

Essays on State and Local Effects of Poverty-Alleviation Policies

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*I dedicate this work to my family for their staggering love and support.*

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## **Chapter 1.**

# **The Role of Proximity in Financial Service Utilization and Implications for the Community Reinvestment Act**

### 1.1 Introduction

The relationship between consumers and lenders has been the subject of significant study in economic literature, but a bank is more than a dispensary of loans. A bank branch can be understood as a bundle of financial services. While this bundle may include secure storage and basic financial advice, most typically, banks are purveyors of lending, depository, and transaction services. Literature's focus on lending has left these other consumer services under-examined. Typical consumers will only take out a few loans in their lifetime. These are significant financial decisions, and it should not be unusual for a consumer seeking a loan to invest significant time and resources toward shopping around or to choose a lender who is located outside their physical neighborhood. One might not expect, then, that the physical location of bank branches is of particular concern to consumers, or vice versa. But the physical dispersal of financial service providers appears neither uniform nor random. Focusing on lending alone fails to illuminate important interrelationships between consumers, banks, and non-bank institutions offering financial services. These under-explored interrelationships may drive the predominant pattern of richer neighborhoods being comparatively thick with bank branches while poorer neighborhoods tend to feature more alternative financial service (AFS) providers.

This general pattern of service location compliments a straightforward economic interpretation of consumer financial service utilization. Consider a continuum of economic affluence along which consumers are distributed. One might expect those on the higher side to uniformly utilize traditional banking services because these services are economically cheaper; checking services are often effectively free for those who can maintain a minimum balance and

otherwise avoid fees. Similarly, one might expect those on the lower side of the continuum to exclusively use AFS. Even though AFS-providers typically charge a percentage of the face-value of transactions that convert checks into cash or vice versa, these fees may be less than those consumers expect to face from traditional banks. By this interpretation, the aforementioned arrangement of banks and AFS-providers is likely an economically optimal outcome. However, there is evidence that some policymakers may not subscribe to this interpretation.

Several policies affect the ultimate location of financial service providers. For example, local zoning regulations may limit the number or type of providers within a given area or shift certain services into particular commercial zones; states and municipal regulations may limit what types of financial services can operate near military bases; and Federal regulations—most notably the Community Reinvestment Act (CRA) of 1977—create incentives for banks to open or maintain branches in low- and middle-income (LMI) neighborhoods. The economic case for these policies is unclear unless the above interpretation fails to account for certain consumer costs or benefits stemming from proximity to particular financial services. Do LMI consumers benefit from having proximate access to traditional financial institutions? Are LMI consumers harmed by having proximate access to AFS?

Simultaneous to policymakers' concerns regarding financial service location, many have expressed worry over the share of income that LMI families spend on AFS versus what they perceive to be cheaper alternatives at banks.<sup>1</sup> The US Senate recently explored allowing US Postal Service offices to extend bank-like services as a means of increasing competition and reducing AFS prices.<sup>2</sup> Might LMI consumers be driven to use comparatively costly AFS because banks are

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<sup>1</sup> Servon (2014)

<sup>2</sup> White (2014)

too sparse or remote? To address this question and those above, one must consider how to detect and quantify any costs and benefits associated with financial service proximity.

Compared to loan-seeking, consumers visit bank branches more frequently for tasks like cashing or depositing checks, making cash withdrawals, and for other services linked to money conversion, transactions, and payments.<sup>3</sup> These are the services for which having a conveniently-located bank could represent a significant time and/or monetary savings over alternatives. Consider hypothetical consumers without access to traditional bank services. These consumers must rely on cash for transactions, wherever possible, and on AFS, elsewhere. If these consumers are granted access to a traditional bank, the cost of using traditional financial services would fall compared to alternative ones. This is immediately true in terms of time and travel costs, but there may also be reduced transaction costs in the form of increased familiarity and comfort with traditional banking or of lower prices through increased competition among service providers. If the appearance of a bank elicits discernible consumer benefits, one would expect to see that manifest through voluntary substitution away from AFS and toward traditional banking services. If bank proximity benefits exist, then, an economist should observe decreasing rates of AFS-use where banks get more plentiful and should observe increasing rates of AFS-use where banks become sparser. If this pattern is not observed, a fundamental assumption behind these bank-location-affecting policies may be incorrect. Regulators could be implementing costly incentives aimed at altering financial service location patterns that have no impact on consumers' financial service choices and therefore no impact on consumer utility. This gives rise to a critical question—to what extent does physical proximity to a bank branch impact consumers' reliance on AFS?

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<sup>3</sup> The alternative to the bank version of these services are check-cashing and money orders, which are typically provided at a fee from non-bank institutions.

In this paper, I utilize a uniquely detailed data set on LMI-neighborhood residents and on the financial services environment of metropolitan Detroit to examine the relationship between bank location and financial service choice.<sup>4</sup> I utilize a representative sample of residents living in LMI neighborhoods and generate a map of the sample respondents and the universe of financial service providers within the area. I integrate survey data on this sample population, census data on the characteristics of their neighborhoods, and I propose and calculate statistics for analyzing physical proximity. With this information assembled, I use variations on the following basic model to quantify the relationship between bank proximity and AFS-use.

$$AFSUse = \gamma_0 + \gamma_1 Prox + \gamma_2 X + \gamma_3 N + \mu \quad (1.1)$$

Here, the matrices  $Prox$ ,  $X$ , and  $N$  contain proximity measures, individual respondent characteristics, and neighborhood characteristics, respectively. I then establish the correlation between proximity and AFS found in the data as an extreme bound on the same correlation in a contemporary setting. Using this bound, I explore the financial impact on consumers of improved physical access to banks. If the financial impact is modest, then policies affecting financial service location may not be economically efficient.<sup>5</sup> However, if the impact is significant, then compelling arguments may exist for enhancing policies that encourage banks to locate branches (or discourage AFS-providers from locating) in LMI neighborhoods.

The remainder of this paper is organized as follows: In Section 1.2, I briefly explore related topics in economic literature, discuss the available data, and establish a sample for analysis. In Section 1.3, I discuss specifics of the sample and of financial service providers in the study area. In Section 1.4, I establish the methodology and determine relevant proximity statistics. In section

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<sup>4</sup> LMI, here, is defined as census tracts with a median income of at most 80% of the study area's median income.

<sup>5</sup> Optimal policy design is beyond the scope of this paper.

1.5, I report the results of the analysis and test their robustness. In Section 1.6, I conclude with a discussion of the findings and of their implications for understanding certain impacts of the CRA.

## 1.2 Literature Review and Data

In this section, I briefly explore the economic literature on the impacts of bank and AFS location on LMI consumers. I also discuss the specifics of the data I assemble for analysis and their various sources. I further outline the sample selection process and report summary statistics for the data on that sample.

### 1.2.1 Literature Review

As stated above, there has been little research exploring the non-lending implications of financial service location. One of the only such studies is Barr, Dokko, Borzekowski, and Kiser (2012), which finds that proximity to AFS-providers reduces bank account ownership. While Schwartz (1998) finds that the CRA has led to the opening of (and the keeping open of) inner-city bank branches, the literature has not reached consensus about the full impacts of the CRA.<sup>6</sup> Some notable examples of research examining the CRA's impact on lending patterns include Brevoort and Hannan (2004), which finds that geography continues to impact banks' lending patterns, Ross and Tootell (2004), which finds that banks continue to find ways to "redline" customers they perceive to be undesirable, and Avery, Bostic, and Canner (2005), which concludes that the CRA continues to boost lending activity.<sup>7</sup> The general dearth of research on geography and non-lending services is likely due, in part, to the complexity of the data required to address related questions. Such research requires knowledge of consumers' revealed preferences for particular service types

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<sup>6</sup> See Getter (2015) for an overview of research relating to the CRA.

<sup>7</sup> A significant body of research regarding the CRA was produced around 2002, which was the 25<sup>th</sup> anniversary of the act.

as well as of their universe of potential options. Fortunately, I utilize a data source that, while limited in scope, contains rich detail on these elements of analysis.

### *1.2.2 The Data*

The Detroit Area Household Financial Services (DAHFS) survey, designed and collected by the University of Michigan Survey Research Center, is well-suited to address questions regarding financial services and geography. The data represent a random sample of both individuals and households located in LMI census tracts in the Detroit tri-county area. The survey draws a random LMI census tract from Oakland, Macomb, or Wayne counties, a random block group from within that tract, random households from within that block group, and a random adult within each household to survey.<sup>8</sup> Note that selected individuals and/or households may not be LMI; the survey is representative of persons and households located in LMI tracts, regardless of respondents' individual socioeconomic status. Interviews were conducted between July of 2005 and March of 2006, in person, with a trained and computer-assisted interviewer.<sup>9</sup> Respondents were encouraged to assemble relevant documentation and paperwork to aid them in accurately answering the questions.<sup>10</sup> The final relevant sample is 938 respondents, representing a response rate to the survey of 65 percent.

The survey collects a broad array of information on financial service utilization along with extensive socioeconomic and demographic data. Of particular interest for this project are information on whether the respondent has a bank account and the characteristics of the bank

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<sup>8</sup> Critically, if the randomly-selected respondent does not make their own financial decisions (paying bills, choosing bank accounts or credit cards, etc.) then the person who makes those decisions for the randomly-selected person responds to the survey. This seems to have pushed the sample toward being more female than would be the case in a truly random sample. However, the adjustment also means that responses regarding financial transactions are likely more reflective of reality than a purely random sample.

<sup>9</sup> Ninety percent of surveys were completed before January 2006; for simplicity, I refer to the survey year as 2005.

<sup>10</sup> For additional information, see Barr (2012), pages 26–27.

account they have (minimum balance, associated fees, etc.) as well as the frequency with which respondents use alternative financial products like check cashing services and money orders. As illustrated in Table 1.1, summary statistics of the DAHFS sample align well with Census 2000 data for tracts in the same area and with similar median incomes.<sup>11</sup> The only statistic that deviates notably from census data is the percent of respondents who are female. Black women tend to have more education than their male peers, which could explain the slight divergence in education levels between census and sample data.<sup>12</sup>

Statistic	Census 2000	DAHFS Sample
Female	52.3%	65.4%
Age	n/a	42.0
Race:		
Black	70.5%	70.7%
White	21.8%	17.0%
Other Race	7.7%	12.3%
Education:		
Less than high school	35.8%	31.1%
High school or GED	31.0%	22.6%
At least some college	33.2%	46.3%
Marital status:		
Single/never married	44.1%	46.6%
Married or cohabitating	24.5%	22.6%
Income:		
Median HH income	\$24,146	\$20,000
Percent below FPL	31.5%	36.1%
Employed	44.5%	51.5%

The extensive geographic component of the DAHFS data make it well-suited for addressing questions related to proximity. Simultaneous to the survey's execution, the Survey

<sup>11</sup> Data from the Census column here is adapted from Barr (2012) Table 2-1. It includes all census tracts in the Detroit tri-county area with a median income of less than 80% of the area's overall median income. The federal poverty level statistic was computed using household income and household size using the US Department of Health and Human Services guidelines from 2005.

<sup>12</sup> Statewide in Michigan, the 2005 American Community Survey (ACS) estimates that about 51% of women and about 43% of men who are Black or African-American (alone) have at least some college education.

Research Center methodically located every traditional and AFS provider in the study area. These data include all banks, check-cashers, and money order sellers in the tri-county area, as well as non-bank institutions not examined in this report, like payday lenders and pawn shops.

Alternative financial service providers are not exclusively stand-alone institutions, but include gas stations, grocery stores, liquor stores, and any other businesses that offer those services. Each location was telephoned by a researcher to confirm that the indicated service was offered by the location at the time of the survey. For this reason, the geographic data associated with the survey is unusually complete and accurate. For all banks and AFS-providers, the data include the location's street address as well as latitude and longitude coordinates.

I combine this service provider data with the locations of survey respondents' homes and work locations (for those employed outside the home). The home and work locations were anonymized for privacy reasons; instead of street address, I use the centroid of the census block group containing each location.<sup>13</sup> This is still a relatively precise definition.<sup>14</sup> A census block group, particularly in an urban area like Detroit, is typically quite small and represents a compact subset of a neighborhood—a small cluster of city blocks. Particularly given the street grid in Detroit, I am comfortable assuming that all residents within a block group face symmetric time and travel costs to move a given distance away from the centroid of that block group. Using respondent home and work locations in concert with traditional and non-traditional financial service provider locations, I construct several variables relevant to assessing the proximity of

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<sup>13</sup> The centroid is the geographic center of the block group. On rare occasions, when working with oddly-shaped areas, the centroid can fall outside of the area, itself. The block groups in this study are all relatively simple polygons, and every centroid falls within its block group.

<sup>14</sup> The median block group size is 0.1 square mile.

financial services. For each proximity measure, I treat each respondent's work location and home location symmetrically.<sup>15</sup>

For certain robustness checks and comparisons in Section 1.5.2, I utilize data from the Federal Deposit Insurance Corporation (FDIC) collected and published as their Summary of Deposits (SOD). This includes the address of every FDIC-insured bank branch location in a given year as well as information on each branch (such as when it was established, and whether it has changed owners). In rare cases, a branch location could not immediately be geocoded due to address ambiguity or inconsistency. I corrected each of these instances individually and successfully mapped all relevant SOD branches to a precise latitude and longitude.

Using the census tract of a respondent's home as a proxy for neighborhood characteristics, I capture information that affects respondents' financial service decisions that is not apparent in their survey responses. The 2000 and 2010 decennial censuses fall almost equally before and after the DAHFS data were collected, however, tract definitions are redefined for each census and techniques for averaging tract-level data between two censuses are problematic.<sup>16</sup> For this reason, I rely on Census 2000 data for neighborhood characteristics.<sup>17</sup>

In all, the following analysis relies on four major data components: 1.) respondent financial service utilization, 2.) respondent demographic and socioeconomic statistics, 3.) demographic and socioeconomic statistics for the respondent's neighborhood, and 4.) proximity data computed from

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<sup>15</sup> The measures themselves are discussed in more detail in Section 1.4.2.

<sup>16</sup> Averaging methods in literature typically require assuming a uniform distribution of characteristics across the full area of each tract in each period. I am uncomfortable with this assumption for these data and so do not attempt this exercise.

<sup>17</sup> The ACS compiles statistics at the tract level for a five-year averaged sample 2005–2009 using the Census 2000 tract geographies. I considered using these data, as they are chronologically closer to the survey date, but the ACS has a much smaller sample size than the decennial census and thus much larger margins of error for the types of data I utilize.

the map of respondent homes, respondent employers, and financial service providers. The final sample includes 938 respondents who represent a random sample of the residents of LMI census tracts in tri-county Detroit in 2005. These 938 respondents represent 523 unique home/work geographic pairings.

### 1.3 The Banking Environment

In this section, I describe the context of the exercise and explore the relative convenience of services as a causal mechanism that could alter service choice.

#### 1.3.1 *LMI Banking*

AFS providers are quite common in the sampled community. While 58% of the sample has an open checking account at a bank, 69% has used a money order in the previous year. It is immediate, then, that traditional banking services and AFS are not perfect substitutes. In fact, of those with an open checking account, 37% have used either a non-bank check-casher or a money order in the last month. The literature refers to people who have bank accounts but continue to use AFS as “under-banked.” In my sample, the under-banked use AFS as much or more than the unbanked population—those who are not observed with an open bank account.

Within the sample, AFS utilization averaged just more than twice per month. Money orders were used about three times as often as check-cashing. Among the subsample observed using AFS in the previous month, an average of 3.5 money orders were purchased and one check was cashed. More than half of this group used AFS three or more times in the month. On average, cashing a check cost the sample about 1.5% of the face-value of the check and purchasing a money order cost slightly less than 1% of face value. Note that for those respondents who do not have a bank account and who receive their income as physical checks, a percentage of their income is syphoned

off, immediately, to cash that check. For those who make substantial payments, such as bills, utilities, rent, or mortgage payments using money orders, another substantial portion of their income goes toward converting their cash back into a check. Each of these AFS conversion costs is small, but they are frequent. For many LMI respondents, they constitute a small but significant portion of total income.<sup>18</sup>

For those with bank accounts, the sample year appears to be an era characterized by relatively consumer-friendly pricing and fee structures. This is consistent with the nation-wide banking climate at the time, in which many banks sought to raise new deposits in order to invest in mortgage products. The median checking account, among those in the sample with one, has no monthly fee, has a minimum balance of \$200, has a fee of \$6 for dropping below the minimum balance, and has a fee of \$30 for over-drafting the account. Notably, only 42% of the sample has a debit card (two-thirds of those with a checking account), and even among those with a debit card, only about half use an ATM regularly. Only 40% of the sample has an active credit card. Only 23% have ever used a computer to check their balance or to bank online.

