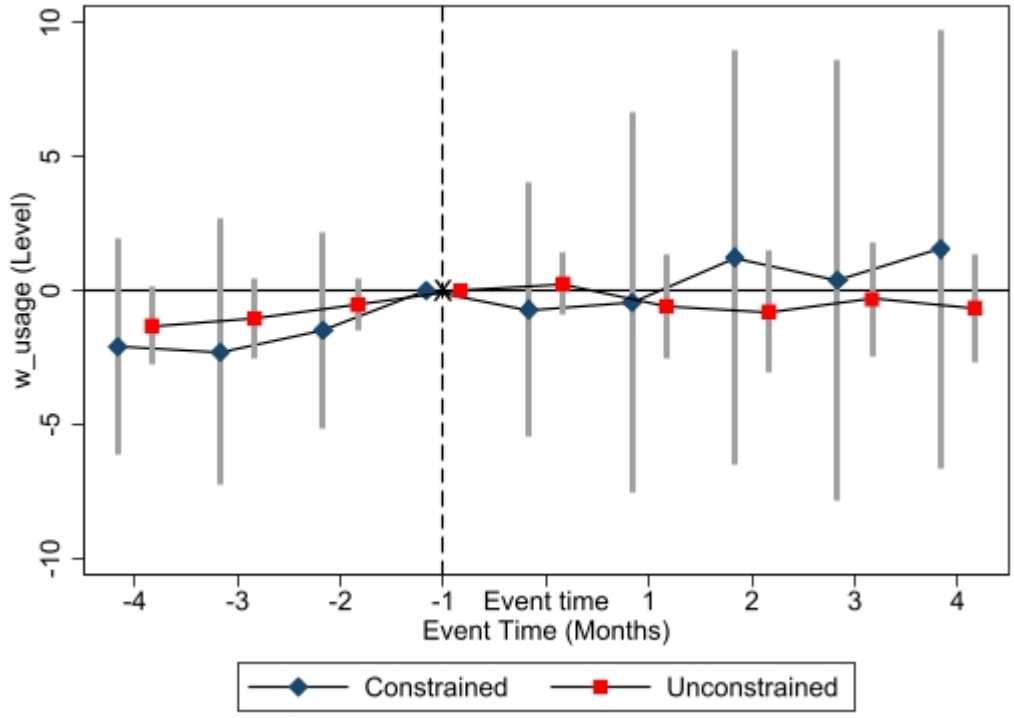
Note: We construct the permanent decrease sample using equation (3.4). The figure plots the log of savings from T_{-4} to T_{+4} using equation (3.7), with separate lines for constrained and unconstrained individuals.

Figure 3.15 – Credit line usage dynamics (Permanent increase in income)



Note: We constructed the permanent increase sample using the equations (3.3 . We plot the credit line usage dynamic from T-4 to T+4 (income shock) using the equation (3.7) where our Y is the credit line usage.

Figure 3.16 – Credit line usage dynamics (Permanent decrease in income)



Note: We constructed the permanent increase sample using the equations (3.4. We plot the credit line usage dynamic from T-4 to T+4 (income shock) using the equation (3.7) where our Y is the credit line usage.

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General Conclusion

This dissertation consists of three independent but thematically connected essays that examine how individuals and firms adjust to economic shocks and institutional frictions. Drawing on rich administrative datasets and quasi-experimental methods, each chapter explores real-world responses to labor displacement, tax enforcement, and income variation, contributing to a broader understanding of behavior under constraint. Taken together, the essays offer new evidence on how financial, regulatory, and informational environments shape economic decision-making. The first chapter studies the aftermath of mass layoffs, focusing on workers who respond by starting new businesses. Using matched employer-employee tax data from Canada and a mass layoff identification strategy, the essay shows that necessity entrepreneurs who opt for unincorporated legal structures tend to outperform their voluntary counterparts, while those who incorporate fare worse. These findings suggest that simpler, more flexible business forms better match the constraints and goals of displaced workers. Interestingly, immigrant founders emerge as an exception, successfully launching larger incorporated firms even after job loss. The results show the importance of aligning entrepreneurial form with individual financial and human capital profiles.

The second chapter shifts the lens from entrepreneurship to formal employment, examining the labor market effects of stricter tax enforcement. Using the rollout of Sales Recording Modules (SRMs) in Québec's restaurant sector, the chapter documents a sharp increase in reported wages and new hires follow-

ing the reform. These findings are consistent with a formalization effect: previously undocumented workers enter official payrolls, and incumbent employees see their reported earnings rise. We find further heterogeneity by immigration status, with native-born workers experiencing stronger income gains and greater financial integration. The results show that policies aimed at improving tax compliance can have significant spillover effects on labor outcomes especially in cash-intensive, low-wage sectors.

The third chapter explores household financial behavior in the face of income shocks, using account-level data from a large North American financial institution. We find little evidence that individuals anticipate income changes. Instead, adjustments such as reduced savings or increased investment occur after the income shock. These reactions vary by the direction of the shock and the household's liquidity position, with unconstrained households responding more strongly. The findings show the importance of liquidity and behavioral frictions in determining how individuals use financial products to smooth consumption and manage risk.

Together, the three chapters highlight the range of behavioral adjustments that individuals and firms make in response to economic and institutional constraints. From necessity entrepreneurship to workforce formalization and household-level savings behavior, this thesis provides insights for policymakers and researchers interested in the design of labor, tax, and financial policies. They also demonstrate the value of administrative microdata and credible identification strategies in uncovering economic mechanisms that are otherwise difficult to observe.