Cash and Tax Evasion

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Economists and public policy experts contend that paper currency facilitates tax evasion. However, due to the illicit nature of tax evasion, there is limited empirical evidence documenting or quantifying this claim. I use the staggered implementation of the Electronic Benefit Transfer program to identify a decrease in local cash circulation that holds constant the level of true income to provide empirical evidence on the role of cash in tax evasion and offer valuable magnitude estimates. The Electronic Benefit Transfer program replaced cash-based government distributions with an electronic system. I use the staggered implementation within Missouri to estimate an increase in reported taxable *sales* of $3.84 to $8.50 for every dollar replaced with electronic payment. Next, I use the staggered implementation of the EBT program across all states to estimate an increase in reported taxable *income* of $0.56 to $1.15 per replaced dollar. Overall, my results suggest that cash transactions are an economically significant means by which small businesses evade both income and non-income taxes, and that a reduction in cash could meaningfully improve tax compliance.

Keywords: cash; paper currency; tax avoidance; small business; electronic benefit transfers

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1. Introduction

Economists and public policy experts argue that paper currency (i.e., Federal Reserve Notes) facilitates tax evasion because cash transactions are difficult for regulators to trace (Slemrod 2007; Morse, Karlinsky and Bankman 2009).[1] However, providing reliable empirical support for this claim is challenging because of the difficulty in measuring both local cash circulation and concealed tax evasion. Therefore, while there is a general belief that small businesses use cash transactions to underreport income, there is limited empirical evidence and no precise estimates on the effect of cash on tax evasion. Tax enforcement agencies, policy makers, and academics are consequently interested in better understanding the effect of cash on tax compliance. I contribute to this important public policy issue by using a novel setting to provide direct empirical evidence on the role of cash in facilitating both non-income and income tax evasion and by producing estimates of the magnitude of the effect.

It is important to understand how cash contributes to the tax evasion of small businesses for at least three key reasons. First, small businesses are economically significant and the single largest contributor the U.S. tax gap (the level of overall tax noncompliance). Small businesses create 43.5 percent of the private non-farm gross domestic product (GDP) (Kobe and Schwinn 2018) and use cash transactions as a means to underreport income (Bankman 2007). The most recent estimates available from the Internal Revenue Service (IRS) report the gross tax gap is $441 billion for the years 2011-2013. The underreporting of business income by individuals is estimated to be $110 billion or 29 percent of the total net tax gap.[2] This amount is larger than the

[1] Cash is sometimes used when referencing money as a transaction medium, whether digital or otherwise. I use the word "cash" throughout the manuscript to signify U.S. Federal Reserve Notes (i.e. "paper" currency).
[2] See https://www.irs.gov/pub/irs-pdf/p1415.pdf. Throughout this manuscript, "small business" refers to independent sole proprietorships, partnerships, and S-corporations having fewer than 500 employees, based on the definition used by the U.S. Small Business Administration for research purposes.

tax gap of $37 billion attributed to all C-corporations, with large corporations accounting for $26 billion. Quantifying the factors that contribute to the underreporting of small business income is essential for regulators to design procedures that improve compliance and reduce the tax gap.[3]

Second, studying small business tax compliance is important because their tax evasion tactics and opportunities are different than those employed by large firms. Small businesses have different disclosure obligations, audit requirements, and reporting incentives than those of large, publicly traded corporations. While all taxpayers have incentives to reduce taxable income, public corporations are limited by incentives to maintain their reputation or to report higher income on their financial statements (e.g. Graham, Hanlon, Shevlin, and Shroff 2014; Chen, Chen, Cheng, and Shevlin 2010; Mills and Newberry 2001). Small businesses, being mostly privately-held, do not generally prepare audited financial statements unless required by creditors, and do not make them public. Thus, small businesses enjoy a greater opportunity to hide cash revenues without negative reputational or stock market pressures. Despite these important differences, the majority of the accounting tax avoidance literature focuses on public corporations, in part, because of data availability. Evidence on small business tax compliance is useful and important to those who design and enforce tax law relevant to small businesses.

Third, studying cash-based tax evasion is important because cash remains a prominent method of payment despite the rise in alternative transaction methods. According to the 2018 Diary of Consumer Payment Choice, cash is the second most common payment instrument with 26 percent of all transactions, behind only debit transactions with 28 percent. The use of cash is largely confined to in-person payments, which account for 88 percent of all non-bill payments. For in-person payments, cash remains the most common payment method at 35 percent of all

[3] See "That Stubborn Tax Gap" available at https://www.taxpolicycenter.org/taxvox/stubborn-tax-gap

transactions. In-person payments provide a greater opportunity for tax evasion because they produce no paper trail, which make the transactions easier to hide from enforcement agencies (Roth, Scholz, and White 1989). Additionally, a single cash note can be underreported numerous times because the cash can be exchanged from one taxpayer to another multiple times annually.

I use Allingham and Sandmo's (1972) foundational theory on taxpayer compliance to predict that a reduction in cash circulation will cause an increase in tax compliance. The theory states a taxpayer's compliance is affected by their perceived detection probability. Taxpayers use cash to engage in anonymous and virtually untraceable transactions, which decreases the detection probability of associated tax evasion. However, a decrease in cash may not cause an increase in compliance if tax evaders simply switch to alternative payment schemes to continue avoiding detection. Additionally, taxpayers might adjust their reporting behavior and change the percentage of cash transactions they do report. Ultimately, whether, and to what degree, a decrease to cash circulation will improve tax compliance remain open empirical questions.

To examine the impact of cash on tax evasion, I use three unique settings to estimate the variation of cash in the economy. In the first two settings, I use the staggered implementation of the Electronic Benefit Transfer (EBT) program. The EBT program replaced the need for government welfare payments to be made in cash. Instead, the EBT system distributes government funds to recipients' accounts digitally, and the recipients can then use a debit card to pay for products using electronic terminals. The revenues small business taxpayers receive from an EBT card transaction are more difficult to underreport than from cash because there is an associated, electronic record. Using the staggered adoption of the EBT program, I am able to identify changes to cash circulation that are unlikely to be correlated with other economic factors that affect true income.

I first examine the impact of cash on reported quarterly taxable sales, using the staggered adoption of EBT within the state of Missouri. Wright et al. (2017) use this setting to examine the effect of cash on crime. This setting is noteworthy for two reasons. First, it reduces concerns the results are impacted by factors other than EBT implementation because, within state, counties are naturally more economically homogenous. Second, it allows me to estimate the effect of cash on a non-income base, taxable sales, which Missouri reports quarterly.[4] It is valuable to estimate the impact on taxable sales because taxpayers are more likely to underreport taxable income if they are also able to hide the taxable sale, which would produce a verifiable paper trail through the sales receipt. Additionally, it demonstrates cash transactions affect both income and non-income tax evasion, an important distinction as not all jurisdictions have an income tax.

I find, after implementation of digital payment transfers, which average $166 million per quarter, Missouri counties report taxable sales that are higher by $117 per person per quarter. This equates to about a seven percent increase in reported taxable sales or a total increase of $639 million per quarter at the state level. I estimate that reported taxable sales increase by $3.84 to $8.50 for every dollar of payment replaced with digital payment.[5] The multiplier effect comes from the fact that a cash dollar can be passed "underground" from business to business a number of times before it reenters the formal economy.

Next, I use the staggered adoption of the EBT program by all states to examine whether the reduction in cash circulation also leads to a change in reported annual taxable income. The national EBT implementation took place from 1993-2004 and has been implemented in all U.S.

[4] I use the staggered, national implementation of EBT to estimate the impact on reported taxable income. I do not estimate it using a single state because income is reported annually and the Missouri implementation occurred within a twelve month period.