While LMI residents—at least those who were able to maintain a minimum balance in a checking account—could hypothetically save money by substituting traditional services for alternative ones, their continued use AFS is informative. However it enters their utility calculation, there is a continued preference for AFS services. One reason could be that these populations are more comfortable with the certainty and clarity of AFS fee structures than those of bank services. However, the DAHFS survey asks respondents who closed a bank account why they did so, and fewer than one percent answered that they explicitly preferred the business model of AFS providers. Another possible explanation is that some payment-receivers have a preference for

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<sup>18</sup> Barr, Dokko, and Keys (2012) estimate that transactional AFS-use costs a typical LMI household about 1% of total income.

money orders over other forms of payment. However, in the survey, only 38% use money orders to pay their bills or rent. A final reason could be that LMI consumers find AFS to be more convenient than traditional banking. This explanation has an extensive evidentiary basis in the DAHFS survey.

### *1.3.2 Convenience as a Determinant of Service Choice*

When those who receive income from physical checks were asked how they choose where to cash those checks, 51% responded that convenience was their primary motivation. By comparison, price considerations were only noted by 21% of respondents and getting their money quickly was noted by only 28%.<sup>19</sup> Parsing what respondents mean by “convenience” is difficult, but it is immediately distinct from quick money and cost considerations, and given the structure of several other survey questions to which convenience is a possible response, it seems likely to be distinct from having fewer fees, lower fees, or less confusing fees. Due to survey respondents’ general antipathy toward 24-hour ATM machines—even among those with checking accounts and debit cards, only about half find an ATM to be more convenient than a full bank branch location—it is possible that convenience is also distinct from hours of operation. Ruling out these other factors as major contributors to “convenience” leaves physical proximity as a likely candidate for determining both convenience (immediately) and financial service utilization (through convenience’s effect on use).

To the extent that proximate location enhances convenience and convenience induces substitution to cheaper services, consumers reap benefits. Thus, bank branch locations may have significant non-lending-related benefits to nearby LMI residents. If true, this helps justify policies

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<sup>19</sup> These statistics are also reported in Barr (2012).

aimed at increasing branch presence in those neighborhoods. The following section investigates the presence and magnitude of these benefits.

## 1.4 Methodology

In this section, I present a general form of the model that I will use in the analysis below and discuss statistics for quantifying a respondent's proximity to a service.

### 1.4.1 *An Outline of the Approach*

I observe a home/work location pairing. Around these locations, I compute measures of proximity that I hypothesize may be significant determinants of financial service choice. Accounting for a matrix of respondents' personal characteristics and a matrix of respondents' neighborhood characteristics, I regress AFS utilization on the proximity measures. The simplest form of the model is:

$$AFSuse_{ij} = \gamma_0 + \gamma_1 Prox_{ij} + \gamma_2 X_{ij} + \gamma_3 N_j + \mu_{ij} \quad (1.2)$$

I alter the specification slightly to examine different effects, but, in each model,  $AFSuse_{ij}$  is the measure of utilization of check-cashing and money order services,  $X_{ij}$  is the matrix of respondent demographics (age, race, income, assets, debt, etc.), and  $N_j$  is the matrix of census tract characteristics (percent White, median income, owner-occupancy rate, median household size, etc).  $Prox_{ij}$  is the matrix of proximity statistics that I compute from the physical locations of respondents and service providers. I describe these in detail below, but each of these measures interacts with a critical variable from the  $X_{ij}$  matrix—whether the respondent has a car.

The statistic of interest yielded by this regression analysis will be the correlation between proximity measures and AFS usage. I have established that a plausible mechanism exists, convenience, through which having proximate access to a traditional bank branch may impact

consumers' choices between traditional and alternative services. While the coefficients on the proximity measures will be informative in their own right, the relative significance of each measure may also illuminate the relationship between proximity, convenience, and choice. As a robustness check, I explore alternative specifications that account for possible endogeneity—specifically, omitted variables that could drive co-location of banks and respondents. If banks locate near their most-likely customers along characteristics which I do not observe, the impact of proximity on AFS-use in an ordinary least squares (OLS) setting will be artificially large in magnitude.

#### *1.4.2 Proximity Measures*

The specificity and completeness of the DAHFS location data offer a rare opportunity to analyze the impact of the physical environment on consumer choice. While there are a multitude of ways to construct measures of proximity, two primary goals guide my decisions: 1.) To the fullest extent possible, I want to weigh the relative importance of competing mechanisms, and 2.) I want to preserve the richness of the data by avoiding the introduction of significant sources of statistical noise or uncertainty.

With the first goal in mind, I will include measures of both bank and AFS proximity. If the nearness of an AFS-provider is more correlated with utilization than nearness of a bank branch, then it may be the case that unobserved preference parameters—possibly including unobservable aspects of convenience—tip the scales in favor of AFS-use. That would imply that banks would have to locate very close—perhaps even implausibly close—to consumers in order to win their business. If the opposite is true, then moving a new bank into a community may drive up the use of traditional services, even where AFS outlets are closer at hand. In addition to nearness of the closest service providers, I also construct variables for the prevalence of bank branches and AFS

providers within an area.<sup>20</sup> The relative significance of these density statistics compared to pure proximity statistics will be informative in two ways. First, it will immediately indicate whether having *some* bank or *some* AFS provider at hand drives utilization choices (i.e. whether consumers seem to use services that are physically closest to them). Second, it will indicate whether having an assortment of similar service providers nearby is associated with more use of that service type. If this is the case, the mechanism driving choice could be an agglomeration effect that dovetails with convenience. For example: more providers within a radius around a respondent may mean that a particular service type is nearer to those respondents more frequently as that respondent runs regular errands in the neighborhood; more providers may mean more competition, which decreases prices or increases service quality; and/or more providers may grow familiarity and comfort with the service type among local residents.

In the service of my second goal for the proximity analysis, maintaining precision, I diverge from much of the economics literature examining physical distances. Probably the most common approach has been to use the great circle distance between two latitude and longitude coordinates to estimate their distance. This is computationally expedient and yields a relatively accurate estimate, particularly at low geographic latitudes, for short distances, and when measuring distance by point-to-point aerial path.<sup>21</sup> Given the richness of the data, though, I use geographic information systems software to construct more accurate estimates of physical distance.

I use data on the actual street grid of Detroit to determine the real-world, turn-by-turn traveling distance between two points. Further, I draw a distinction between those respondents

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<sup>20</sup> I will colloquially refer to this measure as “density,” but it is not normalized by area. This distinction only arises because I will use different radii around those with and without cars to account for their differing degrees of mobility.

<sup>21</sup> Stationary Office (1987)

who have cars and those who do not. Those without cars, 27% of the sample, presumably have less mobility than their counterparts, particularly in Detroit (a generally bus- and pedestrian-unfriendly city).<sup>22</sup> I account for this variation by estimating walking and driving distance separately. Pedestrians may use off-street paths and alleys, but may not walk along freeways, for example. To further account for the distinction between the two groups, I compute not only travel distance to a service provider, which is similar for those with and without a car, but also estimated travel time.<sup>23</sup> If the travel distance and travel time measures vary in their correlation with service choice, the distinction may be informative. Finally, I account for differential mobility in density measures by drawing a narrower radius around respondents without cars. For these observations, I inspect circles with half-mile radii (which is a common approximation of walking distance) around their home and work. I use a radius of one mile for those with cars, because they are presumably more mobile and have ready access to a larger swath of service providers.<sup>24</sup>

## 1.5 Results

In this section, I present the results of the empirical model described in Section 1.4 and discuss the intensive and extensive margin effects of proximity on AFS utilization. I then check

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<sup>22</sup> Despite significant effort, I have not found bus schedules or maps from the time of the survey. Bus service was cut in Detroit's budget in the late 2000s, so I decided not to rely on current bus patterns as a proxy for earlier ones. This forces me to assume that all respondents without cars have identically limited mobility. This assumption is most binding in specifications using travel time, which assumes a particular velocity of travel. To the extent that these respondents may bus, bike, get rides, or have other options than walking, that will appear as differences between the coefficient estimates and significance levels of travel time versus travel distance in otherwise identical specifications. Even for bus-riders and car-sharers, there is a time and labor cost to organizing transportation that will make travel less convenient than it is for those with their own cars.

<sup>23</sup> I do not try to determine the proximity of locations between work and home that are not proximate to either work or home (i.e. locations "on the way" to work). Exact commute paths are impossible to predict with certainty. Further, complications would arise for those who commute along limited-access freeways, where exit and reentry to stop at a waypoint might be a greater hassle than it would appear to the researcher.

<sup>24</sup> Altering this radius does not substantially alter results, as long as it is larger than the radius drawn for those without a car and small enough that the area it encircles is interior to the study area.

the robustness of these results by presenting an alternative specification that could account for omitted variables bias in the results of the OLS estimation.

### *1.5.1 OLS Estimation Results*

I regress the number of AFS transactions on the matrices  $X_{ij}$  and  $N_j$ , the respondent and neighborhood controls, and, separately, on each of the categories of proximity statistics (travel distance to, travel time to, and density of each service). Robust standard errors are clustered by respondent location.<sup>25</sup> For each of these specifications, I separately present results with and without controlling for household income; these are presented in Table 1.2.<sup>26</sup>

Of the individual characteristics, only age, having more than a high school education, owning one's home, and income correlate significantly with AFS utilization. Each of these correlates negatively. Among the other individual controls, none are statistically significant, but characteristics typically associated with more affluent and more stable households are predominantly estimated to correlate negatively with AFS-use. Among the neighborhood controls, density, while imprecisely estimated, is negatively correlated with AFS-use. Higher population density is generally associated with the urban core, which is generally less affluent. In this sense, the density coefficient estimates do not align with the affluence/stability pattern mentioned above.<sup>27</sup>

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<sup>25</sup> Each respondent home location or respondent home/work pairing is treated as unique cluster. This yields 523 unique clusters. I include separate specifications with and without household income because, while I believe it to be a relevant regressor, its inclusion significantly reduces sample size (due to nonresponse).

<sup>26</sup> Including income reduces the sample size from 937 to 750 due to non-responses and eliminating implausible responses. Stars on the table represent statistical significance, one star for p-values less than 10%, two for p-values less than 5%, and three for p-values less than 1%. This pattern is consistent for all tables in this paper. I have also estimated Poisson and negative binomial models with the same regressors. Results from these models were comparable. It appears that extreme values of the dependent variable do not drive the findings.

<sup>27</sup> This could be because many banks are clustered in downtown. There could also be an unobserved relationship between population density and the density of commercial space. Ideally, this analysis would control for the amount of commercial space available in which a bank or AFS could conceivably operate. Unfortunately, this data was not available at sufficient level of detail across the entire study area.

Table 1.2: OLS Regression Results for Total AFS Utilization in Last Month

$X_i$	Age	-0.0175*** (0.00607)	-0.0117 (0.00729)	-0.0175*** (0.00614)	-0.0120 (0.00738)	-0.0166*** (0.00600)	-0.0106 (0.00717)
	More than HS educ.	-0.668* (0.347)	-0.740* (0.417)	-0.664* (0.341)	-0.752* (0.412)	-0.588* (0.342)	-0.637 (0.409)
	Owens their home	-0.416* (0.230)	-0.321 (0.266)	-0.412* (0.231)	-0.308 (0.267)	-0.403* (0.225)	-0.325 (0.262)
	Income (\$1000s)		-0.0921*** (0.0280)		-0.0928*** (0.0274)		-0.0896*** (0.0269)
	Supressed variables:	Female, Black, Hispanic, Other race, Married, Cohabiting, Less than HS, Employed, Family size, Has a car					
$N_i$	Population density	-0.140 (0.0907)	-0.107 (0.112)	-0.138 (0.0907)	-0.104 (0.112)	-0.167* (0.0900)	-0.137 (0.113)
	Percent White	-1.101** (0.556)	-0.901 (0.646)	-1.051** (0.527)	-0.898 (0.609)	-0.607 (0.530)	-0.479 (0.601)
	Supressed variables:	Owner occupancy rate, median HH income					
$G_i$	Bank distance	-0.0554 (0.134)	-0.0272 (0.170)				
	AFS distance	0.0346 (0.185)	-0.0404 (0.204)				
	Bank travel time			-0.00384 (0.0231)	-0.0134 (0.0276)		
	AFS travel time			-0.0142 (0.0404)	-0.0233 (0.0518)		
	Bank density					-0.0748*** (0.0283)	-0.0757** (0.0315)
	AFS density					0.0380* (0.0201)	0.0376* (0.0222)
	Constant	4.085*** (1.020)	3.740*** (1.225)	4.130*** (1.006)	3.970*** (1.242)	4.455*** (1.012)	4.103*** (1.193)
Observations	937	750	937	750	937	750	
R-squared	0.042	0.048	0.042	0.049	0.050	0.055	

Coefficient estimates for two of the sets of proximity variables, travel time and travel distance, are statistically insignificant. The third, which measures the density of each type of service, does appear to significantly impact the dependent variable.<sup>28</sup> All else equal, when more banks are proximate to respondents, they tend to use AFS less, and when more AFS providers are

<sup>28</sup> In similar OLS specifications that include all six of the geographic measures, the coefficient on bank density is negative and statistically significant at the 1% level. In these specifications, I cannot reject that coefficients on the other geographic variables are equal to zero.

proximate, they tend to use AFS more. The marginal effect of a bank branch may more than offset the marginal effect an AFS provider, but one cannot reject that the marginal effects are of equal magnitude. While precisely estimated, the magnitude of the correlations between proximity and AFS-use are modest. The point estimate indicates that a marginal proximate bank is only associated with approximately one less AFS-use per year.

Conducting the same analysis with a binary dependent variable rather than the count of services utilized measures the extensive margin effects of AFS-use. These linear probability results are presented in Table 1.3.<sup>29</sup> Results look broadly similar to the above analysis in that regressors that are generally associated with affluence and stability are negatively correlated with AFS use. Identifying as Black and reporting cohabitation, for example, are both associated with a higher likelihood of using AFS. Notably, none of the proximity measures yields a strongly statistically significant result. The only significant result—although it is barely so, with a P-value of 0.099—is paradoxical; shorter travel times to a bank are associated with higher likelihood of AFS-use. The magnitude of the effect, though, is effectively zero.

Together, these findings indicate that bank proximity is only correlated with a reduction in AFS-use at the intensive margin. Proximity does not appear to significantly correlate with the sample's decision whether to use AFS or to use traditional services, exclusively. This recalls the above finding that traditional and alternative financial services are not perfect substitutes. Among these LMI-neighborhood residents, bank branch proximity slightly affects the number of AFS used, but not the decision whether to use them.

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<sup>29</sup> I have also estimated a probit model using the same variables. The results were similar.

Table 1.3: OLS Regression Results for Whether AFS Was Utilized in Last Month

$X_i$	Age	-0.00320*** (0.00107)	-0.00187 (0.00124)	-0.00332*** (0.00108)	-0.00201 (0.00125)	-0.00328*** (0.00107)	-0.00200 (0.00125)
	Black	0.0525 (0.0556)	0.139** (0.0571)	0.0554 (0.0549)	0.141** (0.0567)	0.0575 (0.0555)	0.141** (0.0578)
	Cohabiting	0.188** (0.0775)	0.254*** (0.0795)	0.185** (0.0792)	0.252*** (0.0808)	0.190** (0.0781)	0.255*** (0.0788)
	Owens their home	-0.134*** (0.0387)	-0.114** (0.0443)	-0.129*** (0.0387)	-0.108** (0.0444)	-0.136*** (0.0385)	-0.116*** (0.0442)
	Income (\$1000s)		-0.0230*** (0.00521)		-0.0235*** (0.00521)		-0.0235*** (0.00515)
	Supressed variables:	Female, Hispanic, Other race, Married, Less than HS, More than HS, Employed, Family size, Has a car					
$N_i$	Percent White	-0.140* (0.0849)	-0.0200 (0.0931)	-0.122 (0.0826)	-0.0108 (0.0906)	-0.101 (0.0858)	0.00418 (0.0958)
	Supressed variables:	Owner occupancy rate, median HH income					
$G_i$	Bank distance	-0.0288 (0.0194)	-0.0225 (0.0243)				
	AFS distance	0.0124 (0.0361)	0.000183 (0.0389)				
	Bank travel time			-0.00620* (0.00375)	-0.00671* (0.00379)		
	AFS travel time			-0.00692 (0.00737)	-0.00682 (0.00890)		
	Bank density					-0.00515 (0.00551)	-0.00371 (0.00522)
	AFS density					0.000152 (0.00265)	-0.000335 (0.00277)
	Constant	0.745*** (0.179)	0.578*** (0.177)	0.817*** (0.182)	0.666*** (0.183)	0.757*** (0.177)	0.587*** (0.181)
Observations	937	750	937	750	937	750	
R-squared	0.095	0.120	0.097	0.124	0.094	0.121	

### 1.5.2 Robustness Check for Omitted Variables Bias

When studying geography and agglomeration, it can be difficult to account for bias stemming from co-location. If there are unobserved variables driving service providers to operate in neighborhoods where residents are more likely to use such services, then OLS estimates of the effect of proximity on service use will tend to be biased upward in magnitude.<sup>30</sup> An instrumental

<sup>30</sup> i.e. biased toward a more negative number (farther from zero)

variable can be utilized in a two-stage least squares (2SLS) model to overcome this potential source of bias. This instrumental variable must be correlated with the original regressor (in this case, proximity), but only affect AFS usage through its impact on service proximity. Instrument-selection, below, is informed by specifics of the landscape in Detroit during the study period.

While historic bank branch location data is available from the FDIC, there is no reliable data source for historical locations of AFS providers.<sup>31</sup> This may not be a significant problem, however. The vast majority of AFS transactions take place not at stand-alone service providers, but at gas stations, convenience stores, and grocery stores. In the sample, only 7% of money orders are purchased from a stand-alone check casher or financial service storefront; 70% are purchased from retail stores including supermarkets and drug stores. The primary business of these “retail” AFS providers is not providing AFS, but selling groceries, gas, etc. It is unlikely, then, that these firms choose their location based on the distribution of likely AFS customers. Further, locating in an LMI neighborhood does not appear to induce retail locations to offer AFS services (which would also raise co-location concerns). From the information available on chain stores, those that have locations in both higher- and lower-income neighborhoods show no difference in AFS offerings between stores. These findings assuage concerns of co-location effects significantly biasing AFS-proximity-related estimates.

Concerns regarding bank co-location, however, are more difficult to overcome. There are clearer incentives for banks to locate near their prospective financial-service customers, and banks are likely to identify these consumers using data that I do not observe. For these reasons, co-location and the bias it may impart on proximity-related coefficient estimates is concerning.

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<sup>31</sup> Even with an old phone book, for example, which could identify the locations of stand-alone AFS providers, there would be no way to determine which liquor, convenience, and grocery stores offered which financial services.

Identifying a statistical instrument for bank proximity will allow me to correct for any such bias using the 2SLS approach.

Residential turnover among the population in LMI neighborhoods is very high. Fifty percent of respondents report having lived in their current residence for less than five years. Even of the 40% of respondents who own their own home, 27% have lived there for less than five years. In other contexts, one might conceptualize residential turnover as the result of a random draw with replacement from a set of broadly similar households. But recall that Detroit, in this era, has suffered a profound secular trend toward a smaller and less-affluent population. The Census estimates that, between 2000 and 2010, the population of municipal Detroit declined by 30% and median household income declined by a third. Comparing all metro Detroit LMI neighborhoods in 2010 to geographically similar neighborhoods in 1990, the population fell by more than half and median household income fell by more than 35%.<sup>32</sup> These trends indicate that more affluent residents—the subpopulations most likely to use traditional banking—either left the study area or suffered significant financial degradation. Meanwhile, bank tenure has tended to be much longer than residential tenure. The median tenure, in its current location, for a bank branch in the survey period was 38 years.<sup>33</sup> Short residential tenure paired with long branch tenure implies that Detroit banks saw significant changes in the socioeconomic characteristics of their proximate clientele, over time. However, bank location is not purely determinative. Between 1994 and 2005, the sample area saw 167 bank branches close, 317 open, and 755 continue operating in the same location.<sup>34</sup>

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<sup>32</sup> US Census 1990 and US Census 2010. Note that tract boundaries change with each census. For these statistics, I select tracts from 1990 that include the centroid of an LMI tract from 2010. The comparison is not necessarily precise, but, paired with municipal data from Detroit, it is indicative of the socioeconomic change occurring.

<sup>33</sup> This exercise treats a branch as constant as long as the branch address is constant, even if its ownership changes.

<sup>34</sup> FDIC Summary of Deposits data.

This pattern points toward a valid instrumental variable for bank branch proximity.<sup>35</sup> I instrument for these measures at the time of the survey using the locations of bank branches in 1994. Specifically, I recalculate the three bank proximity measures (distance, travel time, and density) using the same respondent locations, but the map of bank locations in 1994. As stated above, branch locations tend to stay consistent over time (even if they change hands) while the socioeconomic characteristics of consumers around these branches changes substantially. It is plausible, then, that the constellation of bank branches, as it existed in 1994, is uncorrelated with the AFS-utilization decisions of the survey respondents in 2005 (except insofar as bank locations in 1994 are correlated with bank locations in 2005). The instrumental variables, collectively *Prox94*, enter the 2SLS analysis as follows. The first-stage regression yields

$$\widehat{Prox05}_{ij} = \alpha_0 + \alpha_1 Prox94_{ij} + \alpha_2 X_{ij} + \alpha_3 N_j \quad (1.3)$$

which is used in the second-stage:

$$AFSUse_{ij} = \beta_0 + \beta_1 \widehat{Prox05}_{ij} + \beta_2 X_{ij} + \beta_3 N_j + \varepsilon_{ij} \quad (1.4)$$

First-stage F-statistics are large, which indicates that the instruments are not weak.<sup>36</sup> Results of the second stage are presented in Table 1.4. Coefficient estimates and standard errors are similar to the OLS results reported in Table 1.2. Again, the concentration of banks and of AFS locations significantly correlates with AFS utilization, but, travel distance and travel time to the services do not. Note that the coefficient estimates for the density measures, here, are slightly larger than those in the OLS specification, above. This indicates that the observed association between proximity and AFS-use is not being driven by omitted variables.

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<sup>35</sup> See Angrist, Imbens, and Rubin (1994) for more detail on two-stage least squares regression analysis.

<sup>36</sup> First stage F-statistics are reported at the bottom of Table 1.4.

Table 1.4: 2nd Stage IV Regression Results for AFS Utilization in Last Month

$X_i$	Age	-0.0180*** (0.00613)	-0.0130* (0.00741)	-0.0171*** (0.00612)	-0.0113 (0.00730)	-0.0165*** (0.00595)	-0.0106 (0.00707)
	More than HS educ.	-0.595* (0.362)	-0.663 (0.435)	-0.642* (0.338)	-0.713* (0.405)	-0.566* (0.333)	-0.613 (0.396)
	Owens their home	-0.460** (0.225)	-0.371 (0.259)	-0.427* (0.233)	-0.338 (0.266)	-0.397* (0.222)	-0.321 (0.258)
	Income (\$1000s)		-0.104*** (0.0303)		-0.0940*** (0.0270)		-0.0886*** (0.0264)
	Supressed variables:	Female, Black, Hispanic, Other race, Married, Cohabiting, Less than HS, Employed, Family size, Has a car					
$N_i$	Population density	-0.120 (0.0925)	-0.0840 (0.111)	-0.138 (0.0899)	-0.107 (0.110)	-0.169* (0.0894)	-0.139 (0.111)
	Percent White	-0.788 (0.700)	-0.550 (0.800)	-1.017* (0.533)	-0.837 (0.612)	-0.522 (0.516)	-0.405 (0.580)
	Supressed variables:	Owner occupancy rate, median HH income					
$G_i$	Bank distance	0.283 (0.366)	0.385 (0.441)				
	AFS distance	-0.0240 (0.206)	-0.0742 (0.218)				
	Bank travel time			0.0145 (0.0528)	0.0213 (0.0577)		
	AFS travel time			-0.0183 (0.0426)	-0.0240 (0.0524)		
	Bank density					-0.0945*** (0.0307)	-0.0946*** (0.0332)
	AFS density					0.0437** (0.0212)	0.0429* (0.0236)
	Constant	3.744*** (1.129)	3.361** (1.338)	3.921*** (1.109)	3.554*** (1.358)	4.592*** (1.031)	4.224*** (1.206)
Observations	937	750	937	750	937	750	
First-stage F-statistic	38.09	39.9	28.1	34.65	2,523.50	2,212.93	

## 1.6 Conclusions

In this section, I summarize the findings presented in Section 1.5 and interpret their implications. I briefly explore factors that could partially confound my analysis and offer justifications for my approach. I explore the contemporary context of banking and AFS services in the study area and use the above analysis to establish an upper bound on bank location effects,

today. Finally, I discuss the impact that my findings have for public policies that affect bank branch location, including the CRA.

### *1.6.1 Understanding the Role of Proximity in 2005 Detroit*

For any good or service, one's physical proximity to its purveyor is a transactional element of its economic cost. When the good or service is nearer at hand or more easily accessible, its cost is effectively reduced. When the cost of a good or service decreases, the consumption of its substitutes should diminish. This basic economic logic is echoed in the responses of the DAHFS survey participants—convenience matters to respondents, and it matters enough to alter their consumption choices.

I discover that purchasing decisions are driven less by first-order convenience (the physical distance or travel time to the nearest purveyor) and more by the effect of having a multitude of options in close proximity. Critically, though, the estimated impact of convenience on consumption decisions is small. Even an increase in the number of easily-accessible banks from the 25<sup>th</sup> percentile (one bank) to the 75<sup>th</sup> percentile (five banks) is only associated with a reduction in AFS-use of about four transactions per year. This is a 17% reduction from the average AFS utilization of 24 times per year. This indicates that the benefit to LMI-neighborhood consumers from access to the marginal bank branch is detectable, but modest. Additionally, while differing bank-proximity correlates with differing AFS-consumption, the effects appear focused on the intensive margin. In linear probably, proximity to banks and/or AFS does not significantly correlate with the probability of using AFS.

### *1.6.2 Potential Confounding Factors*

The available data do not include rich information on the prices of services offered but not selected. If either traditional or alternative financial services were significantly cheaper for a given population to use, the lower-cost option would be the exclusive choice of that population. The

DAHFS data aligns with the idea that there is a spectrum of consumers, one end of which uses banks exclusively, the other end of which uses AFS exclusively. However, there is also a broad swath, 22% of the sample, who report using both types of service. These respondents seem relatively indifferent between the two types of service and cite convenience as playing a role in their decisions. Further, as increased competition is likely to drive down prices, both the nominal cost and the economic cost of related services will decline with the number of providers. This likely contributes to the finding that the concentration of service providers has a more significant effect than does their nearness.

The survey also does not specifically check whether those who do not use banking services have the option to do so. It is possible that some banking customers or prospective customers have effectively been blacklisted from opening an account. Some credit reporting agencies, most notably ChexSystems, provide to banks a list of customers who—due to low creditworthiness, previous allegations of fraud or abuse, or a history of over-drafting accounts (and possibly other reasons)—may not be people the bank wants to serve. In the sample used here, 40 respondents report having previously had a bank account closed due to overdrafts or allegations of fraud or abuse. Of those, 30 have an open account at the time of the survey. This indicates a maximum “blacklisting” rate of 1% of the sample.

### *1.6.3 Implications for the Community Reinvestment Act and Regulation of Firm Location*

In 2005 Detroit, the utilization of both traditional checks and payment-related AFS services was high and the use of ATMs, credit cards, and direct deposit were low. Bank account policies and fees were relatively consumer-friendly, and no local or state regulation limited the fees associated with AFS. The survey was conducted 28 years—more than a generation—after the CRA was enacted. To the extent that traditional banking has a learning curve or requires a higher level

of financial sophistication to utilize—and to the extent that the CRA improved LMI access to banking services—much of that information has had ample opportunity to reach local residents. Overall, this is a time and place with a relatively clean division between traditional banking and its alternatives, which aids the identification of financial benefits stemming from bank branch proximity.

That clean division is less clear in the contemporary context. The proliferation of direct deposit, online banking, smartphone banking, and ATMs have all contributed to eroding the convenience benefit of having a physical bank branch nearby. It is unlikely that the proximity effects on AFS purchasing decisions, today, are as large as they were at the time of the DAHFS survey. With that in mind, the findings previously discussed can be employed as an upper bound on the effects of bank proximity today.

The Detroit tri-county area, presently, has approximately 670,000 households living in LMI census tracts.<sup>37</sup> These residents have an average household income of \$42,000.<sup>38</sup> Using the DAHFS data, Barr, Dokko, and Keyes (2012) finds that a typical household in the sample spends approximately 0.5% of its income on transactional AFS.<sup>39</sup> By the most generous estimate of bank proximity's effect on AFS purchasing, the marginal bank in the vicinity of each LMI resident reduces AFS-use by once per year. This is a per-household savings of \$8. Summed across Detroit-area LMI households, this represents a maximum of \$5.4 million dollars less per year spent on AFS fees. In the service of establishing a true upper bound, this calculation assumes that substituting traditional for non-tradition services reduces fees to zero. In reality, that savings is not

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<sup>37</sup> US Census, ACS 2008–2012, five-year estimates.

<sup>38</sup> Ibid.

<sup>39</sup> Repeating their approach, I recover a similar result.

necessarily a one-to-one boost in consumer utility; some portion of it will almost certainly be eroded by new bank fees, reduced convenience, and other indirect costs.

In order for the CRA to be economically efficient, it must be the case that the benefits the policy creates at least offset the costs the policy imposes. The focus of economic literature examining the benefits of the CRA has almost exclusively been on the lending activity induced by the regulation. In the modern context, though, it is not unreasonable to think that all necessary CRA lending could be achieved without the presence of a physical bank branch. The CRA has been amended repeatedly to reflect this idea. At present, banks have numerous alternatives to achieve CRA compliance that do not require the presence of a physical bank branch.<sup>40</sup> This implies that the lending benefits of the CRA can be realized separate and apart from the addition of physical bank branches and that those lending benefits need not enter the present calculation. Estimating the costs imposed on those banks that open or maintain bank branches to achieve CRA compliance is outside the scope of this paper. But, if those costs are greater than the \$5.4 million maximum consumer benefit found above, then these bank location provisions may be economically inefficient.<sup>41</sup>

While the density of bank branch locations appears to offer detectible but minimal non-lending benefits to nearby consumers, AFS locations may impose pecuniary costs to those consumers. Greater densities of AFS locations within the orbit of respondents are associated with greater use of those services, all else equal. While point estimates of the magnitude of this effect

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<sup>40</sup> These include investing in special purpose community development entities in LMI communities, supporting women- or minority-owned credit unions that serve LMI customers or providing jointly-backed loans through those institutions, facilitating financial literacy programs in LMI areas, or providing education loans to LMI borrowers. For a more complete listing of eligible activities and related references, see Getter (2015).

<sup>41</sup> Note that this is not a full accounting of total benefits from bank branch presence. For example, there may be community benefits from the employment of workers to serve those branches. These are not quantifiable from the available data.

are smaller than point estimates of the effect of bank density, there also tend to be significantly more AFS providers near respondents.<sup>42</sup> A marginal reduction of AFS locations near respondents is associated with a reduction of only 0.5 AFS-uses per year. But, a shift from the 75<sup>th</sup> percentile (22 vendors) to the 25<sup>th</sup> percentile (7 vendors) is estimated to reduce AFS-use by 28%. If proximate AFS options induce LMI consumers to substitute toward more expensive financial services, then these consumers can be made financially better by reducing the relative convenience of these options. That said, if consumers are rationally valuing the time and effort associated with substituting a cheaper option for a more convenient one, there is no reason to believe that their overall utility would be improved by reducing conveniently-located AFS.

Many policymakers appear to be concerned about the distribution of traditional and alternative financial services and have passed regulations aimed at altering the financial service landscape. The findings reported here do not uncover significant consumer benefits from bank branch presence that might justify policies aimed at inducing their proliferation. AFS density is associated with higher use of those services, which may be more costly than traditional banking services. However, policies aimed at reducing their density around consumers (and therefore consumers' options) can only be justified if consumers' substitution decisions are irrational.<sup>43</sup> Consumers in this sample, on average, spend only about 0.5% of their income on transactional AFS services; this may undercut the argument that similar consumers spend a significant portion of their income on services that might be cheaper to conduct through a traditional bank. In summary, the above analysis reveals very little justification for policies that might alter the equilibrium distribution of financial service providers in the study area. Further, there is reason to

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<sup>42</sup> Again, I cannot reject that the two magnitudes are identical.

<sup>43</sup> Testing consumer rationality in this regard is beyond the scope of this paper.

believe that technological and competitive evolution in the financial service sector has significantly eroded even the small consumer benefits that may have been realized from such policies in 2005 Detroit.

## **Chapter 2.**

### **Labor Demand Responses to Unemployment Insurance Incentives (with Victoria Udalova)**

#### 2.1 Introduction

In the wake of the severe recession that began in 2007, the unemployment rate spiked above ten percent and the average duration of unemployment jumped to over 40 weeks.<sup>44</sup> These forces magnified the importance of the nation's unemployment insurance (UI) systems both to the households relying on UI benefits and to the governments tasked with financing those benefits. This tide of unemployed workers caused state-level UI systems, which had been largely uncontroversial and self-sustaining since their inception, to see their financial reserves dwindle toward insolvency. Of the 53 state and territory UI programs, 36 relied on loans from the U.S. Treasury in order to ensure full payment of all benefits to which unemployed workers were entitled.<sup>45</sup>

Great Recession-related unemployment was not the only cause of UI systems' woes. Wisconsin, for example, had been experiencing a steady decline in its UI reserve accounts since 2000, even through the peak of the business cycle that followed.<sup>46</sup> For these systems to remain solvent in the long-run, independent of federal government intervention, they must raise additional revenue. This policy change, however, cannot be undertaken lightly. Firms finance UI benefits through taxes, and, all else equal, higher UI taxes make labor more expensive. This shift could cause firms to reduce their labor demand. It is critical to estimate this impact accurately if

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<sup>44</sup> Valletta and Kuang (2012)

<sup>45</sup> Vroman and Woodbury (2011)

<sup>46</sup> Newson (2013)

policymakers are to strike a proper balance between increasing UI revenues and minimizing labor demand reduction.