[5] The range of estimates are derived using the amounts distributed under different programs included in the EBT system. I discuss these programs in detail in Section 2.

states and the District of Columbia. I find economically and statistically significant increases in reported taxable income after EBT implementation. Specifically, I find replacing one dollar of cash benefit payment with a digital payment on an EBT card increases reported taxable income by $0.56 to $1.15.

I compare the findings on reported taxable sales and reported taxable income to assess the validity of the magnitudes of the two results. If small businesses do not report revenue from a transaction, they correspondingly do not report the associated expenses because doing so would increase the risk the tax evasion will be discovered (Morse et al. 2009). I reason that when taxpayers begin reporting sales due to EBT implementation, they also begin reporting the related expenses. This indicates the average small business profit margin in my sample period is about 14 percent. I assert this estimate is reasonable and validates the estimated magnitude of the effects on reported taxable sales and reported income from the two settings.

In my final setting, I proxy for cash circulation using the Federal Deposit Insurance Corporation (FDIC) National Survey of Unbanked and Underbanked Households. Underbanked households are more likely to rely on cash as a means of exchange relative to other transaction methods when compared to fully banked households (Apaam et al. 2018). Underbanked households use alternative financial services such as check cashing services that provide payments in cash.

I find that underbanked areas have lower levels of reported sole proprietor income. Specifically, a one standard deviation increase in the percentage of the underbanked population (5 percentage points) is associated with a decrease of $150 in reported income per business. With an average of 77,718 sole proprietor returns filed per MSA-year, that translates to a decrease of

$11.7 million in reported taxable income per MSA, or an average decrease of about one percent of reported income per sole proprietorship.[6]

It is possible that regions with a higher percentage of the population that is underbanked also have lower levels of true income that affect reported taxable income. To provide evidence this is not impacting the results, I replace business income with three different types of income that are more verifiable and therefore unlikely to be impacted by cash circulation in a region: wages, interest, and dividends. As expected, I do not find a statistically significant association with any of these three types of income. These results are consistent with the increased use of cash in an area affecting only lower levels of reported small business income.

The results of my study are of interest to academics, policy makers, and tax enforcement agencies. Enforcement agencies have limited budgets and need to understand the compliance behavior of taxpayers to efficiently assess and collect taxes. This topic is particularly notable now as the IRS seeks to enforce tax compliance for new transaction methods with different levels of verifiability and auditability such as cryptocurrencies. My evidence also supports the speculation of public policy experts that decreasing cash circulation could "have a significant impact on discouraging tax evasion" (Rogoff 2017).

2. Background and hypothesis development

Tax avoidance and tax evasion are prominent areas of research in both the accounting and public economics literatures. The extensive accounting literature on tax avoidance largely finds that firms' tax avoidance and reporting behavior responds to changes in disclosure requirements and public pressure (e.g. Hope, Ma, and Thomas 2013; De Simone 2016; and Dyreng, Hoopes,

[6] In 2017, the total number of returns that reported business or professional net income or loss was 25,952,780 with a total net income of $348 billion reported. My sample has an average of 77,718 returns reporting income per MSA-year. With 258 MSAs included in my sample per year, I cover an average of 20,051,244 returns per year. This indicates my sample covers about 77 percent of the returns filed.

and Wilde 2016). The vast majority of this literature focuses on large, public companies (see Shackelford and Shevlin 2001; Hanlon and Heitzman 2010; and Wilson and Wilde 2018 for reviews of the literature). In part, this focus is due to the fact that these corporations are required to publicly disclose the amount of income tax they pay and owe, which allows researchers the ability to measure tax avoidance activity.

Despite the literature's focus on tax avoidance by large public corporations, it is valuable to study and understand small business tax compliance behavior as well because they represent an economically significant segment of the overall economy. Small businesses account for 43.5 percent of GDP and $1.03 trillion (27 percent) of U.S. individual non-wage income according to the most recent Statistics of Income (SOI) data available for the year 2017.[7] Additionally, small businesses may be more aggressive in tax planning because they do not have the same incentives as public companies to increase reported income for financial statement purposes (Hanlon, Mills, and Slemrod 2007). Therefore, their tax evasion activities are thought to contribute substantially to the tax gap.

The tax gap is the IRS's estimate of the difference between the total taxes owed and taxes paid on time. The IRS began periodically estimating the tax gap in 1979, and continues to adapt the program to provide the most thorough and comprehensive estimates of tax noncompliance. The IRS develops its estimates by combining information from the National Research Program (NRP), formerly the Taxpayer Compliance Measurement Program (TCMP), with information

[7] Data are available from https://www.irs.gov/statistics/soi-tax-stats-individual-income-tax-returns-publication-1304-complete-report#_IndReturns. The $1.03 trillion includes sole-proprietor ($346 billion) and partnership/S-corporation ($680 billion) entities. I include partnerships (S-corporations) because 73 (92) percent have assets under $1 million, indicating the majority are small businesses. There are three sources of individual income larger than individual business income: salaries and wages ($7.6 trillion), capital gains ($854 billion), and pensions and annuities ($729 billion).

from enforcement activities and focused research about a particular source of income, for instance, cash payments.

According to the IRS's most recent estimates, the gross tax gap for the years 2011-2013 is $441 billion, which is almost 20 percent of the $2,242 billion of tax that is paid on time and voluntarily.[8] The tax gap is comprised of three broad types of noncompliance: non-filing ($39 billion), underpayment ($50 billion), and underreporting ($352 billion). Individual business income underreporting represents the single largest contributor to the tax gap, estimated to be $110 billion or 29 percent of the total net tax gap. This is larger than the tax gap attributed to all C-corporations with small and large corporations accounting for $11 billion and $26 billion, respectively. Therefore, quantifying the factors that contribute to the underreporting of income for small businesses is important for designing remedies that can help close the tax gap.

In addition to helping improve tax revenue collection, improved compliance could potentially lead to more efficient capital allocation. When a small business seeks capital funding, they generally rely on their tax return to support loan applications. Consequently, income not reported on the tax return cannot support a bank loan and the taxpayer must rely on personal earnings and savings to fund needed operations. Properly allocating capital to small business is essential for the economy because the "self-employed, 14.6 million in all, represented 10% of the nation's 146 million workers, and they in turn provided jobs for 29.4 million other workers."[9] Inefficient capital allocation stemming from the underreporting of income could be improved through enhancements in tax compliance by better understanding small businesses tax evasion.

[8] The IRS eventually collects an additional $52 billion from enforcement efforts and late payments for a net tax gap estimate of $406 billion.

[9] Pew Research Center analysis using U.S. Census Bureau data. https://www.pewsocialtrends.org/2015/10/22/three-in-ten-u-s-jobs-are-held-by-the-self-employed-and-the-workers-they-hire/

Policy makers and regulators argue that small business use cash transactions as a principal means to evade taxes. This view is consistent with standard economic model of tax compliance formulated by Allingham and Sandmo (1972). They detail that a taxpayer's compliance is impacted by their perceived detection probability, the penalty for evasion, and the tax rate. Because it is difficult for regulators to verify cash transactions, the detection probability of underreporting cash transactions decreases, which increases the utility and ability of taxpayers who use cash to evade taxes.

Cash remains a viable payment option despite advancements in cashless payment alternatives such as debit or credit cards, electronic funds transfers, and other online banking systems (PayPal, Venmo, etc.). According to the 2018 Diary of Consumer Payment Choice, cash is the second most common payment method at 26 percent of transactions, behind only debit transactions at 28 percent. Cash remains the most common method of payment for transaction amounts up to $50 and for all in-person payments. In-person cash payments provide a greater opportunity for tax evasion because they do not produce an auditable paper trail. Additionally, because a single cash note is used in multiple transactions through the course of a year, a note could be underreported in numerous transactions annually. According to a survey by the Federal Reserve, cash is exchanged an average of 55 times per year (Avery 1986).

Estimating the impact of cash on tax evasion remains a difficult problem for researchers because of the nature of the activity. As Slemrod (2016) noted, "empirical analysis of tax evasion is very straightforward, except for two things: (1) you can't measure the right-hand-side variables, and (2) you can't measure the left-hand-side variable." Tax evasion is illegal, so taxpayers necessarily conceal their actions to decrease the probability of detection. The

concealment efforts of evaders limits the ability of interested parties to study and accurately evaluate tax evasion.

Prior literature provides qualitative or indirect evidence on the effect of cash on tax avoidance. Allingham and Sandmo (1972) adapt the economics of crime model from Becker (1968) to provide the foundational economic model of tax compliance.[10] Jackson and Milliron (1986) and Richardson and Sawyer (2001) provide a summary of factors that may affect tax compliance, including age, sex, education, income level, income source, occupation, peer influence, ethics, fairness, complexity, IRS contact, probability of detection, sanctions, and tax rates.[11] Among these factors, the most important determinant of tax compliance is income source.

The IRS's tax gap estimates are commonly cited as support for the importance of income source. Slemrod (2007) notes the "most striking and important aspect of (the tax gap) is the huge variation of misreporting…by type of income." The underreporting of verifiable types of income is relatively low: wages and salaries (one percent), pension annuities (three percent), and dividends (five percent). In comparison, estimated underreporting from nonfarm small businesses is 56 percent, which represent almost a third of all individual income tax underreporting. Cash transactions contribute to the large underreporting of small businesses, but it is difficult to estimate precisely.

Several studies indirectly measure the total effect of cash on the entire underground economy. [12] Feige (1989) estimates the overall size of the underground economy by making the

[10] See Andreoni, Erard, and Feinstein (1998) for a review of theoretical findings on tax compliance.
[11] Additional factors that impact tax compliance include how taxpayers value public goods and political alignment. See Alm, McClelland, and Schulze (1992) and Cullen, Turner, and Washington (2018).
[12] Rogoff (2015) states "(t)he underground economy includes agents evading taxes, laws, and regulations. The size of the underground economy is not known within any precision…" and that "(e)ven with all of the Internal Revenue Service's effort to estimate the tax gap, there is of course a high degree of uncertainty about the exact size of the gap."

assumptions that the majority of unreported economic activity takes place in cash and that there is a base year when all transactions are legally reported. With these assumptions, he estimates the growth in the underground economy by measuring growth in cash holdings. This provides a rough estimate of the underground economy but the assumptions limit the implications for understanding how cash impacts tax evasion. Using a similar change in currency demand model, Tanzi (1980, 1983) examines the ratio of currency to the total money supply (M2) in a regression framework.[13] He then calculates changes in the underground economy using the ratio of currency to the M2 explained by changes in the tax level. This model has been adapted to estimate the underground economy in foreign countries as well (e.g. Hepburn 1992). Although these estimates may be informative, they are difficult, if not impossible, to verify and "cannot provide much of a guidance for policy" (Tanzi 1999).

Perhaps the most direct evidence on how cash payments affect tax evasion is from qualitative analysis. Morse, Karlinsky, and Bankman (2009) conduct field study interviews with 273 individuals including, 92 cash business owners, 149 tax preparers, and 32 bankers to better understand who evades taxes, what taxes they evade, and how they evade. They find that small businesses are less likely to report cash transactions because a perceived low likelihood of detection and penalty. The revealed amount of underreporting could be remarkably high. When asked if small cash businesses report as little as 50 percent of their income, one interviewee responded "50%? No. I'd say 33%." Other interviewees noted that they underreport income to save on income and non-income based taxes, such as sales tax.[14]

[13] The M2 is a money stock measure reported by the Federal Reserve. The M1 includes currency, traveler's checks, and demand deposits. The M2 includes the M1 in addition to savings deposits, small-denomination time deposits (less than $100,000) and balances in retail money market mutual funds.

[14] Discussions with the Texas Associate Deputy Comptroller for Tax confirm that cash transactions can be difficult to trace. For example, many small businesses use multiple cash registers and direct all cash transactions through one register. They then do not record or disclose any of those transactions for tax purposes. This type of evasion is generally only caught through in-person audits.

The authors find taxpayers are able to hide income by relying on "parallel cash economies." A parallel cash economy is a system whereby the businesses do not report cash revenue but they also do not report the associated expenses. They use the cash received to subsequently purchase supplies and inventory from their dealers off the books. Several accountants told the study's authors "If you are going to cheat, cheat on the income side or cheat on the deduction side, but not both." Their interviews confirm assumptions that small business do not report all of their gross income from cash transactions, and that the cash is passed "underground" from business to business.[15] However, they cannot quantify the degree to which cash contributes to tax evasion.

I seek to add to our understanding of the tax compliance of small businesses by examining the effect of cash on reported taxes. I examine effects on total reported taxable sales, because those affect both non-income and income based taxes, and on taxable income, which affects income tax directly.

2.1 Electronic Benefit Transfers (EBT)

I use the staggered adoption of EBT programs to capture a change in cash circulation in a particular region that is plausibly orthogonal to consumer spending and true income levels. The first test uses cross-time and cross-county variation of transfer payments within Missouri. The second test uses cross-time and cross-state variation of transfer payments across all states.

The EBT system is an "electronic system that allows a recipient to authorize transfer of their government benefits from a Federal account to a retailer account to pay for products received."[16] EBT was established as an alternative government payment issuance platform on

[15] The interview findings are also consistent with the empirical findings of Slemrod, Collins, Hoopes, Reck, and Sebastiani (2017). The authors find that after sole proprietorships are subject to a new information reporting requirement to the IRS, the businesses' increase in reported revenues are largely offset by an increase in reported expenses.

[16] U.S. Department of Agriculture https://www.fns.usda.gov/snap/ebt

November 28, 1990 as part of the Mickey Leland Memorial Domestic Hunger Relief Act of November 28, 1990 (P.L. 101-624). Three years later, on August 10, 1993, the Conference Report for the Omnibus Budget Reconciliation Act of 1993 (P.L. 103-66) recommended the Secretary of Agriculture encourage State agencies to adopt EBT systems. The EBT system's implementation at the state level began with Maryland in 1993 and concluded with California in 2004. It is now used in all 50 States, the District of Columbia, as well as several U.S. territories.

There are several welfare programs available through the EBT system. By far, the most common and economically significant are the Supplemental Nutrition Assistance Program (SNAP) (formerly referred to as food stamps) and the Temporary Assistance for Needy Families (TANF). SNAP is available through EBT in all 51 jurisdictions and TANF is available through EBT in 38 jurisdictions. Smaller state programs, such as Washington's 'Aged, Blind, or Disabled' program, are also sometimes available through EBT.[17] See Appendix A for the programs available through each state's EBT program.

Among the federal and state programs available through EBT, the transition of TANF to electronic transfer provides the most direct mechanism through which jurisdictions experienced a decrease in cash. Prior to the EBT system, TANF benefits were paid by paper check. Recipients would subsequently cash their government checks and use cash as their primary means of transaction. SNAP benefits were previously distributed as food stamps, a paper coupon-based transaction medium. While recipients had no legal means to convert their stamps to cash, they often illegally converted them to cash to purchase goods or services not permitted under the food stamp program (e.g. Pulliam 1997; Macaluso 2000; Schanzenbach 2007). A principal reason for

[17] "The Aged, Blind, or Disabled (ABD) program provides cash assistance to eligible low-income adults who are age 65 or older, blind, or determined likely to meet Supplemental Security Income (SSI) disability criteria based on a physical or mental impairment that is expected to last at least 12 consecutive months." https://www.dshs.wa.gov/esa/program-summary/aged-blind-or-disabled-abd-cash

the implementation of the EBT program was to curtail this illegal conversion. Therefore, although there was no legal conversion mechanism, it is possible the transition of SNAP to EBT also contributed to decreased levels of cash.