Topel (1983) developed a theoretical measure of marginal tax cost (MTC). This statistic quantifies the tax implications for a firm following a marginal increase in layoffs. MTC has become an important element of subsequent UI-related research, and it is critical to understanding the relationship between UI taxes and labor demand. Topel (1983, 1984) uses MTC to analyze the effects of UI taxes and finds that UI-related subsidies to high-layoff firms increase both temporary and permanent layoffs. Feldstein (1976, 1978) utilizes MTC to investigate the consequences of “incomplete” experience ratings and finds that “incompleteness” leads firms to lay off more workers.<sup>47</sup> Card & Levine (1994) examines the relationship between a firm’s MTC and their propensity to temporarily lay-off workers. Anderson & Meyer (1993) examines the distribution of MTCs between firms and notes patterns of firm-level cross-subsidy resulting from UI laws. This paper also examines whether UI systems inherently discourage layoffs and finds a small but detectable effect. Ratner (2012) uses MTC as a basis for investigating the labor-demand effects of UI laws on firms using a structural model. Critically, each of these papers makes a common set of simplifying assumptions in adapting Topel’s MTC formulation to their empirical approach.

In this paper, we motivate and construct a methodology for estimating MTC that does not rely on several simplifying assumptions that are common in the above literature. Our approach is more generic and can be adapted to the specifics of most state UI systems. It can also account for nuances that the traditional approach ignores by construction. We illustrate our methodology using administrative data from the Wisconsin Department of Workforce Development on the population of Wisconsin firms subject to UI taxation. By focusing on a single UI system, we are able to

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<sup>47</sup> Incompleteness is discussed in more detail in Section 2.2.1, below, but it stems from aspects of statute that cause firms not to bear the full costs of UI benefits paid to their laid-off workers.

precisely emulate the tax-rate assignment mechanism employed by the state, which is the critical mechanism for exploring the tax implications of layoffs. We compare estimates of MTC generated both by our proposed method and by the standard model, and find that the standard model fails to properly account for certain classes of firms.<sup>48</sup> Finally, we use both estimates of MTC to quantify the correlation between UI taxes and future layoffs. These findings will help inform the policy debate about the labor demand implications of raising UI system revenue. We find that policymakers may have more leeway to replenish the coffers of state UI systems than the standard model predicts.

## 2.2 UI System Financing and Standard Analysis

In this section, we describe the reserve ratio system of UI finance and the standard approach to estimating MTC. We note the implications of several common assumptions used in MTC-estimation and motivate an alternative approach.

### 2.2.1 *The Reserve Ratio System*

In 1932, the state of Wisconsin established the first state-wide UI system in the nation.<sup>49</sup> By 1948, every state had adopted a UI program, and the preponderance of these systems used Wisconsin as a model. Thirty-three states, including Wisconsin, currently use a “reserve ratio” system to finance their UI programs. In these states, a firm’s total UI tax liability can be decomposed into two components.

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<sup>48</sup> Specifically, we use an MTC-estimation approach adopted from Anderson & Meyer (1993) to represent the standard model. Each of the listed papers has a slightly different set of available data, so models and assumptions differ slightly, but their approach is representative of similar approaches in literature.

<sup>49</sup> Design of the funding system now referred to as experience rating is largely attributed to University of Wisconsin–Madison economist John R. Commons. Commons was also instrumental in drafting the bill passed and enacted by the state legislature which established the state-wide UI program.

The first component is the “basic rate” contribution. The basic tax rate is determined—via a tax schedule—by a firm’s reserve ratio. Multiplying the basic tax rate by the firm’s taxable payroll yields the firm’s basic rate contribution. Taxable payroll is the sum of each worker’s taxable wages. In Wisconsin, the current per-employee taxable wage base is \$13,000—UI taxes apply to all wages below this amount, but not to wages beyond it. Each firm’s basic rate contribution is credited to its firm-specific reserve account. If the firm lays-off UI-eligible workers, those workers’ benefits are debited from this firm-specific reserve account. Mechanically, the reserve account balance increases as the firm pays in its basic rate contributions and decreases as former workers draw out UI benefits. The balance can be negative. The reserve account balance, then, is the firm’s net basic rate contributions over the history of the firm.<sup>50</sup> A firm’s reserve ratio determines the tax rates it pays via the aforementioned rate schedule. Reserve ratio is defined as a firm’s reserve account balance—positive or negative—divided by its taxable payroll.

The second component of firms’ total UI tax liability is the “solvency rate” contribution. A firm’s solvency rate is determined by its size, its reserve ratio, and the overall solvency of the UI system. The solvency rate, multiplied by taxable payroll, is the firm’s solvency rate contribution. Rather than being credited to the firm’s reserve account balance, solvency contributions are pooled from all employers and credited to the state’s balancing account. The balancing account is used to pay UI benefits to the former workers of two types of firms: those that have permanently shuttered and those that have a non-positive reserve account balance.<sup>51</sup>

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<sup>50</sup> The reserve account is virtually always established concurrently with the business. Exceptions to this rule occur most often in cases where a firm is set up with the owner as its only employee, but where it subsequently hires UI-eligible personnel. In these cases, the reserve account is established at the time the first UI-covered worker is hired.

<sup>51</sup> Note that when a firm’s reserve account balance is non-positive, the state covers further UI benefit payments from its balancing account. These payments are still debited from the firm’s reserve account balance, though. The balancing account essentially lends money to the firm’s reserve account. However, when further debits would reduce a firm’s reserve ratio beyond negative ten percent, the balancing account pays the benefits and the firm’s reserve account balance is not debited. This exception is explored in more detail below.

When the UI balancing account drops below specified thresholds, this triggers changes to the solvency tax rate schedule that increase solvency contributions from most firms. The goal is to maintain significant reserves in the balancing account. These higher-rate triggers tend to track with macroeconomic employment trends and affect the contributions of all employers in the state.<sup>52</sup>

This system can be described by the following equations. The reserve ratio  $r$  in year  $t$  (sometimes called an “experience rating”) is defined as

$$r_t \equiv \frac{R_t}{W_t} \quad (2.1)$$

where  $R$  is the firm’s reserve account balance and  $W$  is the firm’s taxable payroll. The former may be expressed as

$$R_t \equiv \sum_{t=1}^T (C_t - B_t) = R_{t-1} + C_t - B_t \quad (2.2)$$

where  $C$  is basic-rate contributions paid by the firm and  $B$  is UI benefits paid to the firm’s former employees. The firm’s current reserve ratio,  $r_t$ , determines its basic and solvency tax rates via a rate schedule. Table 2.1 describes the rate schedule in effect in Wisconsin in 2010.

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<sup>52</sup> This implies that a firm’s solvency rate contribution depends not only on its own layoff history, but on the layoff history of all firms. This creates an externality whereby firms with fewer layoffs relative to their size subsidize firms with more, particularly when unemployment is high in the state.

Table 2.1: Reserve Ratio and Corresponding Tax Rates

Reserve Percent	Basic Rate	Solvency Rate	
		Small Firms	Large Firms
-6.0% or lower	8.50%	1.30%	1.30%
-6.0% to -5.1%	7.80%	1.30%	1.30%
5.0% to -4.1%	7.30%	1.30%	1.30%
-4.0% to -3.1%	6.80%	1.30%	1.30%
-3.0% to -2.1%	6.30%	1.30%	1.30%
-2.0% to -1.1%	5.80%	1.30%	1.30%
-1.0% to 0.1%	5.30%	1.30%	1.30%
0.0% to 3.5%	3.37%	1.40%	1.90%
3.6% to 4.0%	2.98%	1.30%	1.80%
4.1% to 4.5%	2.64%	1.20%	1.70%
4.6% to 5.0%	2.30%	1.10%	1.60%
5.1% to 5.5%	1.96%	1.10%	1.50%
5.6% to 6.0%	1.62%	1.00%	1.40%
6.1% to 6.5%	1.28%	0.90%	1.30%
6.6% to 7.0%	1.03%	0.80%	1.20%
7.1% to 7.5%	0.77%	0.70%	1.20%
7.6% to 8.0%	0.66%	0.60%	1.10%
8.1% to 8.5%	0.59%	0.50%	1.00%
8.6% to 9.0%	0.52%	0.40%	0.90%
9.1% to 9.5%	0.33%	0.20%	0.90%
9.6% to 10.0%	0.25%	0.20%	0.80%
10.1% or more	0.07%	0.20%	0.63%
New Employer Rate	2.50%	1.10%	1.60%
New Construction Rate	5.30%	1.30%	1.30%

This system yields an experience rating that is considered “incomplete.” The incompleteness stems from distortions in the mapping of firm layoff history to current firm tax rate. The four most significant such distortions are as follows (in no particular order of significance): First, the tax schedules have minimum and maximum tax rates. This implies that firms with extremely high or low reserve ratios face the same rates as counterparts with less extreme reserve ratios. Second, statute dictates that no firm’s reserve ratio can dip below negative ten percent. This implies that firms with extremely frequent layoffs, relative to their size, face the same tax rates as counterparts with moderately less extreme layoff histories. Third, there are limits to the rate of change of any firm’s basic and solvency tax rates, year-over-year. This implies that a firm with an extremely large number of layoffs in a short period will face the same tax rates as counterparts with either a less extreme number of layoffs or with layoffs spread over a longer time horizon. Fourth, all firms are assigned a fixed tax rate for their first three years of operation. This

implies that new firms face different tax rates than older, but otherwise identical, counterparts. These four sources of nonlinearity have been hurdles to accurately modeling firms' tax liabilities—and therefore labor demand incentives—in literature.

### 2.2.2 *Approaches to Quantifying Layoff Disincentive in Literature*

Topel (1983) established a theoretical framework for studying the impacts of UI systems that has proved highly influential. Subsequent empirical work, though, has had to adapt the theoretical model to align with commonly available data. The key to quantifying UI-related labor demand incentives is in modeling the relationship between a firm's current reserve ratio and its future tax rates. In practice, this is done using a rate schedule, as shown above. The standard model that has emerged in literature, however, approximates this mapping with a simple linear projection:

$$\tau_{t+1} = \eta_0 - \eta_1 r_t \quad (2.3)$$

where  $r_t$  is the current reserve ratio and  $\tau_{t+1}$  is the next-period tax rate;  $\eta_0$  and  $\eta_1$  are the OLS coefficients that best fit the available data. This formulation has appealed to many empirical researchers because, in conjunction with a few other assumptions, it simplifies ancillary calculations. Anderson & Meyer (1993), for example, present the following system definitions and equations to describe a firm.

$C_t$  = contributions (in dollars) based on the total tax rate, such that  $C_t = \tau_t W_t$

$B_t$  = benefits (in dollars) charged to the firm's reserve account

$W_t$  = taxable payroll (in dollars)

$R_t$  = reserve account balance

$r_t$  = reserve ratio

$\tau_t$  = total UI tax rate for a given year (basic rate plus solvency rate)

$\theta$  = growth rate of taxable payroll, such that  $W_{t+1} = \theta W_t$

$i =$  nominal interest rate

Note that this definition of  $C_t$  differs from Equation 2.2. Here, it is determined by the total tax rate rather than by the basic rate alone.<sup>53</sup> This environment facilitates several useful transformations. For example, substituting Equation 2.2 into Equation 2.1 and using the definition of  $C_t$  to simplify the result yields

$$r_t = \frac{R_{t-1}}{W_t} + \tau_t - \frac{B_t}{W_t} \quad (2.4)$$

Solving Equation 2.3 for the reserve ratio yields

$$r_t = \frac{\eta_0}{\eta_1} - \frac{\tau_{t+1}}{\eta_1} \quad (2.5)$$

Substituting Equation 2.5 into Equation 2.4 yields

$$\frac{\eta_0}{\eta_1} - \frac{\tau_{t+1}}{\eta_1} = \frac{R_{t-1}}{W_t} + \tau_t - \frac{B_t}{W_t} \quad (2.6)$$

Solving for  $\tau_{t+1}$  yields

$$\tau_{t+1} = \frac{B_t \eta_1}{W_t} + \eta_0 - \frac{R_{t-1} \eta_1}{W_t} - \tau_t \eta_1 \quad (2.7)$$

Multiply both sides by next-period taxable payroll,  $W_{t+1}$ , and simplify using the definition of  $C_t$ .

This yields total contributions for year  $t + 1$

$$C_{t+1} = \theta B_t \eta_1 + \theta W_t \eta_0 - \theta R_{t-1} \eta_1 - \theta C_t \eta_1 \quad (2.8)$$

From here, it is straightforward to determine the tax impact of the marginal layoff. Taking the partial derivative of Equation 2.8 with respect to  $B_t$  yields

$$\frac{\partial C_{t+1}}{\partial B_t} = \theta \eta_1 \quad (2.9)$$

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<sup>53</sup> This alteration in definition has significant implications. We explore those, below.

This is the single-period increase in tax contributions resulting from a marginal increase in benefits paid to former employees. By construction, the firm faces this cost in all subsequent periods, so the discounted present value of this cost increase, over an infinite horizon, is the MTC<sup>54</sup>

$$MTC \equiv \frac{\theta\eta_1}{i+\theta\eta_1} \quad (2.10)$$

In the wake of a layoff, MTC is the present-value total cost to the firm associated with higher subsequent tax payments. In literature, the MTC of firms in the highest tax bracket is assumed to be zero. For these firms, paying more benefits cannot increase their tax rate.<sup>55</sup>

### 2.2.3 *Limitations of the Standard Model*

While computationally expedient, the standard model requires several strict assumptions that assume away complicating characteristics of UI systems. These assumptions may leave gaps in our understanding of UI-related incentives, which may bias estimates of those incentives' effects on subsequent labor demand.

We alluded to the first such unrealistic assumption in Section 2.2.2. Equation 2.3 imposes a purely linear relationship between current reserve ratio and future taxes. However, in practice, the state assigns tax rates using a rate schedule. That schedule defines a non-linear, non-continuous function in which lower reserve ratio values correspond to higher tax rates. In the function, tax rates increase at an increasing rate as reserve ratio falls. The function is also flat for small changes in reserve ratio. By the same logic that assigns an MTC of zero to firms in the highest tax bracket, small changes in reserve ratio—those that do not result in jumping to a higher or lower step—may

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<sup>54</sup> Examples include Anderson & Meyer (1991, 1993) and Topel (1983).

<sup>55</sup> Similarly, such models assign an MTC of zero to all firms in the lowest tax-rate bracket in states where the lowest tax rate is zero. We ignore this case because, under current Wisconsin implementation, the lowest assigned tax rate is positive.

also imply an MTC of zero. The linearization assumption in the standard model, however, imposes a uniform, positive MTC on all firms outside the highest tax bracket.

Another significant assumption of the model is a corollary of Equation 2.10. The tax increase defined in Equation 2.9 is assumed to be fixed and permanent. Returning to the definition of reserve ratio in Equation 2.1, consider how a marginal layoff affects the evolution of the reserve ratio over time. In the first period after the layoff, both the numerator and denominator will change; the layoff reduces taxable wages and increases benefits paid. In subsequent periods, however, assuming no other changes in employment, the numerator (net contributions) will increase while the denominator (taxable wages) stays fixed. Therefore, the reserve ratio will unambiguously increase over time. This implies that the firm's tax rate will decline, over time, as well. This dynamic is explored further in Section 2.2.4, but it is immediately apparent that the standard model's assumption that a marginal layoff will result in a fixed and permanent tax increase is incongruous with the evolution of reserve ratio.

Another limitation of the standard model stems from the definition of  $\theta$ .<sup>56</sup> Topel's model defines it as a constant growth rate of taxable payroll. Exogenously fixing the growth rate of employment, however, limits analysis of UI program effects. A less deterministic definition of taxable wage evolution (and, consequently, of MTC as it is expressed in Equation 2.10) may prove more flexible.

The standard model also disregards several other relevant factors by simplifying aspects of UI financing. Section 2.2.1 describes the two-part funding scheme whereby taxes are paid into both the firm's reserve account and the state balancing account via the basic and solvency

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<sup>56</sup> In some model variants, there is a growth rate statistic for taxable wages (which incorporates changes to both the taxable wage base and employment). In the setting above, the taxable wage base is constant and employment grows at rate  $\theta$ .

contributions, respectively. The standard model dispenses with the solvency rate portion of contributions and focuses on the basic rate portion exclusively.<sup>57</sup> This simplification obscures certain implications of the solvency system and leads to underestimation of the effect of a marginal layoff on future taxes for firms. Layoffs will increase both the firm's basic and solvency rates.<sup>58</sup> A similar simplification eliminates differential tax rate evolution for firms of different sizes, industries, and ages. State UI systems commonly set higher UI tax rates for firms larger than a particular size and for firms in high-layoff industries, like construction. They also typically set a fixed tax rate for firms under a certain age. A model that accounts for these complications will more precisely estimate the effects of a particular UI system.