I use the adoption of the EBT system to identify a decrease to the level of cash that is unlikely to be correlated with other economic factors such as true income levels. I first use the staggered adoption of EBT within the state of Missouri to examine the impact from a decrease to cash on reported taxable sales. Missouri staggered the implementation of EBT adoption by county in eight core phases from June 1997 to May 1998. By examining reported taxable sales, I provide evidence cash directly affects sales tax, which is a non-income based tax, and contributes to income tax. Wright et al. (2017) use this setting to provide evidence that less cash leads to less street crime such as robbery and assault.

Although Morse et al. (2009) document through interviews that cash transactions are less commonly reported, it is not clear that an EBT system will impact tax compliance. If EBT recipients choose to incur withdrawal fees (ATM or otherwise), they can continue to spend their benefits in cash. Thus, businesses would continue to receive cash payments and underreport report the cash income. It is also possible that businesses were reporting a portion of their cash transactions, and they could simply adjust the portion they report in response to an increase in more verifiable payment methods. Although these factors could explain no effect of EBT adoption and reported income, they should not predict a negative association. Thus, I state my first hypothesis in the alternative form.

HYPOTHESIS 1: *Reported taxable sales increase after EBT implementation.*

Next, I use the staggered adoption of EBT across all states to examine the impact on reported taxable income. The national adoption occurred from 1993 to 2004. See Appendix B for

the implementation dates of state EBT programs. The adoption pattern of the states is not associated with geographical clustering or state economic connections. As with the within-state setting, the national adoption is unlikely to be associated with other economic characteristics. Consistent with hypothesis one, I state my second hypothesis in the alternate form.

HYPOTHESIS 2: *Reported taxable income increases after EBT implementation.*

2.2 Federal Deposit Insurance Corporation Underbanked Survey

I obtain my third measure of cash from the FDIC National Survey of Unbanked and Underbanked Households. The FDIC first conducted the household survey in 2009 and continues to do so on a biennial basis with the most recent data available for 2017. The data are available at the state level and for 273 MSAs, which allows for needed variation in my analyses. The survey includes a series of questions to determine an individual's banking status. It also includes questions as to why individuals are underbanked and general demographic information such as age and education levels.

The survey indicates that "18.7 percent of U.S. households were "underbanked" in 2017, meaning that the household had an account at an insured institution but also obtained financial products or services outside of the banking system. Specifically, a household is categorized as underbanked if it had a checking or savings account and used one of the following products or services from an alternative financial services (AFS) provider in the past 12 months: money orders, check cashing, international remittances, payday loans, refund anticipation loans, rent-to-own services, pawn shop loans, or auto title loans." (Underbanked Executive Summary 2017).

Underbanked households are more likely to rely on cash as a means of exchange relative to other transaction methods. According to the FDIC survey, 26.2 percent of underbanked households pay bills with cash and 41.3 percent receive income in the form of a paper check or cash. I use the underbanked rate to proxy for the relative cash circulation within an MSA. I use

underbanked households instead of unbanked because I am better able to capture the effect of their cash spending on reported income for two reasons. First, the percentage of underbanked households is significantly larger than unbanked households (18.7 percent compared to 6.5 percent). Second, compared to unbanked households, underbanked households have significantly higher levels of income with approximately 55.8 percent having an income above $30,000. Although an increase in cash circulation could affect tax compliance, the economic effect of underbanked households might be relatively small and difficult to detect in large-sample analyses. As before, these factors could explain no effect of on reported income, but they should not predict a negative association. Thus, I state my third hypothesis in the alternative form.

HYPOTHESIS 3: *The percentage of underbanked households is associated with lower reported small business income.*

3. Data and sample selection

The data for my tests come from several different government agencies, including the IRS, the Bureau of Economic Analysis (BEA), the FDIC, the U.S. Department of Health & Human Services' Office of Family Assistance, the U.S. Department of Agriculture, and the Missouri Department of Revenue. In total, across my analyses, the data are collected and reported from 1990 to 2015 and contain income data from individual tax returns. For each set of analyses, data are aggregated at either the county or MSA level.

The staggered EBT adoption in the state of Missouri occurred from June 1997 to May 1998. Figure 1 depicts the counties of Missouri and the date each adopted the EBT program. I collect taxable sales data reported quarterly from the Missouri Department of Revenue from January 1995 to December 2000 to provide sufficient data pre and post implementation for my analysis. See Table 1, Panel A for my sample construction. I collect the data for all 115 counties

for a total of 2,760 county-quarter observations. I drop 24 county-quarters missing economic profile data from the BEA, for a total sample of 2,736 county-quarters. My final sample covers 114 counties per quarter for a coverage of over 99 percent of the counties in Missouri.

The staggered national EBT adoption occurred over a period of 12 years; Maryland was the first state to adopt in 1993 and California was the last state to adopt in 2004. Figure 2 depicts the number of state adoptions of EBT programs by year. The largest number of states that adopted an EBT program in a single year was 14 in 1998. I gather implementation dates from the U.S. Department of Agriculture's EBT Status Report. I collect components of taxable income measures from the IRS SOI for the years 1990 to 2007 to provide sufficient data pre and post implementation covering 18 years. See Table 1, Panel B for my sample construction. I collect data for each available county for a total of 56,400 county-year observations. I then drop county-years missing information from the IRS and BEA to conduct my analyses. This leaves me with a total of 55,338 county-years, indicating my sample covers about 97.8 percent of the counties in the U.S.[18]

To provide magnitude estimates on the effect of cash on tax evasion, I collect the amount of money distributed through the SNAP and TANF programs from the U.S Department of Agriculture and the Office of Family Assistance. In Appendix C, I detail total average expenditures by state. Average annual (from 1997-1999) expenditures from SNAP and TANF are $17.4 billion and $21.4 billion, for a total of $38.7 billion distributed. As expected, states with the largest expenditures include California and New York, and states with the smallest include Idaho and Wyoming.

[18] This estimate is based off the U.S. Geological Survey report that there are a total of 3,142 counties in the United States.

I collect data on the number of underbanked households from the FDIC National Survey of Unbanked and Underbanked Households. Table 1, Panel C reports the sample construction for my underbanked sample. The FDIC survey is conducted on a biennial basis starting in 2009. I collect income measures from the SOI at the county level and match to the FDIC survey at the MSA level using the National Bureau of Economic Research CBSA (Core-Based Statistical Area) to FIPS (Federal Information Processing Standards) County Crosswalk linking table for a total sample of 1,060 MSA-year observations.[19] Starting in 2010, the SOI began reporting components of gross income, which permit more powerful tests of my theory. Thus, I begin the underbanked sample with the 2011 biennial survey and end in 2017, the most recent year for which both the FDIC survey and SOI data are available. I remove observations missing sufficient data from the FDIC for a final sample of 1,032 MSA-years.

4. Empirical design and results

4.1 Staggered EBT Implementation within Missouri

I test hypothesis one examining the impact of the staggered EBT implementation in Missouri on reported taxable sales using the following OLS pooled, cross-sectional regression:

$$TAXABLE\ SALES_{cq} = \beta_0 + \beta_1 EBT_{cq} + \gamma ECONOMIC\ PROFILE_{cq} + \varepsilon_{cq} \quad (1)$$

The outcome variable is the taxable sales reported in county *c* during quarter *q* divided by the number of persons in the county. My variable interest (*EBT*) is an indicator equal to one for all county-quarterly reporting periods ending after the implementation of the EBT program in that county. H1 predicts *EBT* will be positively associated with *TAXABLE SALES*. A significant coefficient on *EBT* indicates reported taxable sales increased because of the decrease in cash

[19] The linking table is available at https://www.nber.org/data/cbsa-fips-county-crosswalk.html

caused by the EBT program implementation. The magnitude of the coefficient measures the economic effect of the change in cash.

The EBT program implementation occurred within a 12 month time period in Missouri, which should lessen concerns results are affected by correlated-omitted variables between counties because, within-state, the county economics profiles are likely more homogenous. Equation (1) includes a vector of control variables (*ECONOMIC PROFILE*) measured at the county level to further control for the economic traits of a county that could impact reported taxable sales. I include a series of variables to control for different types of income that impact purchasing power and spending behavior. *WAGE* is the amount of wages and salaries (in thousands) divided by the population. *RETIREMENT* is the amount of retirement income (in thousands) transferred from businesses or governments, including retirement and disability insurance benefits, divided by the population. *DIVIDENDS AND INTEREST* controls for the amount of personal income from dividends, interest, and rental properties (in thousands) divided by the population. *SUPPLEMENTAL* is income from employer contributions to government social insurance and pension plans (in thousands) divided by the population. *TRANSFER RECEIPTS* represent income for which no current services are performed, such as unemployment insurance benefits and gifts (in thousands), divided by population. Overall, I would expect all these income numbers (per person) would be positively associated with taxable sales. However, retirees and high-wealth individuals spend a much lower proportion of income on taxable purchases, so I expect *RETIREMENT* and *DIVIDENDS AND INTEREST* to contribute less to taxable sales. I also include *EMPLOYMENT* to control for the employment rate, defined as the total number of jobs divided by the population. *EMPLOYMENT* rate should be positively associated with taxable sales per person, because people spend more when the local economy is

doing well. Finally, I include *POPULATION* to control for the total population (in thousands) of all civilian and military persons in a county. I expect *POPULATION* to be weakly positively associated because prosperous economies attract businesses and people. In certain specifications, I also include county and year fixed effects.

Table 2, Panel A details my summary statistics. The average reported taxable sales per person per quarter is $1,560. Median taxable sales were $1,346 per person per quarter, revealing the Missouri sales data are not markedly skewed between counties. The average (median) population of a county in Missouri for my sample period is 48,067 (18,057), indicating population can vary significantly between counties. Wage income represents the largest source of income with an annual average of $7,420 per person, where person is the entire population, including non-working children and retirees. The employment rate, including all persons, is about 51 percent, which is in line with the national average.

Table 3, Panel A displays Pearson and Spearman correlations. As expected, *TAXABLE SALES* is generally positively correlated with the different types of income, including *WAGE* and *DIVIDENDS AND INTEREST*. Two of the income variables are negatively associated, providing preliminary evidence that different types of income have a differential impact on spending behavior and taxable income.

In Table 4, I detail the results of my tests of hypothesis one. In Column 1, I include my full set of control variables, but I do not include county or year fixed effects. The coefficient on *EBT* of 60.22 is positive and significant (*p-value* < 0.01). This indicates that after the EBT implementation reduced cash, reported taxable income increased by about $60.22 per person per quarter.

In Column 2, I include both county and year fixed effects and the coefficient on *EBT* remains significant (*p-value* < 0.01) at 116.65. This indicates that after EBT implementation, reported taxable sales increased by $116.65 per person each quarter. This change equates to about an eight percent increase in reported taxable sales compared to the pre-period average of $1,472 per person per quarter. In the aggregate, this increase in taxable sales is $639.20 million per quarter at the state level. Based on the current state sales tax rate of 4.225 percent, the EBT implementation in Missouri increased state sales tax revenue by $27 million per quarter.

To provide magnitude estimates on the effect of a decrease to cash to taxable sales, I use the amount of money distributed through the EBT program. In Missouri, on average, SNAP expenditures are $364 million and TANF expenditures are $300 million, annually. I compare these dollar amounts to the total increase in reported taxable sales to determine the impact of a decrease to cash circulation on tax compliance. As I discussed in Section 2, shifting TANF payments to EBT caused a direct decrease in cash, therefore, I assume transitioning TANF payments to EBT caused a dollar for dollar decrease to cash. However, it is less clear how much SNAP's transition to EBT decreased cash because there is no legal mechanism for conversion from SNAP to cash pre-EBT. Therefore, I develop a range of estimates based on different assumptions about the effect on cash of SNAP's transition to EBT. I assume the effect of SNAP on cash could range from no effect to a dollar for dollar decrease. In other words, I estimate a direct decrease to cash circulation ranging from $301 to $666 million per year after EBT implementation. Using this range of estimates, I calculate that by transition a dollar of cash payment to a dollar of digital payment, reported taxable sales increase by $3.84 to $8.50.

4.2 Staggered EBT Implementation Nationally

Next, I test hypothesis two examining the impact of the staggered, national EBT implementation on reported taxable income using the following OLS pooled, cross-sectional regression:

$$GROSS\ INCOME_{cy} = \beta_0 + \beta_1 EBT_{cy} + \beta_2 ECONOMIC\ PROFILE_{cy} + \varepsilon_{cy} \quad (2)$$

The outcome variable is the natural log of gross income reported by the IRS in county *c* during year *y*. Unfortunately, the IRS does not separately report all components of gross income during my sample period for EBT implementation. See Figure 3 for a timeline of my sample periods and data availability. Ideally, I would prefer to separately test for the hypothesized effect on Schedule C Self-Employment income, with a falsification test of no-effect on wages, interest, and dividend income; however, that is not possible during the EBT sample period. My variable interest (*EBT*) is an indicator equal to one for each full county-year after the EBT program was implemented. As in Equation 1, a significant coefficient on *EBT* indicates reported taxable income was impacted by the decrease to cash caused by the EBT program implementation. The magnitude of the coefficient measures the economic effect of the change in cash.

I include the full set of country-year control variables (*ECONOMIC PROFILE*) from Equation (1). The national implementation occurred between 1993 and 2004, spanning the 1997-1998 period of the Missouri implementation. Therefore, I inflation adjust all per-capita dollar amounts to the midpoint year 1998, using the Consumer Price Index Inflation Calculator from the Bureau of Labor Statistics. This allows me to compare real dollar effects across my sample period. In certain specifications, I include county and year fixed effects.

Table 2, Panel B details my summary statistics. The national summary statistics are comparable similar to those of the Missouri sample. Wage income is again the largest source of income with an average (median) annual amount of $9,162 ($8,039). The employment rate is

very similar at around 51 percent. The average county population of 88,500 people is larger than the Missouri sample. Medians reveal that population levels can vary significantly, but the income data are not markedly skewed between counties. Table 3, Panel B displays Pearson and Spearman correlations. Correlation findings are consistent with the within-Missouri sample.

In Table 5, I detail the results of my tests of hypothesis two. In Column 1, I include my full set of control variables, but I do not include county or year fixed effects. The coefficient on *EBT* of 0.098 is positive and significant (*p-value* < 0.01), which indicates that reported taxable income did increase, on average, after the national EBT implementation. In Column 2, I include both county and year fixed effects and the coefficient on *EBT* of 0.005 remains significant (*p-value* < 0.1) although the magnitude of the effect decreases. The coefficient indicates reported taxable income increased by about half a percent, on average, after EBT implementation.

I again develop my range of magnitude estimates from the SNAP and TANF expenditures transferred to the EBT program. However, not all states make TANF payments available through their EBT programs. Therefore, my estimates on the decrease to cash range from $19.1 billion, which includes only states where TANF payments are available through EBT, to $38.7 billion that includes all states' SNAP and TANF payments. Using these amounts, I calculate that, on average, by changing one dollar of cash payment to one dollar of digital payment, reported taxable income increases by $0.56 to $1.15. This range indicates that because a cash note is spent numerous times throughout the year, it can be underreported in multiple instances. Therefore, by replacing cash with digital currency, the estimated increase in taxable income range exceeds one dollar per replaced dollar.