#### 2.2.4 *Implications of Reserve Ratio Evolution*

In Section 2.2.3 we observed, following a marginal layoff, that the reserve ratio evolves predictably and that related tax rate increases are not necessarily either fixed or permanent. In this section, we formally quantify this evolution and note its further implications.

Assume a prototypical firm in which all employees are paid at least the taxable wage base and the firm has never before paid UI benefits. Combining Equations 2.1 and 2.2 yields

$$r_t \equiv \frac{R_{t-1} + \tau_t w N_t}{w N_t} \quad (2.11)$$

where  $w$  is the taxable wage base and  $N_t$  is the number of employees. Assume a single layoff occurs between periods  $t - 1$  and  $t$  and that no other employment changes occur thereafter. At

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<sup>57</sup> Identically, one could interpret the standard model as focusing on the total tax rate, exclusively, and ignoring the distinction between the basic and solvency rates. Either interpretation has the same implications.

<sup>58</sup> The standard model could, alternatively, be understood to account only for the total tax rate—rather than only for the basic tax rate—but this also leads to problems related to the differing evolution of solvency and basic rates. Critically, while one firm's layoffs immediately affect both its basic and solvency tax rates, layoffs also affect statewide unemployment, which can impact the solvency of the balancing account, which can further impact the firm's solvency rate. These downstream effects are impossible to study without modeling the basic and solvency rates separately.

time  $t$ , the laid-off worker's benefits will be paid ( $B_t$  is subtracted from the reserve account balance), and for all subsequent periods  $B_{t+1+n} = 0$ . The effect on the reserve ratio in the immediate period is ambiguous because both the numerator and denominator will change. Note, though, that  $N$  decreases only once, and taxable payroll (the denominator of Equation 2.11) thereafter evolves by

$$wN_{t-1} > wN_t = w(N_{t-1} - 1) = wN_{t+n} \quad (2.12)$$

Also for all subsequent periods, the expression

$$r_{t+n+1} - r_{t+n} = \frac{R_{t+n-1}}{wN_{t+n}} + \tau_{t+n} + \tau_{t+n+1} - \frac{R_{t+n-1}}{wN_{t+n}} - \tau_{t+n} = \tau_{t+n+1} \quad (2.13)$$

is positive, because all tax rates are positive. Thus, for all periods following  $t$  (after the former employee's UI benefits have been exhausted) the reserve ratio increases unambiguously. Because the reserve ratio monotonically increases, the firm's tax rate must monotonically decrease. This proves the assertion in Section 2.2.3 that post-layoff tax rate increases are neither fixed nor permanent, which the standard model assumes.

Consider the tax contributions of a firm following a layoff compared to its contributions prior to that layoff.

$$\frac{C_t}{C_{t-1}} = \frac{\tau_t w(N_{t-1} - 1)}{\tau_{t-1} wN_{t-1}} \quad (2.14)$$

While taxable payroll in the numerator is strictly smaller, the relative magnitude of the tax rates is ambiguous. As mentioned above, immediately following a layoff, a firm's reserve ratio may either increase or decrease. This implies that the firm's tax rate may also either increase or decrease, which, in turn, implies that the firm's total tax contributions may either increase or decrease. A firm's MTC after a layoff event, therefore, may be either positive or negative. This contradicts the standard model in which MTC is non-negative by construction. Given these weaknesses in the

standard approach to estimating MTC, we believe the UI literature could benefit from an alternative methodology.

## 2.3 An Alternative Model of MTC

In this section, we are motivated by the limitations of the standard approach to develop an alternative means of estimating MTC. Specifically, we exploit the predictable aspects of reserve ratio evolution as defined by Equations 2.12 and 2.13 to quantify the effects of a marginal layoff on a firm's subsequent UI tax contributions. We then weigh the strengths and weaknesses of the alternative approach versus the standard model.

### 2.3.1 *A Theoretical Approach to Estimating MTC Using Reserve Ratio Evolution*

In literature, MTC is a measure of the net present cost of a marginal increase in UI benefits paid. Because benefits necessarily follow layoffs, this is equivalently the net present value of marginally reducing employment. The standard model approaches this problem by first simplifying and abstracting UI systems until they are a series of differentiable equations, and then by taking the first derivative of future contributions with respect to current benefits. Many of these differentiability-ensuring abstractions, however, can be avoided by employing an approach that estimates this derivative without requiring the function to be continuously differentiable.

Consider the following exercise: observe the UI-relevant characteristics of a firm; determine the effect that a layoff event would have on the firm's reserve ratio, tax rate, and total contributions; chart the effect that this layoff has on the firm's stream of future tax contributions using the evolution equations, above; and calculate the net present value of this stream of tax changes. While the approach is different than the standard model, the concept is identical—this statistic is the MTC.

Equation 2.12 proves that, without further employment changes, the denominator of the reserve ratio is purely deterministic after a layoff. Equation 2.13 proves that, starting in the second period after a layoff, the reserve ratio increases monotonically and the tax rate decreases monotonically. Because this approach does not compute a derivative directly, we must be specific about how we define a layoff. Workers are not perfectly divisible, and different sized layoff events could differentially affect  $r_{t+1} - r_t$ .<sup>59</sup> We will first consider the layoff of a single worker who earns at least the taxable wage base, such that  $(N_{t-1} - N_t) = 1$  and  $(W_{t-1} - W_t) = w$ , but we relax this assumption below.

To calculate MTC as described in the exercise above, we assume that a single layoff event occurs and that no subsequent employment changes happen. This assumption is made only to facilitate the estimation of MTC for the firm's current characteristics; it is not meant to imply that the firm will not, in practice, make further employment changes.<sup>60</sup> A firm's MTC is specific to the firm's characteristics and to the time period—as either changes, so does the MTC.<sup>61</sup> In the next section, we will take this theoretical approach to data and empirically construct this evolutionary estimate of MTC.

## 2.4 Data

In this section, we discuss the administrative data from the Unemployment Insurance Division of the Wisconsin Department of Workforce Development with which our analysis will

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<sup>59</sup> When approximating a derivative by calculating the slope of a secant line between points on a function, one must choose a finite distance across which to compute that slope. Choosing the size of the layoff event, here, is akin to choosing that finite distance. The standard model bypasses this concern by imposing differentiability.

<sup>60</sup> This assumption is consistent with the standard model.

<sup>61</sup> This departs from the standard model and allows more precise MTC estimation. The standard model calculates one, time-invariant MTC for all firms outside the highest tax bracket; our approach allows us to account for tax implications that vary with firm size, layoff size, and time period, among other factors.

proceed. These data are derived from the mandatory quarterly tax reports submitted by Wisconsin employers. Only contributing employers with open account status as of November 2010 are included in the data.<sup>62</sup> Note that these data represent Wisconsin's UI system only, and do not include Federal extended UI benefits.

#### 2.4.1 *Data Contents*

These administrative records include the characteristics used to determine a firm's experience rating and, therefore, its UI tax liability. For each firm, we observe its age, size, industry classification, UI-qualifying employee count, tax rate, contributions paid in, benefits drawn out, reserve account balance, and taxable payroll. We do not directly observe the wages of employees; we assume that each employee earns at least \$13,000 annually.<sup>63</sup>

The population of UI-participating employers contains 83,929 unique firms across two fiscal years (July 1, 2008 to June 30, 2010). We drop firms with missing identifiers, setup dates, tax rates, or taxable payroll. We also drop firms with a taxable payroll of less than \$13,000.<sup>64</sup> Finally, we drop firms without established experience ratings.<sup>65</sup> As a practical matter, tax rates are assigned over fiscal years (July to June), but our raw data are organized by calendar year; we construct necessary fiscal-year statistics as the average of the overlapping calendar years' data.<sup>66</sup>

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<sup>62</sup> "Contributing" firms are those participating in the UI system. Some non-profit and government entities are "reimbursing" rather than "contributing"; these are effectively exempt from the UI system. While the Department of Workforce Development maintains some records for such firms, they are outside the purview of this research. "Open" status indicates that the firm is currently in operation.

<sup>63</sup> We are comfortable that this assumption is broadly accurate because, even at minimum wage, a full-time worker earns well over \$13,000 per year. We are unable, with the available data, to determine which workers have not been employed by the firm for the full year. These workers may not earn enough to surpass the taxable wage base.

<sup>64</sup> These firms employ, at most, one full-time, UI-eligible employee. Laying off one's only employee has significant business implications that are outside the scope of this paper. While such firms constitute approximately 20% of our initial observations, the great majority register no UI activity during the study period.

<sup>65</sup> Firms without experience ratings are new firms or firms with no UI-eligible employees. These firms pay a fixed annual contribution, and thus face no meaningful layoff-related MTC.

Variable definitions are presented in Appendix 1. Our final sample consists of a constant panel of 67,257 firms.

#### 2.4.2 Data Summary

Summary statistics of our final sample are illustrated in Table 2.2. In the sample, 61% of firms experienced a layoff in fiscal 2010. In that year, the average number of employees laid off was 4.4, but the largest number was nearly 2,500 workers.<sup>67</sup> Ninety percent of firms have a taxable payroll of less than \$500,000, which formally qualifies them as “small,” but firm employment ranges from 2 to nearly 28,500.<sup>68</sup> Most workers are employed by large firms.<sup>69</sup> On average, firm tax contributions into the UI system represent only 56% of the total benefits paid out to the unemployed. While the average and median firms have positive reserve account balances, these accounts range from negative \$11.1 million to positive \$15.2 million.

Table 2.2: Raw Data Descriptive Statistics

Variable	Mean	Median	Std. Deviation	Min	Max
employment	28.1	7.1	178.1	2	28,413
estimated layoffs	4.4	0.3	27.5	0	2,441
taxable payroll	\$337,173	\$85,289	\$2,137,722	\$26,000	\$341,000,000
reserve acct. balance	\$791	\$3,793	\$154,365	-\$11,100,000	\$15,200,000
total contributions	\$10,412	\$1,803	\$63,035	\$35	\$8,217,161
benefits paid	\$18,600	\$1,120	\$116,987	\$0	\$10,400,000
firm age	14.5	12.3	9.7	0	30
size (small=1)	0.9	1.0	0.3	0	1

<sup>66</sup> A firm’s tax rate for fiscal 2009 (July 1, 2008 to June 30, 2009), for example, is the average of its tax rates in calendar 2008 and calendar 2009.

<sup>67</sup> Because we do not observe employee salary directly, we assume that one worker is laid off for every \$13,000 reduction we observe in a firm’s taxable payroll.

<sup>68</sup> Small firms face weakly lower UI tax rates.

<sup>69</sup> Large firms have taxable payrolls greater than \$500,000.

## 2.5 MTC Estimation

In this section, we empirically estimate the MTC of a layoff to the firms in our sample. We estimate MTC by three methods: The first two methods are variations on the theoretical approach we outline in Section 2.3.1. We call this approach the “evolutionary” method of MTC estimation. The first evolutionary variant defines a layoff as a reduction of exactly one employee. The second evolutionary variant defines a layoff as a 10% reduction in firm employment. The third method simply follows the standard approach in literature detailed in Section 2.2.2. Finally, we compare the results from each estimation method, and discuss what drives observed differences.

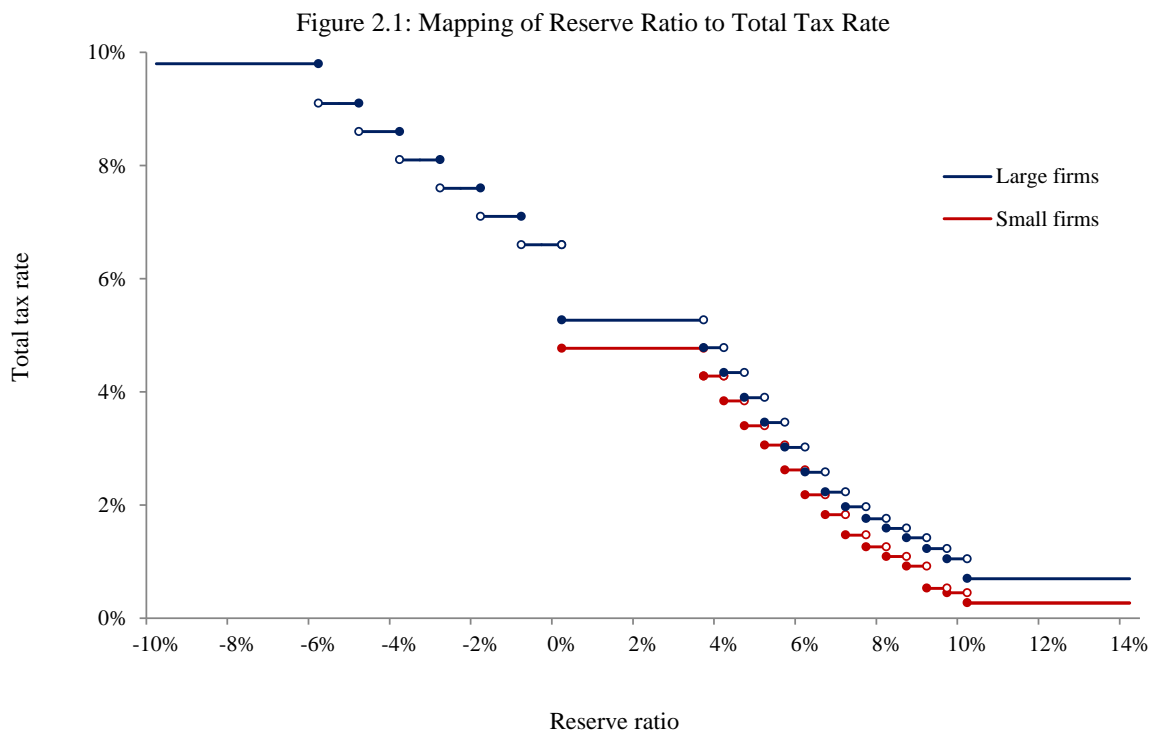
### 2.5.1 *An Empirical Approach to Estimating MTC Using Reserve Ratio Evolution*

Following the thought experiment laid out in Section 2.3.1, we calculate the evolutionary estimate of MTC as follows: In period 1, we observe a firm and all of the characteristics that factor into the calculation of its reserve ratio. Using the tax rate assignment schedule, we observe where that firm falls on the mapping of reserve ratio onto tax rate. In order to compute the impact of a layoff, we generate a counterfactual version of the firm with marginally lower employment.<sup>70</sup> This employment reduction decreases the counterfactual firm’s taxable payroll and increases the UI benefits paid out of the firm’s reserve account.<sup>71</sup>

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<sup>70</sup> Employment is reduced by one worker in the first variant and by 10% of employment in the second. The second variant, like the standard model, assumes that employment is perfectly divisible.

<sup>71</sup> We assign benefits of \$3,400 for each laid-off worker; this is the statewide average.



Recall that, over time, as contributions are paid into the UI system, the reserve ratio increases monotonically. This implies that, plotted over time, each firm will eventually converge upon the lowest tax bracket. This is true of both the factual and counterfactual versions of the firm. However, given the initial difference in their reserve ratios (due the hypothetical layoff in the counterfactual firm), the two versions of the firm will not necessarily converge on the lowest tax bracket simultaneously. With this in mind, we plot both the factual and the counterfactual versions of the firm onto the graph of tax rate versus reserve ratio. This graph is illustrated in Figure 2.1. Consider the initial plotting of firm variants to represent  $t = 1$ . Using the evolutionary equations established in Section 2.2.4, we can trace the movement of each firm version along the graph, over time, until both versions have reached the minimum tax bracket. Consider this period  $t = T$ . In all subsequent periods,  $T + n$ , the factual and counterfactual versions of the firm pay identical tax

rates. We define evolutionary MTC as the net present value of the sum (over  $t = 1 \dots T$ ) of period-by-period differences in total UI tax contributions.<sup>72</sup>

The evolutionary approach contrasts with the standard approach in several ways: it allows MTC to be negative; it accounts for the step-wise relationship between reserve ratio and tax rate rather than employing a linear approximation; it does not impose a positive MTC on firms below the top tax bracket; it does not impose an MTC of zero on firms within the top tax bracket; and it allows tax rates to evolve over time, rather than remaining fixed and permanent. Critically, it also allows precise modeling of the nuances of the UI system, including maximum annual rate increases, the dual-rate (basic rate and solvency rate) system, and distinctions in rate-assignment by firm age, size, and industry. We account for each of these factors in our calculations of tax rate evolution and total tax differential over time. Each of these departures from the standard model should reduce bias and significantly increase the precision of MTC estimation.

### 2.5.2 Comparison of MTC Estimation Results

Table 2.3 compares the distribution of MTC as calculated by each of the three methods listed above. Note that the evolutionary model results are renormalized to match the standard model.<sup>73</sup>

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<sup>72</sup> As noted above, this calculation implicitly assumes that no further changes in employment occur. This allows us to calculate the tax costs associated with a layoff of the specified type from a firm with the specified characteristics occurring in the specified period, *ceteris paribus*. This matches the intuition of MTC estimation in literature.