In Column 3, I test whether the effect on reported taxable income is less pronounced in areas less likely to be affected by the EBT implementation. Counties with higher levels of

income per capita are less likely to receive government welfare payments and might be less affected by the switch from cash payments. To test this, I interact *EBT* with *WAGE* to examine the effect of the EBT transition in wealthier counties. I find the coefficient on *EBT* WAGE* of -0.005 is negative and significant (*p-value* < 0.01), indicating the effect is more pronounced in areas more likely to receive government welfare payments. This evidence is consistent with the decrease in cash circulation affecting the observed increase in reported taxable income.

4.3 FDIC Underbanked Survey

Next, I test hypothesis three by examining the association between under-banking and reported small business income using the following OLS pooled, cross-sectional regression:

$$REPORTED\ INCOME_{mt} = \beta_0 + \beta_1 UNDERBANKED_{mt} + \gamma CONTROLS_{mt} + \varepsilon_{mt} \quad (3)$$

The outcome variable is one of four measures of income reported on an individual tax return. The IRS began separately reporting income types in 2010, so I am able to capture different income measures in this setting because it starts in 2011.[20] *BUSINESS INCOME* is the business income reported on Schedule C (in thousands) on an individual tax return (Form 1040) divided by the number of returns filed that reported business income by MSA. *BUSINESS INCOME* is less verifiable than other forms of income and therefore more likely to be associated with cash circulation. The other three measures of income are all more verifiable and therefore less likely to be affected by cash. *SALARY AND WAGE* is the amount of salary and wage income reported (in thousands) divided by the number of returns reporting wage income. *INTEREST* is the amount of interest income reported (in thousands) divided by the number of returns reporting interest income. *DIVIDENDS* are ordinary dividends reported (in thousands) divided by the number of returns reporting dividends.

[20] The FDIC first administered the underbanked survey in 2009. However, due to the IRS reporting change in 2010, I begin my sample period in 2011 and conclude with the most recent survey data in 2017.

My variable of interest is *UNDERBANKED*, which captures a population that is more likely to rely on cash as a means of transaction. *UNDERBANKED* is measured as the percentage of FDIC survey respondents identified as underbanked by MSA per year. A significant coefficient on *UNDERBANKED* indicates the taxable income reported by small businesses is associated with the cash.

I also include a series of control variables in my analysis to control for other factors available in the FDIC survey data that can affect reported incomes. I control for the average age of survey respondents (*AGE*) because earnings potential fluctuates with age. *AGE* is the average age group of survey respondents within an MSA measured in ten year increments from 15 to 64 and then as 65 years or greater. *EMPLOYMENT RATE* captures the percentage of survey respondents identified as employed because employment status directly affects income. I include *EDUCATION* to control for education level, which is categorized in four groups: no high school diploma, high school diploma, some college, and college degree. Finally, I include the Gross Domestic Product (GDP) of a state, measured in billions of dollars, to control for overall economic activity within a state.

Table 2, Panel C details my summary statistics. The average percentage of underbanked households in an MSA is about 10 percent. Salary and wage income is the largest source of income with the average of $49,502 per reporting tax return. Business income is, on average, $12,355 per reporting tax return. The average age group is from 45 to 54 years old, and the average respondent has received a high school diploma. The employment rate is similar to the previous two settings at 57 percent.

Table 3, Panel C displays the correlation table. *BUSINESS INCOME* is generally positively correlated with the different types of income as well as *AGE GROUP*,

EMPLOYMENT RATE, EDUCATION, and *STATE GDP.* Additionally, it is negatively correlated with *UNDERBANKED,* which provides preliminary evidence in support of hypothesis three.

Table 6 presents the regression results of tests of hypothesis three. In column 1, I test the association with reported *BUSINESS INCOME*. I find the coefficient on *UNDERBANKED* of -2.827 is negative and significant (*p-value* < 0.05), which indicates areas more likely to rely on cash as a means of transaction have lower reported levels of income from small businesses. Specifically, I find that a one standard deviation increase in *UNDERBANKED* is associated with a decrease of $149.83 reported income per business.

I next test whether the association could be affected by economic factors other than cash. To test this, I replace the dependent variable with three different types of income that are more verifiable than business income and so are less likely to be affected by cash. In Columns 2 through 4 the dependent variables are *SALARY AND WAGE, INTEREST*, and *DIVIDENDS*. Consistent with my expectations, I do not find a significant results for any of the more verifiable types of income. This evidence is consistent with lower business income being associated with higher levels of cash, and that the results are not being impacted by other economic factors.

5. Additional analysis

5.1 Falsification using randomized treatment iterations

I next perform a falsification test to address concerns that the increases in taxable sales and taxable income were not caused the EBT implementation. An alternate explanation is that significant results could be found in various assignments of the pre and post indicators on each observation and I am incorrectly attributing the results to the EBT programs. To perform this test I randomly assign pre and post period indicators to observations in both the within-Missouri and national settings. I then re-estimate the baseline regressions with all of the same parameters from

the original analysis. I repeat this analysis over 1,000 total iterations and measure the percentage of estimates that are significant.

In Table 7, Panel A, I report the results from the randomized falsification analysis for the within-Missouri sample. The baseline comparison regression for this analysis is Table 4, Column 2. Consistent with a reduction in cash causing an increase in reported taxable sales, I do not find statistically significant results at the standard levels of significance for the expected percent of iterations. Specifically, I find 99 percent of the iterations are not significant at the same level as my baseline regression, consistent with the EBT implementation causing the higher levels of reported taxable sales.

In Table 7, Panel B, I report the results from the randomized falsification analysis for the national sample. Consistent with the falsification test above, the baseline regression for this analysis is Table 5, Column 2. In this analysis, I find 93.1 percent of the iterations are not significant at the same level as my baseline regression. Overall, the results support the conclusion that the EBT system reduced cash causing an increase in reported taxable income.

5.2 Examination of the programs offered through EBT

In my final analysis, I examine the differential impact of SNAP and TANF programs transitioning to the EBT system. As discussed in Section 2, the effect of SNAP's transition to EBT on cash is less clear because there is no legal conversion mechanism from SNAP coupons to cash. Therefore, I split my sample observations into two groups. The first group contains states where both TANF and SNAP payments are available through the EBT programs. The second group contains and states where only SNAP, but not TANF, payments are available. I expect to find a stronger effect in states where TANF is available through the EBT system because of the direct mechanism through which electronic TANF payments reduced cash.

I report the results of my tests in Table 8. In Column 1, I include the county-year observations where TANF is available through EBT. I find the coefficient on *EBT* is positive and statistically significant, and the magnitude of the effect is equivalent to my main analysis. In Column 2, I include only county-year observations where TANF is not available through EBT. I find the coefficient on *EBT* is insignificant with a *p*-value of 0.305.[21] Although the coefficients are not statistically different from one another, this is evidence consistent with the assumption that TANF had a larger effect on cash than SNAP and that the reduction in cash is affecting reported taxable income.

6. Conclusion

Cash plays a significant role in tax compliance. Because of the difficulty in verifying cash-based transactions, public policy experts speculate that cash is used to underreport income to tax authorities. However, due to the concealment activities of tax evaders, studying and quantifying the impact of cash on tax evasion remains a difficult problem. Using several measures of cash circulation, I provide new and important evidence on the impact of cash on tax compliance.

I capture a reduction to cash circulation plausibly exogenous to true income and spending habits using the implementation of the EBT program. I find that when the government replaces cash payments with digital payments, reported taxable sales and reported taxable income both increase. Specifically, I find that, per replaced dollar, reported taxable sales increase by $3.84 to $8.50 and reported taxable income increases by $0.56 to $1.15. I use the FDIC National Survey of Underbanked Households to confirm the effect is concentrated among small businesses, which

[21] In untabulated results, I re-estimate the regression in Column 1 with the sample size adjusted to be comparable to the sample size in Column 2. The results indicate the reduction in significance level of Column 2 is not due to a smaller sample size.

are most likely to be affected by a change to cash circulation. My evidence is consistent with cash being used as method by which taxpayers evade an economically significant amount of tax.

Overall, my results support the claim by public policy experts that a decrease to cash circulation can increase tax compliance. Practicably, a decrease to cash circulation can be used by policy makers in conjunction with other proposals to improve tax compliance. Such proposals include taxing cash withdrawals (Benshalom 2012), enlisting consumers as tax auditors (Naritomi 2019), improving access to mobile banking (Apaam et al. 2018), or eliminating high denomination currency (Sands 2016). My findings can help policy makers as they evaluate how to design systems that will best improve tax compliance.

Appendix A: Programs Available on a State's EBT system

A detailed table of programs that are available through the state's EBT system

State	SNAP	TANF	Other Programs available
Alabama	Yes	Yes	
Alaska	Yes	Yes	
Arizona	Yes	Yes	TRE (Training Related Expenses)
Arkansas	Yes	Yes	
California	Yes	Yes	California Food Assistance Program (CFAP), Work Incentive Nutritional Supplement (WINS), General Assistance, Refugee Assistance, and State Utility Assistance Subsidy (SUAS)
Colorado	Yes	Yes	Child Care, Old Age Pension (OAP), Aid to the Needy Disabled (AND), Aid to the Blind (AB), Health Care Allowance (HCA), SSI-Colorado Supplement (SSI-CS), Low-Income Energy Assistance Program (LIEAP), Child Welfare and Subsidized Adoption
Connecticut	Yes	Yes	State Supplemental (Aid to Aged, Blind, Disabled), State Administered General Assistance (SAGA), Child Support Passthrough, Refugee, and LIHEAP
Delaware	Yes	No	
District of Columbia	Yes	Yes	Refuge Assistance, General Assistance for Children, and Disability
Florida	Yes	Yes	Refugee Cash and E&T support
Georgia	Yes	No	
Hawaii	Yes	Yes	TAONF (Temporary Assistance for Other Needy Families), General Assistance, AABD, Child Care subsidy, and First To Work support services
Idaho	Yes	Yes	
Illinois	Yes	Yes	State-Funded Food Assistance, Aid to the Aged Blind and Disabled (AABD), Refugee and Repatriation Assistance (RRA), TANF Supportive Services, WorkFirst, SNAP Employment and Training, Child Support Pass-Through, & Crisis Assistance
Indiana	Yes	Yes	
Iowa	Yes	No	
Kansas	Yes	Yes	Child Care
Kentucky	Yes	Yes	
Louisiana	Yes	Yes	
Maine	Yes	Yes	State Supplemental benefits
Maryland	Yes	Yes	
Massachusetts	Yes	Yes	Emergency Aid to the Elderly, Disabled and Children (EAEDC), Supplemental Nutrition Assistance (SNA)
Michigan	Yes	Yes	(Family Independence Program), SDA (State Disability Assistance) and LIHEAP (Low Income Home Energy Assistance Program).

Minnesota	Yes	Yes	Minnesota Family Investment Program (MFIP), Refugee Cash Assistance (RCA), General Assistance (GA), Minnesota Supplemental Aid (MSA), Diversionary Work Program (DWP) and Emergency Assistance (EA)
Mississippi	Yes	No	
Missouri	Yes	Yes	
Montana	Yes	Yes	TANF supportive services and Refugee cash
Nebraska	Yes	No	Child Care Time and Attendance
Nevada	Yes	Yes	
New Hampshire	Yes	Yes	Old Age, Aid to Needy, Blind and Disabled, State Funded Food Benefit, and Refugee Cash
New Jersey	Yes	Yes	General Assistance (GA) and e-Child Care
New Mexico	Yes	Yes	General Assistance (GA), Refugee Resettlement , Residential Shelter Care, and Support Services
New York	Yes	Yes	Medicaid, HBE, and HEAP
North Carolina	Yes	Yes	
North Dakota	Yes	No	
Ohio	Yes	No	
Oklahoma	Yes	No	
Oregon	Yes	Yes	Refugee Program, Prison Release Funds, Summer Electronic Benefit for Children, Low Income Heat and Eat Assistance Program and JOBS Participation Incentive
Pennsylvania	Yes	Yes	Cash, General Assistance, SSI, Medicaid
Rhode Island	Yes	Yes	
South Carolina	Yes	No	
South Dakota	Yes	No	
Tennessee	Yes	Yes	
Texas	Yes	Yes	TANF-State Program (TANF-SP)
Utah	Yes	Yes	General Assistance, Emergency Assistance, Refugee Assistance, Medical Transportation, Y and Z Funds, and SSI State Supplemental
Vermont	Yes	Yes	LIHEAP, Fuel benefits (“heat and eat”), cash benefits for renters and those that heat with wood.
Virginia	Yes	No	
Washington	Yes	Yes	State Financial Assistance, Aged Blind and Disabled (ABD), Refugee, Consolidated Emergency Assistance, LIHeap, SSP (State Portion)
West Virginia	Yes	Yes	Child Support
Wisconsin	Yes	No	
Wyoming	Yes	No	

The programs available through each state’s EBT program is available from the United States Department of Agriculture EBT Status Report

Appendix B: Statewide EBT Implementation

A detailed table of the year in which a state's EBT program became operational statewide

State	Year of statewide implementation	State	Year of statewide implementation
Alabama	1997	Montana	2002
Alaska	1998	Nebraska	2002
Arizona	1999	Nevada	2002
Arkansas	1998	New Hampshire	1999
California	2004	New Jersey	1999
Colorado	1998	New Mexico	1995
Connecticut	1997	New York	2001
Delaware	2003	North Carolina	1999
District of Columbia	1998	North Dakota	1997
Florida	1998	Ohio	1999
Georgia	1998	Oklahoma	1998
Hawaii	1998	Oregon	1998
Idaho	1998	Pennsylvania	1997
Illinois	1997	Rhode Island	1998
Indiana	2002	South Carolina	1995
Iowa	2003	South Dakota	1997
Kansas	1997	Tennessee	1999
Kentucky	1999	Texas	1995
Louisiana	1997	Utah	1996
Maine	2003	Vermont	1998
Maryland	1993	Virginia	2002
Massachusetts	1997	Washington	1999
Michigan	2001	West Virginia	2003
Minnesota	1998	Wisconsin	2000
Mississippi	2002	Wyoming	2000
Missouri	1998		

The dates of statewide implementation of EBT transfers are available from the United States Department of Agriculture EBT Status Report

Appendix C: State SNAP and TANF Expenditures

Average SNAP and TANF expenditures per state across 1997-1999.