<sup>73</sup> As previously noted, the evolutionary approach can be conceptualized as a finite difference approximation of a derivative. This renormalization is akin to dividing by the denominator of a difference quotient. Specifically, we divide the single-layoff evolutionary model's MTC estimates by \$3,400, the average benefits paid out to unemployed workers. Similarly, we divide the ten-percent-of-workforce MTC estimates by \$3,400 times the number of workers that 10% of employment represents.

Table 2.3: Distribution of MTC by Three Estimation Methods

	Standard Model	Evolutionary Model (single layoff)	Evolutionary Model (10% of employment)
Minimum	0.00	-0.27	-0.01
1st Quartile	0.27	0.02	0.00
Median	0.34	0.11	0.11
3rd Quartile	0.40	0.27	0.51
Maximum	1.00	1.25	2.53
Mean	0.34	0.19	0.37
Std. Deviation	0.17	0.22	0.53
Share of firms with:			
MTC less than zero	0.00%	0.14%	4.77%
MTC equal to zero	9.33%	17.35%	17.71%
MTC between zero and 1	90.67%	81.85%	64.26%
MTC greater than 1	0.00%	0.67%	13.26%
Share of employment at firms with:			
MTC less than zero	0.00%	1.30%	42.39%
MTC equal to zero	7.32%	36.44%	9.52%
MTC between zero and 1	92.68%	62.20%	46.78%
MTC greater than 1	0.00%	0.06%	1.32%

These distributions have several significant implications. First, the evolutionary models allow for cases where a layoff requires a firm to pay more into the UI system than the laid-off workers received in benefits. These instances have an MTC greater than one. These are typically small firms, where a layoff can result in significantly higher tax rates. Also, because the firm is small, the reserve ratio evolves slowly thereafter. These firms pay higher tax rates over very long time horizons.

Second, the share of firms and of employment at firms with an MTC of zero is higher in the evolutionary model. The standard model imposes an MTC of zero on maximum-tax-rate firms. The evolutionary model accounts for the fact that, for most of these top-tax-bracket firms, additional layoffs will cause them to keep paying the top rate for longer, as opposed to moving back toward lower rates sooner. The evolutionary model, by contrast, assigns an MTC of zero to layoffs that occur in firms already paying the lowest tax rate that do not result in movement to a higher tax bracket. For approximately 30% of the sample, the single-layoff counterfactual version

of the firm represents movement along a plateau rather than movement between tax brackets. In the very few cases where subsequent evolution of the factual and counterfactual firm versions make simultaneous jumps to lower steps, these firms are also assigned an MTC of zero.

The third major difference between the estimation results is the share of firms with negative MTC. In Section 2.2.4, we proved the existence of a class of firms which face a negative MTC. These firms are unusual in that they face a marginal tax incentive (rather than disincentive) to lay workers off. Typically, these are large firms where a layoff does not cause the tax rate to increase. These firms pay the same tax rate on a smaller taxable payroll, so their total contributions decrease.

## 2.6 Layoff Incentive Effects of the UI System

In this section, we use the estimates of MTC described in Section 2.5 to examine the extent to which UI taxes affect firm labor demand. We present a basic model of labor demand, discuss how MTC may affect it, and predict how the standard model and evolutionary model estimates MTC may differ in their correlation with labor demand. Finally, we empirically estimate the correlation between observable firm characteristics—including MTC—and the firm's subsequent layoffs.

### 2.6.1 *Theoretical Impact of MTC on Labor Demand*

We consider a basic model of firm behavior. Firms will retain workers as long as their marginal revenue product exceeds the wages and benefits paid. A firm will lay off a worker if his or her marginal revenue product is less than the wages and benefits he or she is paid plus the costs associated with the layoff. MTC enters this calculation as a part of layoff costs, and therefore

affects the layoff decision.<sup>74</sup> Higher layoff costs, in this model, will tend to be protective of employment. However, when layoffs do occur, this typically raises subsequent UI tax rates, which increases the cost of labor. Higher labor costs will tend to decrease employment. For this reason, the prevailing relationship between UI tax incentives (as measured by MTC) and subsequent labor demand is theoretically ambiguous. In order to pin down their effect, we will estimate a firm-level model wherein we regress next-period layoffs on current-period firm characteristics, including MTC. Our statistic of interest is the coefficient on MTC. This will indicate the extent to which higher UI-related taxes are correlated with subsequent layoffs. We will estimate the model using the three estimates of MTC described in Section 2.5.2, and then compare the coefficients on MTC yielded by each specification.

### 2.6.2 *Empirical Impact of MTC on Labor Demand*

Table 2.4 reports the results of estimating next-period layoffs using firm characteristics and MTC. The three columns represent specifications using each of the three means of estimating MTC. In each case, we find a statistically significant negative correlation between each measure of MTC and layoffs. This implies that the Wisconsin UI program is, on net, protective of existing employment. Comparing specifications, the coefficient on MTC using the evolutionary methods is substantially smaller in magnitude. This suggests that analyses using standard model MTC estimation techniques will tend to overstate the impact of MTC on layoffs. Coefficients reported here can be interpreted as the effect on layoffs associated with changing the UI system from one that does not require firms to finance any UI benefits paid to one that requires firms to perfectly

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<sup>74</sup> Note that there are also UI-related tax incentives associated with hiring additional workers. Recall, though, that the standard model estimates the effect of benefits paid on future tax contributions. Neither of these statistics is affected by new hiring. As a consequence, standard-model MTC is silent on hiring incentives. Our evolutionary model could be adapted to estimate hiring incentives. From Equation 2.11, hiring an additional worker increases taxable payroll. Because  $\tau < 1$ , the reserve ratio decreases unambiguously in the first period and increases thereafter. Data limitations, however, currently prevent us from exploring this fully. For more information about the standard model and hiring effects, see Ratner (2013).

finance all UI benefits paid. We estimate that the average firm would lay-off between 1.1 and 15.4 more workers under the latter system than the former. This informs our thinking about the effects of UI revenue on labor demand. If the state government moved to increase revenue by increasing firm UI contributions, the standard model predicts the impact on labor demand will be between 5 and 14 times what is predicted using the evolutionary model. Policymakers, then, may have more room to increase UI system revenue without distorting labor demand as significantly as traditional analysis suggests.

Table 2.4: Regression Analysis of Next-Period Layoffs on Marginal Tax Cost

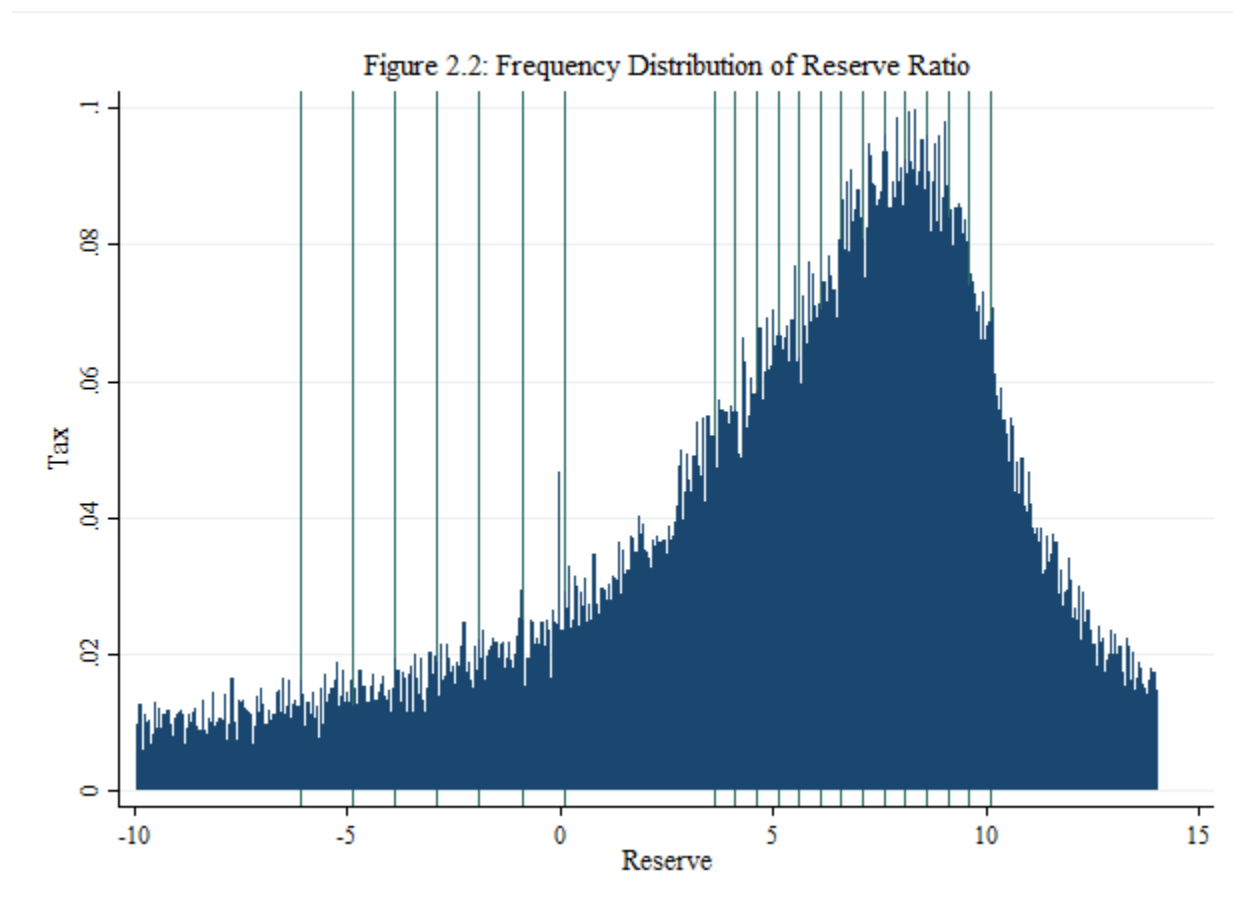
Estimated Layoffs	Standard Model	Evolutionary Model	
		Single Layoff	10% Layoff
Marginal Tax Cost	-15.38*** (0.674)	-3.03*** (0.196)	-1.10*** (0.0527)
Small firm	-24.74*** (0.899)	-24.35*** (0.892)	-24.47*** (0.905)
Age less than 3	-0.387 (0.307)	-1.374*** (0.309)	-1.365*** (0.313)
Age 3–10	-0.750*** (0.227)	-1.174*** (0.231)	-1.196*** (0.235)
Age 10–20	-0.811*** (0.305)	-0.946*** (0.308)	-0.964*** (0.310)
Industry Dummies		(output suppressed)	
Constant	35.37*** (1.246)	32.48*** (1.177)	32.24*** (1.164)
Observations	67,257	67,257	67,257
R-squared	0.107	0.099	0.099

Note: Robust standard errors are in parentheses. (\*\*\*)  $p < 0.01$ , (\*\*)  $p < 0.05$ , (\*)  $p < 0.10$

### 2.6.3 Potential Complicating Factors

In practice, firms have the option to make voluntary contributions to their reserve account. We cannot observe such contributions in our data, but firms may pay extra into the UI system in order to “buy” a lower tax rate. Conversations with Wisconsin DWD staff have assured us that such payments are not solicited by the state and are rare. Figure 2.2 illustrates the distribution of firms by reserve ratio, where vertical lines represent break points between tax brackets. If tax rate-targeting is a common practice, discontinuous spikes in frequency should appear to the right of

these vertical lines—firms just below the tax rate cutoff would make small extra payments that move them into a lower tax bracket. Because no such clustering is apparent, we discount this concern.



While firms are responsible for paying UI contributions, it is plausible that firms could simply pass these costs on to their workers in the form of lower wages. In this case, the UI system would have no direct impact on labor demand. To the extent that the labor market is competitive, however, not all firms can fully pass these costs through to workers. If a firm facing a high tax-rate must compete for labor against a firm facing a low tax-rate, then the high-rate firm can only pass through the same amount of tax as the low-rate firm. Otherwise the high-rate firm will always pay lower wages than the low-rate firm and will be unable to attract labor. At most, then, only the lowest tax-rate firms can pass through all of their UI taxes to employees.

## 2.7 Conclusions

In the wake of the Great Recession, policymakers have been faced with state UI funds that have been rapidly approaching insolvency. However, many have been reticent to increase UI taxes in order to maintain fund solvency, for fear that those taxes may reduce labor demand. To aid in this debate, we contribute a new means of modeling the tax implications of layoffs. Our evolutionary method overcomes several weaknesses of the literature-standard approach. Most importantly, it eliminates the need to impose differentiability on the mapping of reserve ratio to tax rates. This allows us to fully account for the nuances of the tax rate-assignment process in Wisconsin statute. This includes such factors as maximum year-over-year rate increases, caps on reserve ratios, and differential rates for solvency and basic rate portions of total contributions. We then take this approach to administrative data from the state of Wisconsin. After estimating the MTC of marginal layoffs using both the evolutionary and standard methodologies, we explore the relationship between UI taxation and observed firm layoffs. We find that the impact of MTC on firms' layoff decisions is statistically significant and robust to the size of the layoff event. We also find that traditional estimates of MTC overstate the relationship between UI taxes and subsequent layoffs. Our analysis indicates that policies that marginally increase UI system revenue will be less distortive of labor demand than previously thought.

## **Chapter 3.**

### **Sources and Implications of Firm-Level Subsidy and Cross-Subsidy in Unemployment Insurance**

#### 3.1 Introduction

The severe macroeconomic recession that began in 2007, commonly called the Great Recession, saw unemployment spike dramatically. This employment shock had profound effects for economies and the governments tasked with responding. One of the most direct policy mechanisms for mitigating the economic effects of job-loss is the nation-wide system of state-level unemployment insurance (UI) programs. In 1935, as a part of the Social Security Act, the federal government mandated that every state set up its own UI system. Most states chose to model their program on that of Wisconsin, which had enacted its own UI system in 1932. These systems were designed with the goal of partially-internalizing externalities created by firms through unemployment. From Chapter 108 of Wisconsin Statute, “In good times and in bad times unemployment is a heavy social cost, directly affecting many thousands of wage earners. Each employing unit in Wisconsin should pay at least a part of this social cost, connected with its own irregular operations, by financing benefits for its own unemployed workers.” Critically, the UI contributions that firms pay are not simply a means of financing a state welfare program. These insurance payments are designed to incentivize stable employment over time.

As with any insurance program that pools risk, however, complications arise in ensuring that firms finance the benefits of their own unemployed workers (as opposed to the workers of other firms). In a system of perfectly pooled risk, wherein all firms contribute to the UI fund equally, there is a clear moral hazard concern; any firm could choose to operate such that the large-scale layoff of its workers is likely, but pay only a fraction of the UI benefits these workers would collect if those layoffs occur. To reduce this moral hazard concern, UI programs include a system

of experience rating. This rating uses information about each firm's history of layoffs to increase UI contributions for high-risk firms and to reduce contributions for others. This experience rating, however, is an imperfect metric for quantifying risk. As noted by Topel (1983) and others, this incompleteness leaves state UI systems in a middle-ground between perfectly pooled-risk insurance and one in which each firm effectively self-insures. The precise nature and implications of experience rating incompleteness has been an active area of research.

This paper investigates the nature and magnitude of firm-level subsidies and cross-subsidies in the Wisconsin UI system. I use administrative data on the full population of firms subject to the UI system in the state of Wisconsin. These data were provided by the Wisconsin Department of Workforce Development, which administers the UI program. A basic measure of firm subsidy is net contributions, the total tax contributions paid by a firm minus benefits paid out to the firm's former workers. Rather than computing the difference between contributions and benefits over a finite horizon, as is common in literature, I observe the net subsidy received by each firm over its life.<sup>75</sup> I use this measure to analyze subsidy and cross-subsidy receipt by observable firm characteristics. As a point of comparison, I also construct measures of subsidy using marginal tax cost (MTC). This statistic was first proposed by Topel (1983) as a means of estimating the net present value of UI taxes that a firm pays in response to a marginal increase in benefits paid. As it has commonly been constructed in empirical literature, such as in Anderson & Meyer (1993), MTC falls between zero and one, inclusive. A large MTC indicates that the firm directly finances a large share of the UI benefits its laid-off former workers receive.<sup>76</sup> I will also

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<sup>75</sup> More precisely, this is over the life of the firm from when it first participated in the UI system. If a firm started with no UI qualifying employees, for example, the firm life would be longer than the life of the firm's UI account.

<sup>76</sup> As the statistic is a net present value, it could also indicate that the firm finances the same share of UI benefits as a lower MTC firm, but that it does so at a faster rate.

employ the evolutionary MTC statistic described in Reynolds & Udalova (2015), which accounts for firms with MTCs outside of the zero-to-one bounds and which more precisely estimates tax implications for specific firms. Examining MTC in addition to firms' reserve account strengthens the analysis of cross-subsidy; it also reveals a more general notion of firm subsidy under UI finance mechanisms.

The remainder of this paper is organized as follows: Section 3.2 introduces the Wisconsin-style UI finance system and outlines experience rating and potential sources of firm subsidy. Section 3.3 introduces three statistics for quantifying firm-level subsidy and uses them to estimate the extent to which firms' UI obligations are subsidized by the state. Section 3.4 quantifies firm-level cross-subsidy and investigates potential determinants of firm subsidy. In this section I uncover observable firm characteristics that impact layoff propensity which are not directly accounted for in the assignment of insurance rates. Section 3.5 concludes and compares the findings to those described in the literature.

## 3.2 UI System Financing and Subsidy Sources

In this section, I briefly describe Wisconsin's system of UI finance, how tax rates are assigned to firms, and how firms might be subsidized or cross-subsidize one another.

### *3.2.1 Overview of the Reserve Ratio System*

The 1935 Social Security Act mandated that every state develop a UI system broadly similar to what had been in place in Wisconsin since 1932. Many states adopted the Wisconsin statutes with little alteration. Today, thirty-three states employ a Wisconsin-style "reserve ratio" system to account for firm layoff propensity and assign premiums. In these states, each firm's total UI tax liability consists of a "basic rate" portion and a "solvency rate" portion. The basic rate share

of total tax liability is deposited into an account held by the state in the name of the individual firm. Benefits paid to this firm's employees are drawn from this reserve account. All firms' solvency rate shares of contributions are paid into a single pool managed by the state; this is called the balancing account. The state draws from the balancing account to pay benefits to the employees of firms that have permanently closed and to employees of firms without a positive reserve account balance.

Except in cases where a firm's reserve account balance has a large-magnitude negative balance (described in Section 3.2.2), benefits paid to workers are debited from their former employer's reserve account. The reserve account balance can be negative; in this case, benefits are paid from the state's balancing account. For firms with a negative reserve account balance, then, the benefits paid by the state essentially represent a loan to the firm. Mechanically, firms pay down these "loans" when they pay the basic rate portion of their UI contributions each year. However, these loans are effectively interest-free; interest payments are not required in addition to firms' regular UI contributions. Contributions only increase when the ratio of reserve account balance to taxable payroll (the reserve ratio) declines below certain thresholds, which triggers increases in firms' basic and solvency tax rates.<sup>77</sup>

The reserve account balance represents a running total of UI contributions paid into the system by the firm, net of UI benefits paid out of the system to laid-off workers.<sup>78</sup> By accounting for net contributions in this way, the reserve account quantifies the firm's layoff experience over its lifetime. Higher reserve ratios indicate firms that have effectively experienced fewer layoffs.<sup>79</sup>

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<sup>77</sup> Taxable payroll is each worker's taxable wage base (presently \$13,000 in Wisconsin) multiplied by the number of UI eligible workers employed by the firm.

<sup>78</sup> This includes only the basic rate portion of firm contributions, not their solvency rate portion.

<sup>79</sup> Indirectly—and to the extent that UI benefits are intended to offset the social cost of unemployment—the reserve ratio can be thought of as an accounting of the relative costliness to society of the firm's past layoffs. A worker laid-

The state uses reserve ratio as an “experience rating,” an indirect measure of a firm’s historical risk of layoffs. By assigning higher tax rates to firms with lower experience ratings, the state incentivizes employment stability—unstable employment entails more layoffs, which depletes the reserve account, which causes the firm to pay higher UI tax rates.

### 3.2.2 *Exceptions and Incompleteness*

While the above description characterizes the tax rate assignment process for most firms, there are exceptions that apply to firms with specific characteristics. First, there are maximum and minimum tax rates that apply to firms with extremely high or low balances in their reserve account.<sup>80</sup> Second, firms with large, negative reserve account balances (typically those that have frequently laid workers off) have their tax rates capped. When debiting additional benefits from a firm’s reserve account would push the account beyond negative ten percent of current taxable payroll, these disbursements are not debited from the firm’s reserve account. Third, by statute, no firm can face a year-over-year tax-rate increase of more than 2 percentage points, so increases are smoothed over time for firms that would otherwise face large shifts.<sup>81</sup> Finally, new firms, those in operation under the UI system for less than three calendar years are assigned a flat UI tax rate.<sup>82</sup>

The above rules all have the effect of muting the impact of a firm’s layoff history on its subsequent UI contributions. Their existence breaks the otherwise direct link between firms’ exhibited layoff risk and the insurance premiums they pay. This “incompleteness” of the experience rating causes some firms to pay less into the UI system than their risk profile and history

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off when new work is easy to find, for example, is unlikely to draw out as many UI benefits as a worker laid-off when work is scarce.

<sup>80</sup> In recent history, even the firms with no history of layoffs and with large UI reserves are required to pay positive contributions.

<sup>81</sup> The increase is capped at 1% for firms with a positive reserve account balance.

<sup>82</sup> In Wisconsin, this flat rate is 2.5 percentage points higher for new construction firms than for all other new firms.

would otherwise dictate. In order for the system, as a whole, to remain solvent, all other firms must pay marginally larger contributions than they would under a more complete accounting of firm risk. This creates a cross-subsidy whereby high-layoff firms tend to be subsidized by other firms. This dynamic is explored in detail in Sections 3.3 and 3.4.

While the above examples contribute to experience rating incompleteness, there are also aspects of the law that try to improve the alignment between layoff risk and UI premiums. First, large firms face higher tax rates than their small counterparts.<sup>83</sup> And second, new construction firms pay higher initial rates than other new firms. These adjustments could be thought of as attempts to improve the correlation between layoff experience and tax rates. Section 3.4 explores the extent to which these factors affect subsidy.

In general, making labor more expensive by increasing employment-related taxes will decrease labor demand. Under a system where layoff risk is more perfectly correlated with UI premiums paid, high-risk firms could be discouraged from hiring marginal workers and/or encouraged to lay off additional workers as their UI taxes increase. However, reducing the correlation between layoff risk and UI contributions carries labor demand risk of its own. Feldstein (1976, 1978) finds that experience rating incompleteness makes firms more likely to lay off workers when demand falls. Topel (1983, 1984) finds that, as the cross-subsidy associated with experience rating incompleteness increases, so too do both temporary and permanent layoffs. Anderson & Meyer (1993) supports Topel's theoretical conclusions with empirical analysis. Policymakers must strike a balance between a creating a system that is too onerous on volatile employers and creating one that allows those employers to impose significant costs on other firms.

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<sup>83</sup> Large firms are those that have a taxable payroll of at least \$500,000. This represents approximately 40 full-time, UI-qualifying employees. Large firms pay weakly higher basic and solvency rates than small firms with identical reserve ratios.

The remainder of this paper informs that balancing process by using an array of tools to quantify the nature of subsidies and cross-subsidies present in the Wisconsin UI system.

### 3.3 Subsidy in the Wisconsin UI System

Wisconsin UI statute reads, “Each employing unit in Wisconsin should pay at least a part of [the] social cost” associated with unemployment;<sup>84</sup> this section quantifies the size of that part. I begin by introducing the administrative data available for analysis. I then discuss three measures of subsidy: the reserve account balance and two estimates of the MTC of layoffs to firms. The first MTC estimate follows Anderson & Meyer (1993) in its construction; the second follows Reynolds & Udalova (2015).<sup>85</sup> The section concludes with a discussion of evidence regarding subsidy and system solvency.

#### 3.3.1 Data

The analysis in this project relies on data from the Wisconsin Department of Workforce Development, which is responsible for administering the state’s UI program. The data are firm-level and contains the population of firms subject to the UI system.<sup>86</sup> The available data include firm characteristics such as size, tenure, industry, and physical location as well as the statistics needed for the state to assign tax rates to the firms. These statistics include the firms’ reserve ratio, reserve account balance, current tax rates, and taxable payroll. The analysis in this paper will rely on a balanced sample of firms from July 2008 through June of 2010 (fiscal 2009 and 2010). This

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<sup>84</sup> State of Wisconsin (2008).

<sup>85</sup> Hereafter, I refer to MTC as constructed by Anderson & Meyer (1993) as “Topel-derived MTC” and MTC as constructed by Reynolds & Udalova (2015) as “evolutionary MTC.”

<sup>86</sup> Not all employers are subject to UI. Sole-proprietorships, governments, not-for-profits, and firms that do not employ any UI-qualifying workers (only non-qualifying part-time or temporary workers) are not subject to UI taxation and their workers are not eligible to receive UI benefits.

sample narrows the scope of the population data down to those firms employing multiple UI-eligible workers in both periods.<sup>87</sup> The final sample includes 67,257 Wisconsin firms observed in each period.<sup>88</sup> While the data cover only a limited time horizon, they have two distinct advantages over related projects in the literature: first, concern regarding sample size and construction are all but eliminated by observing the population of UI-subject firms, and second, both reserve account balances and reserve ratios are directly observed rather than requiring imputation.

### 2.3.2 *Measures of Subsidy*

While the data are limited to fiscal years 2009–2010, the reserve account balance contains information on the entire history of the firm. As a running balance of (basic rate) UI contributions paid into the system minus UI benefits drawn out by the firm's former workers, it is a direct measure of net subsidy. If the reserve account balance is positive, the firm has paid more into the system than it has drawn out. If the reserve account balance is negative, the firm has drawn more from the UI system than it has contributed since its reserve account was established.<sup>89</sup> In this case, the firm has received a net subsidy.<sup>90</sup> The reserve account balance (and thus the reserve ratio) also reflects the magnitude of that subsidy, positive or negative. Table 3.1 lists summary statistics for reserve ratio.<sup>91</sup>

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<sup>87</sup> Firms which employ only one UI-eligible worker face significantly different repercussions from reducing labor demand than other firms. The panel structure of the data is essential for calculating the MTC measures.

<sup>88</sup> For a more detailed description of this dataset, see Reynolds & Udalova (2015).

<sup>89</sup> As noted above, this is almost always concurrent with the establishment of the firm, but may be delayed until the firm hires its first UI-eligible employee.

<sup>90</sup> This is not necessarily a perfect measure of net subsidy. In the rare case where a firm's UI benefits paid are not debited from the firm's reserve account, as described in Section 3.2.2, the full extent of the subsidy will not be captured. For this reason, reserve account balance is more accurately a minimum estimate of net subsidy over time.

<sup>91</sup> Note that reserve ratio, rather than reserve account balance, is used by the state to assign tax rates.

Table 3.1: Distribution of Firm Reserve Ratio

	All Firms	Small Firms	Large Firms
Avg. reserve ratio	3.48	3.70	1.64
25th percentile	-2.01	-1.95	-2.32
Median	5.39	5.72	3.64
75th percentile	8.78	9.05	6.31
% negative balance	27%	29%	32%
Minimum balance	16%	16%	14%
Number of firms	67,257	60,180	7,077

The average firm holds a reserve account balance of more than 3% of its annual taxable payroll. The median reserve account holds a positive balance of \$3,792, which is sufficient to fully finance the average benefits claimed by a single laid-off worker (\$3,400). By this measure of subsidy, about one fourth of firms have received a net subsidy from the UI system. The subsidy these firms receive, however, is significant. Of firms with a negative reserve account balance, the median and mean balances are -\$11,340 and -\$45,701, respectively. Each of these statistics is approximately twice as large, in magnitude, as the balances of firms with a positive reserve account balance.

Approximately 16% of firms have reserve ratios of -10%, which indicates that their reserve account is at the minimum-allowed threshold. These firms could be receiving very large subsidies, but any additional UI benefits paid to their former workers are not debited from their reserve account. This makes it impossible to accurately estimate total subsidy for these firms. Using MTC rather than reserve account balance to estimate total subsidy can offer additional insight.

Marginal tax cost (MTC) quantifies the subsequent tax implications faced by a firm after a layoff. It effectively answers the question, “How much does a marginal increase in UI benefits cost a firm, in present value?” The measure was initially proposed by Topel (1983) in a theoretical framework and was formalized in an empirical context by Anderson & Meyer (1993). Reynolds & Udalova (2015) offered a different means of empirically estimating the statistic, which refined

the Topel-derived approach. For the purposes of comparison to previous literature and in the interest of comparing the estimates against one another, I report both statistics below.

Using MTC as a measure of subsidy clarifies a critical effect of the UI finance system that is difficult to quantify using the reserve account balance approach, alone. UI benefits debited to a firm's reserve account do not need to be immediately repaid by the firm. Typically, a firm's tax rate will increase after a layoff, but it frequently (particularly among small firms) takes several years of contributions to fully repay the benefits claimed by just one laid-off employee. Further, firms with a negative reserve account balance have their additional UI benefits paid by the state's balancing account.<sup>92</sup> The effect of this structure is that the net present value, to a firm, of a \$1 increase in benefits paid is often significantly smaller than \$1. Entirely aside from the question of cross-subsidy, this intertemporal subsidy ensures that many firms do not bear the full cost to the UI system of their layoffs. Over time, as has been the case in Wisconsin, this can diminish the UI system's balancing account and push the entire system toward insolvency.<sup>93</sup>

The Topel-derived approach approximates the relationship between firm reserve ratio and tax rates by using a two-tiered approach. The first tier encompasses all firms in the highest UI tax bracket. These firms are assigned an MTC of zero because subsequent layoffs do not increase their tax rate. The second tier consists of all other firms. For these, a linear projection of current-period tax rates on previous-period reserve ratio is estimated. The slope of this line (the coefficient estimate on reserve ratio) is assumed to describe the single-period tradeoff between reserve ratio changes and tax rates. This single-period tradeoff is then projected into the infinite future and

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<sup>92</sup> As noted above, in most cases, the firm still has these funds deducted from its reserve account. While the state's balancing account is effectively loaning money to the firm's reserve account to finance the benefits paid, the firm is not charged any interest on this loan.

<sup>93</sup> See Vroman and Woodbury (2011) for discussion of several issues pushing state UI systems toward insolvency.

discounted by relevant interest and growth rates.<sup>94</sup> All firms outside the top tax bracket, then, have positive MTC estimates between zero and one.

Reynolds & Udalova (2015) defines an alternative approach to estimating MTC using a method that replicates the statutory tax rate assignment mechanism and avoids the linearity assumption employed above. This approach notes that, in the absence of a layoff, firms' tax rates converge, over time, toward the minimum tax rate. It assumes a hypothetical fixed-sized layoff event for each firm and tracks how that employment reduction affects the firm's future tax payments over an infinite horizon.<sup>95</sup> The authors define MTC as the discounted present value of this stream of future tax changes. This "evolutionary" construction of MTC accounts for MTCs that fall outside the zero to one range, which is imposed under the Topel-derived approach.

Table 3.2: Marginal Tax Cost (MTC) Estimates

	Topel-Derived Model	Evolutionary Model
Minimum	0.00	-0.27
25th percentile	0.27	0.02
Median	0.34	0.11
75th percentile	0.40	0.27
Maximum	1.00	1.25
Mean	0.34	0.19
Std. Deviation	0.17	0.22

Table 3.2 illustrates the distribution of MTC by each estimation method described above. These estimates indicate that when the average firm pays out UI benefits to its former workers, the firm is only subsequently required to reimburse the UI system the present value of between one fifth and one third of those benefits. In other words, for each dollar of UI benefits claimed by a firm's workers, the average firm only contributes the equivalent of \$0.19 to \$0.34 back into the UI system.

<sup>94</sup> For more information, see Anderson and Meyer (1993) and Reynolds and Udalova (2015).

<sup>95</sup> The statistic used here assumes a one-worker layoff event.

Theoretically, such low contribution rates are sustainable when layoffs are relatively few compared to the size of total insured employment and when the state system can accrue interest on substantial UI reserves. However, neither of these conditions held for Wisconsin over the period observed in this data. Because of this, the Wisconsin UI system, among others, failed to maintain solvency in the wake of the Great Recession. During less severe downturns, the system is designed to respond to dwindling reserves by switching to a higher-rate tax schedule. When this occurs, each reserve ratio category subsequently corresponds with a higher tax rate than under the previous schedule. However, since 2010, Wisconsin has been using Schedule A, the highest-rate schedule, which has meant that UI taxes could not continue to increase in order to preserve the system's solvency.

### 3.4 Cross-Subsidy in the Wisconsin UI System

In this section, I employ the measures of subsidy introduced in the previous section to identify and quantify levels of cross-subsidy between firms. I employ regression analysis to identify statistically significant determinants of subsidy receipt and analyze whether there are firm characteristics that correlate with layoff risk but which are unaccounted for under the current system of experience rating.

#### 3.4.1 *Sources of Cross-Subsidy*

The economic principle behind firm cross-subsidy is simple. In the long run, the UI system, as a whole, must maintain a level of total capital sufficient to compensate all eligible beneficiaries. As discussed in Section 3.3, some firms receive larger subsidies under the system than others. In order to maintain sufficient reserves, it must be the case that firms with the lowest subsidy levels are paying more and that these “excess” contributions are used to offset the cost of financing UI

benefits to higher-subsidy firms. This general regime is typical of insurance markets; one of the primary benefits of holding insurance is that the risk of incurring a cost is shared among a pool. However, because firms, themselves, have significant power to determine their own labor demand, there may be a higher risk of moral hazard under UI than under other types of insurance. If this is the case, pooling the risk of unemployment more perfectly under UI may simply cause employment to shift away from stable employers toward more volatile ones. Over time, this will tend to drive the price of insurance upward, and that increase will be felt most sharply by the most stable (and least subsidized) firms. Perfect identification of firm-level layoff risk is likely impractical. If, however, there are easily-identifiable classes of firms with persistently high or low subsidy levels, then these may represent “low-hanging fruit” for improving the experience rating mechanism. Using data it already directly observes, the state could adjust its tax rate assignment formula to account for these factors with little administrative expense. Even slightly increasing or decreasing these classes’ tax rates could improve the allocation of risk in the system and reduce the moral hazard concern.

### 3.4.2 *Identification of Cross-Subsidy*

I investigate the existence of such classes of firms by segmenting the sample by observable characteristics.<sup>96</sup> From the data described in Section 3.3.1, I can identify firms by their size, industry classification, age, and geographic location.<sup>97</sup> The Wisconsin Department of Workforce Development divides the state into ten Workforce Development Areas (WDA), which are designed

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<sup>96</sup> Through its various administrative programs, the state may have access a wider array of firm-level characteristics than I observe, here.

<sup>97</sup> Size, as above, is defined as large or small (having a taxable payroll above or below \$500,000, respectively). Industry classification is defined by two digit NAICS code. Age is defined as years since the establishment of a UI account; this statistic top-coded at 30 years. Geographic location is defined by the ZIP code of the firm’s headquarters; for firms with multiple locations, precise assignment of location is impossible from the available data.

to represent separate and distinct labor markets within the state.<sup>98</sup> Using the ZIP code of each firm, I use geographic information systems software to assign it to a WDA.<sup>99</sup>

Table 3.3 reports the means of each of the three subsidy measures discussed in Section 3.3 for each of the observable characteristics defined above. In the table, I also include the total number of firms in each category (row) and the average number of UI-eligible workers at firms in that category. Of all of these firm categories, only those in the construction and manufacturing industries have, on average, a negative reserve ratio.<sup>100</sup> This comports with the findings of Anderson & Meyer (1993), which reported mining, construction, and manufacturing to be the primary beneficiaries of cross-subsidization. Deere (1991) found a similar pattern and noted that these subsidies appear to primarily be paid by service industry firms. This comports with the evidence, here. By every measure, industries other than construction and manufacturing appear to be less subsidized than their peers. Large firms are already required, under statute, to pay higher tax rates than small firms. Despite this, the subsidy measures all indicate that large firms remain net subsidy-receivers compared to their smaller counterparts.<sup>101</sup> This may indicate that the additional premium paid by large firms is insufficient to fully account for the layoff risk differential between these firm types. Lawrence (1991, 1993) found that firm age was a primary determinant of subsidization. The evidence, here, is mixed. While both measures of MTC indicate that subsidy

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<sup>98</sup> For a map of the regions, see Department of Workforce Development (2015). Note that I combine the Milwaukee and WOW WDAs into a single region. The WOW WDA consists of Waukesha, Ozaukee, and Washington counties, which collectively comprise most of suburban Milwaukee.

<sup>99</sup> Note that 140 firms were missing critical geographic information and could not be assigned to a WDA.

<sup>100</sup> For this analysis, I eliminate employers that are classified as either government or education. Government and some not-for-profit employers have the option of exempting themselves from the UI system described in this paper and effectively self-financing any UI benefits paid to their former workers. It is possible that the firms that appear in the data from these industries are atypical both of those industries and of participants in the UI system as a whole.

<sup>101</sup> Firms that have shuttered completely are not represented in this data because they do not have active reserve accounts. If small firms are more likely than large firms to close rather than downsize, one could interpret UI benefits paid to shuttered firms' employees as a subsidy to small firms that is unaccounted for in this analysis.

increases with firm age, the reserve ratio increases non-monotonically with age. When segmenting the sample by geographic region, Topel-derived MTC displays less variation than the other measures.

Table 3.3: Means of Three Subsidy Measures by Firm Characteristics

	Topel-Derived MTC	Evolutionary MTC	Reserve Ratio	Firm Count	UI-Covered Employment
Size:					
All Firms	0.34	0.19	3.48	67,257	28
Small	0.34	0.21	3.70	60,180	9
Large	0.33	0.01	1.64	7,077	186
Industry:					
Natural Resources and Mining	0.32	0.15	4.79	1,752	14
Trade/Transport/Util.	0.35	0.17	4.62	15,192	31
Construction	0.23	0.33	-4.81	7,864	14
Manufacturing	0.32	0.13	-0.25	6,770	68
All Other Industries	0.36	0.18	5.47	35,679	23
Firm Age:					
Zero to Three Years	0.39	0.24	3.59	6,171	28
Three to Ten Years	0.36	0.23	3.04	21,503	18
Ten to Twenty Years	0.33	0.19	3.54	19,400	25
More Than Twenty Years	0.31	0.13	3.86	20,183	42
Region:					
Bay Area	0.33	0.20	2.89	6,914	22
Fox Valley	0.33	0.19	3.35	6,094	23
Milwaukee	0.34	0.18	6.56	15,906	24
North Central	0.32	0.22	2.60	4,741	18
Northwest	0.34	0.24	2.64	2,294	14
South Central	0.34	0.18	4.10	8,648	24
Southeast	0.34	0.20	3.36	4,173	18
Southwest	0.34	0.19	4.27	2,759	18
West Central	0.34	0.20	3.76	4,489	19
Western	0.34	0.20	3.95	3,127	22
Out of State	0.35	0.16	3.51	7,972	75

The three subsidy measures predominantly reflect similar trends, but they deviate from one other in some categories. Consider the construction industry, for example. The reserve ratio reflects information about the history of a firm, while MTC is primarily a reflection of instantaneous firm characteristics. Construction, as an industry, was profoundly affected by the Great Recession. It is unsurprising that data from 2008–10 should reflect that construction has a large, negative reserve ratio. If a construction firm laid workers off during the recession, those

workers would claim UI benefits, driving the reserve ratio down. Subsequently, the lower reserve ratio would typically lead to the assignment of a higher tax rate to the firm. This higher tax rate is reflected in evolutionary MTC as a larger number, reflecting increased tax contributions over time (or similar contributions paid over a longer horizon for firms already in the highest tax bracket). Those firms in the highest tax rate bracket (or firms which are moved into that bracket by the layoffs in question), are assigned an MTC of zero by the Topel-derived method of estimating MTC. The difference in the MTC estimation techniques leads, in these cases, to substantially different MTC estimates. The Topel-derived method reflects that these firms' UI benefits are being substantially subsidized in the short run, but the evolutionary method more accurately accounts for the long-run costs associated with having a lower reserve ratio.

### *3.4.3 Determinants of Subsidy*

Regression analysis of the subsidy measures on observable characteristics can inform whether particular aspects of firms are associated with higher subsidy receipt. Table 3.4 reports these results. Note that both reserve ratio and MTC are negatively correlated with subsidy receipt. Negative coefficients indicate, all else equal, a higher degree of subsidization, and positive coefficients indicate characteristics correlated with firms that cross-subsidize their peers.

Here, as above, small firms are associated with paying cross-subsidies, rather than receiving them. Coefficients on reserve ratio indicate percentage point changes. Small firms, for example, are estimated to have a reserve ratio 2 percentage points larger than large firms. This reserve ratio difference corresponds with a tax rate change of between zero and one percentage point. Coefficients on MTC indicate the share of \$1 of benefits financed by the firm from subsequent taxes (in present value). For example, the evolutionary MTC coefficient estimate

indicates that small firms pay approximately \$0.16 more than large firms for every additional dollar of benefits distributed.

		Reserve Ratio	Topel-Derived MTC	Evolutionary MTC
Size:				
	Small	1.946*** (0.0953)	0.00795*** (0.00177)	0.164*** (0.00120)
Industry:				
	Construction	-10.80*** (0.138)	-0.140*** (0.00305)	0.129*** (0.00364)
	Health and Social Assistance	0.720*** (0.176)	-0.00337 (0.00213)	-0.0656*** (0.00275)
	Information Services	0.125 (0.327)	-0.00750 (0.00532)	-0.0497*** (0.00583)
	Leisure and Hospitality	0.357*** (0.137)	-0.0169*** (0.00210)	-0.0583*** (0.00276)
	Manufacturing	-5.930*** (0.150)	-0.0411*** (0.00239)	-0.0220*** (0.00288)
	Natural Resources and Mining	-1.033*** (0.217)	-0.0483*** (0.00408)	-0.0668*** (0.00477)
	Trade/Transport/Util.	-1.277*** (0.141)	-0.0186*** (0.00193)	-0.0232*** (0.00249)
	Prof. and Business Services	-2.290*** (0.153)	-0.0316*** (0.00244)	0.00244 (0.00297)
Age:				
	Less than 3 Years	-1.406*** (0.139)	0.0777*** (0.00278)	0.105*** (0.00293)
	3 to 10 Years	-1.468*** (0.105)	0.0435*** (0.00160)	0.0886*** (0.00196)
	10 to 20 Years	-0.614*** (0.104)	0.0176*** (0.00151)	0.0459*** (0.00192)
Region:				
	Bay Area	-0.409*** (0.113)	-0.00925*** (0.00230)	0.0100*** (0.00285)
	Fox Valley	-0.00571 (0.115)	-0.00527** (0.00235)	0.00579* (0.00296)
	North Central	-0.911*** (0.148)	-0.0166*** (0.00277)	0.0337*** (0.00351)
	Northwest	-1.068*** (0.172)	-0.00177 (0.00402)	0.0535*** (0.00498)
	South Central	0.613*** (0.106)	-0.00224 (0.00210)	-0.00603** (0.00256)
	Southeast	-0.0842 (0.157)	-0.00256 (0.00285)	0.0172*** (0.00356)
	Southwest	0.730*** (0.154)	0.00440 (0.00320)	0.00758* (0.00404)
	West Central	0.239* (0.129)	-0.00341 (0.00277)	0.0117*** (0.00346)
	Western	0.393*** (0.152)	-0.00178 (0.00318)	0.0130*** (0.00394)
	Out of State	-0.0880 (0.201)	-0.00208 (0.00250)	-0.00928*** (0.00257)
Constant		4.906*** (0.144)	0.340*** (0.00247)	-0.00900*** (0.00257)
Observations		66,584	66,584	66,584
R-squared		0.139	0.082	0.173

Note: Robust standard errors in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Among the industry classifications, the manufacturing, the natural resources and mining, and the trade transportation and utilities sectors are all associated with higher rates of subsidy-receipt than their peers. Construction is more difficult to assess, as noted in Section 3.4.2. Coefficient estimates on construction in the reserve ratio and Topel-derived MTC specifications match findings in previous literature that construction firms are typically associated with cross-subsidy receipt. However, the evolutionary MTC specification indicates the contrary.<sup>102</sup>

Estimates regarding firm age fail to strongly support the findings in Lawrence (1991, 1993) that age is the most significant determinant of subsidy receipt. While age appears to correlate positively with MTC (and thus negatively with subsidy-receipt), the opposite effect is estimated using reserve ratio as a measure of subsidy. Reserve account balances tend to grow, over time, as contributions are paid into the account. This finding is consistent with the following: older firms receive higher subsidies, but, during their younger years, they contributed enough into the UI system that the subsidy is difficult to detect by using reserve ratio, alone. These firms' reserve ratios tend to be large simply by virtue of their survival over many years. All age categories are strongly statistically significant, but the t-values on dummies indicating construction industry and firm size are larger than those for firm age.

Despite the high degree of statistical significance among the other observable firm characteristics, geographic region appears to be of secondary importance in predicting subsidy receipt. This is especially true using the Topel-derived MTC measure. Both the reserve ratio and evolutionary MTC statistics, though, indicate that location in the western half of the state (the

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<sup>102</sup> If construction firms tend to continually lay off large numbers of workers, and thus perpetually remain in the top tax bracket, then the Topel-derived MTC estimate is likely more accurate than the evolutionary estimate. However, if construction firms suffered an atypically high number of layoffs during the Great Recession and their long-run employment trend is more stable, then the evolutionary MTC likely better captures firm effects. Future research on this topic would benefit from data spanning a longer time horizon, which would help arbitrate whether construction's current subsidy level is persistent or whether it declines over time.

Southwest, West Central, and Western regions) tends to correlate with higher rates of cross-subsidy payment. Similarly, firms headquartered outside the state of Wisconsin are associated with higher rates of cross-subsidy receipt.

### 3.5 Conclusions

When Wisconsin designed its state-wide UI program, it was not intended simply as a poverty alleviation measure, and the system that collects the funds that pay for workers' benefits was not intended simply as a tax. Rather, the system was intended to encourage employment stability by ensuring that firms financed UI benefits at least partially in proportion to their labor demand volatility. The experience rating (reserve ratio) captures information about each firm's history of payments into and out from the UI system and assigns progressively higher tax rates to those firms that have, on net, drawn more out from the system. This generally ensures that high-volatility firms finance a higher share of UI benefits paid. However, this system, which has been implemented in the majority of American states, only imperfectly accounts for layoff risk.

This paper identifies and quantifies two key sources of subsidy under Wisconsin-style systems of UI finance. The first source is the effective system of interest-free lending to firms, particularly to those with negative reserve account balances. After UI benefits are claimed by a firm's former workers, the firm is only required to replenish a small portion of its reserve account every year. This spreads the effective cost of those benefits over a long time horizon. The net present value of these future payments is often minute in comparison to the amount of benefits paid. Generically, this temporal diffusion of costs is a normal function of insurance programs; however, there is a critical distinction between many state UI systems and other forms of insurance. While private insurance providers increase premiums until long-run revenue at least matches long-

run payouts, states face political friction against raising revenue. Over the last fifteen years, this has meant that Wisconsin's UI system has been paying out significantly more than it collects.<sup>103</sup> This has created a subsidy to firms. That subsidy, however, does not affect all firms equally. The second source of subsidy under the UI financing system is firm cross-subsidy. Due to imperfections in the experience rating system, layoff risk is only imperfectly attributed to firms. The effect of this imperfect risk assignment is that volatile firms are typically subsidized by their stable peers. While statute incorporates firm size and (partially) industry into its tax rate assignment formula, the adjustments appear to insufficiently account for the level of risk typical of these firms. Regression results also indicate that industry and size are not the only readily identifiable firm characteristics that are significant predictors of layoff risk. Firm age and location (to a lesser extent) are statistically significantly correlated with cross-subsidy receipt.

This paper makes four primary contributions to the literature on state UI programs and subsidy. First, it identifies the interrelationship between firm cross-subsidy and the general subsidy generated by insufficient revenue collection. Second, the data used in this paper have key advantages over that used in previous literature. Firms' reserve account balance is the best indicator of their historical interaction with the UI system; by observing it directly rather than imputing it over a fixed period of observation, I am able to more completely weigh its value as an indicator of subsidy and to capture relevant variation in regression analysis. Additionally, by observing the population of UI-subject firms rather than a sample, I am able to avoid sample-construction concerns and to develop more precise estimates regarding smaller subsamples.<sup>104</sup> Third, I observe reported firm location and use GIS to incorporate information regarding the

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<sup>103</sup> Newson (2013).

<sup>104</sup> For example, firms in the information services sector represent only 1% of all Wisconsin firms, but I observe more than 800 such firms in the data analyzed, here.

physical location of firms. Finally, I employ evolutionary MTC estimation as an alternative to reserve ratio and Topel-derived MTC estimates. While reserve ratio contains information on the history of the firm, its value tends to be heavily impacted by recent employment changes. Topel-derived MTC projects the single-period tax implications of marginal UI payments into the infinite future, which may also over-weight present-period firm characteristics. Evolutionary MTC, by contrast, more precisely captures the tax implications of marginal UI benefits in each subsequent period. This offers a different picture than previous approaches, particularly of firms where recent layoff experience has diverged sharply from the trend.<sup>105</sup>

This analysis finds that there are several observable firm characteristics that are significantly correlated with firm subsidy, and therefore with firm layoff risk. The state of Wisconsin could adjust its rate-assignment formula to account for these additional characteristics.<sup>106</sup> Such an adjustment would more perfectly account for the employment volatility and thus UI-benefit claim rates of firms in the state. In general, this would make labor less costly at firms with more stable labor-demand, and more costly elsewhere. The overwhelming conclusion of previous literature, including Feldstein (1976, 1978), Topel (1983, 1984), Anderson & Meyer (1993), and Reynolds & Udalova (2015) is that layoffs are reduced when firms are responsible for paying a greater share of the benefits claimed by their former workers. Reducing the number of layoffs in the state would have the additional benefit of decreasing payments out of the UI system, which would improve overall system solvency.

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<sup>105</sup> Construction industry firms are the clearest example of this difference in this data. Evolutionary MTC predicts that the mass of recent layoffs in the industry will lead to atypically large and persistent increases in UI taxes over several years. Topel-derived MTC assumes that UI tax increases for construction firms will be identical to tax increases for other firms, controlling for wage- and employment-growth rates.

<sup>106</sup> In addition to reserve ratio, firm size, and construction-industry participation for firms less than three years old.

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