State	SNAP Expenditures	TANF Expenditures
Alabama	$ 365,530,150	$ 97,497,496
Alaska	50,286,352	72,257,778
Arizona	267,384,754	255,839,322
Arkansas	209,786,978	38,249,765
California	2,062,384,314	5,704,593,095
Colorado	161,221,059	134,025,557
Connecticut	160,243,986	435,051,107
Delaware*	35,765,654	50,376,626
District of Columbia	86,429,373	120,063,334
Florida	906,522,732	704,966,512
Georgia*	553,989,695	405,670,497
Hawaii	182,317,910	127,889,928
Idaho	48,446,736	20,501,664
Illinois	848,176,282	702,247,242
Indiana	270,524,709	233,952,033
Iowa*	112,562,212	158,587,819
Kansas	91,573,111	155,550,055
Kentucky	351,115,025	206,930,213
Louisiana	480,643,527	140,488,131
Maine	97,542,078	113,839,851
Maryland	279,510,665	302,133,952
Massachusetts	229,422,227	686,507,305
Michigan	593,647,140	1,035,648,303
Minnesota	181,678,437	280,601,144
Mississippi*	266,445,271	63,987,779
Missouri	364,769,826	300,738,815
Montana	53,395,322	40,641,572
Nebraska*	68,620,874	83,064,423
Nevada	64,401,018	61,127,712
New Hampshire	32,059,672	67,157,941
New Jersey	392,683,893	490,805,220
New Mexico	152,212,960	125,420,819
New York	1,582,693,316	3,371,482,910
North Carolina	444,662,100	371,941,552
North Dakota*	26,644,051	24,800,408
Ohio*	631,282,547	826,229,208
Oklahoma*	235,953,437	146,988,870
Oregon	201,310,661	289,430,236
Pennsylvania	777,735,505	687,996,404
Rhode Island	62,577,657	131,606,703

South Carolina*	265,253,796	69,974,489
South Dakota*	37,481,516	22,243,083
Tennessee	445,509,172	200,867,990
Texas	1,481,638,731	588,569,868
Utah	75,582,450	94,363,736
Vermont	36,047,158	63,284,292
Virginia*	322,840,887	156,191,796
Washington	317,984,449	524,932,234
West Virginia	223,807,858	75,500,713
Wisconsin*	137,445,172	318,187,261
Wyoming*	21,263,970	6,056,131
Total	$ 17,349,008,376	$ 21,387,060,896
Total available through EBT	$ 17,349,008,376	$ 19,054,702,505

TANF expenditures include both the federal and state maintenance-of-effort (MOE) funds. TANF expenditures are available from the U.S. Office of Family Assistance. SNAP expenditures are available from the U.S. Department of Agriculture. Amounts presented are averaged from the years 1997 through 1999. * indicates TANF payments are not available through the state's EBT program.

Appendix D: Variable Definitions

Variable	Definition	Source[†]
AGE	Average age group of survey respondents by MSA. Age groups are identified in ten year increments from 15 to 64 years and then as 65 years or more.	FDIC
BUSINESS INCOME	Business or professional income amount (in thousands) divided by the number of returns with business or professional income reported by MSA.	IRS
DIVIDENDS	Ordinary dividends amount (in thousands) divided by the number of returns with dividends reported by MSA.	IRS
DIVIDENDS AND INTEREST	Dividends, interest, and rental income amount (in thousands) divided by the number of persons by county.	BEA
EBT	Indicator variable equal to one for time periods after the implementation of an EBT program and zero otherwise.	
EMPLOYMENT	Total employment, number of jobs, divided by the number of persons by county	BEA
EMPLOYMENT RATE	Percentage of survey respondents identified as employed by MSA.	FDIC
GROSS INCOME	Natural log of reported adjusted gross income (in thousands)	IRS
INTEREST	Taxable interest amount (in thousands) divided by the number of returns with taxable income reported by MSA.	IRS
POPULATION	Population in number of persons by county (in thousands)	BEA
RETIREMENT	Retirement income amount (in thousands) divided by the number of persons by county.	BEA
SALARY AND WAGE	Salaries and wages amount (in thousands) divided by the number of returns with salaries and wages reported by MSA.	IRS
STATE GDP	Gross domestic product (in billions) by state	BEA
SUPPLEMENTAL	Supplements to wages and salaries, employer contributions for employee pensions and insurance funds, (in thousands) divided by the number of persons by county.	BEA
TAXABLE SALES	Dollar amount of taxable sales divided by the number of persons by county	Missouri Department of Revenue
TRANSFER RECEIPTS	Transfer receipts, benefits received for which no services are performed, (in thousands) divided by the number of persons by county.	BEA
UNDERBANKED	Percentage of survey respondents identified as underbanked by MSA.	FDIC

WAGE	Wages and salaries amount (in thousands) divided by the number of persons by county.	BEA

†FDIC: https://www.economicinclusion.gov/
IRS: https://www.irs.gov/statistics/soi-tax-stats-county-data
BEA: https://www.bea.gov/data/income-saving/personal-income-county-metro-and-other-areas

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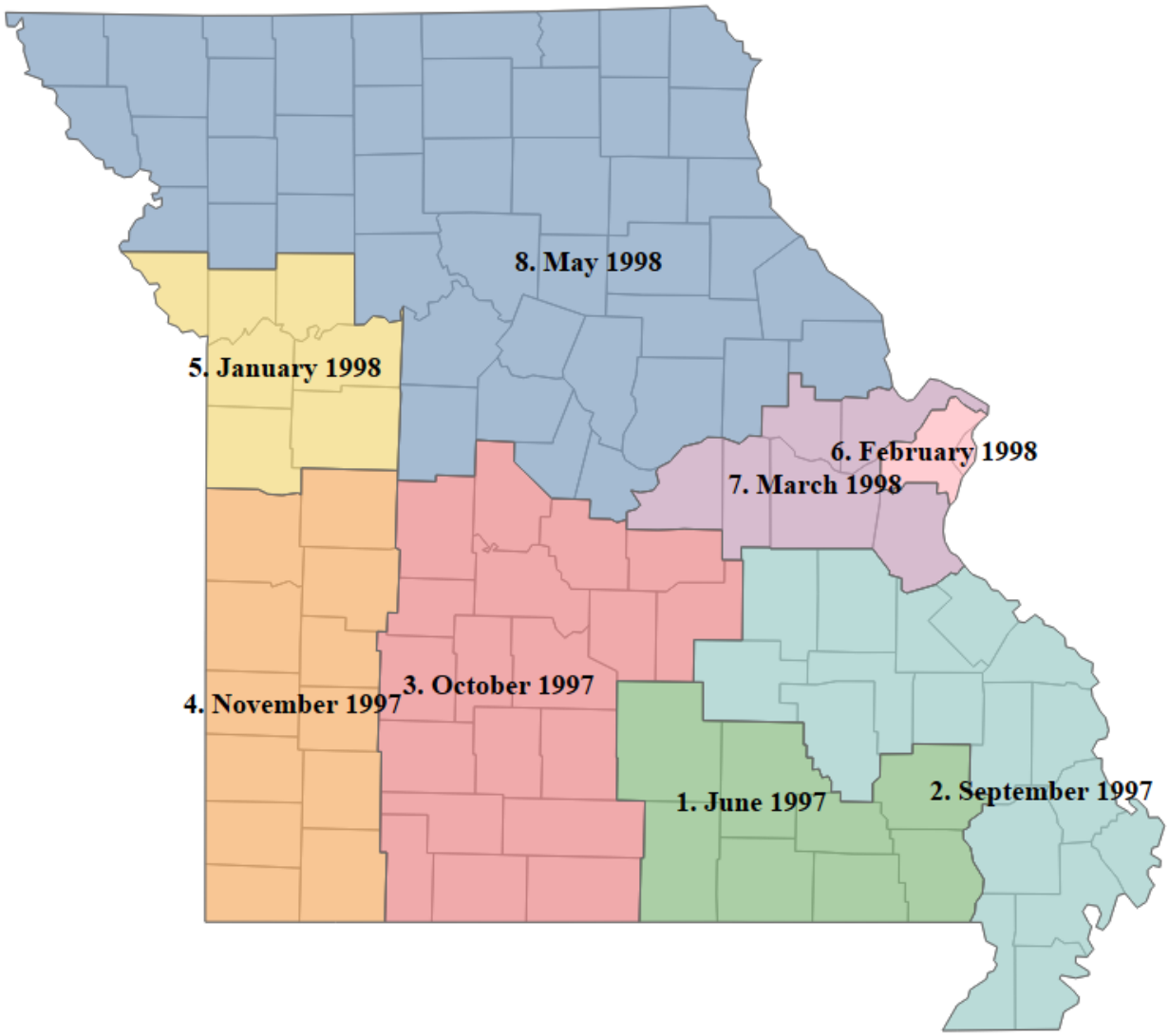
Figure 1
Missouri EBT implementation by county

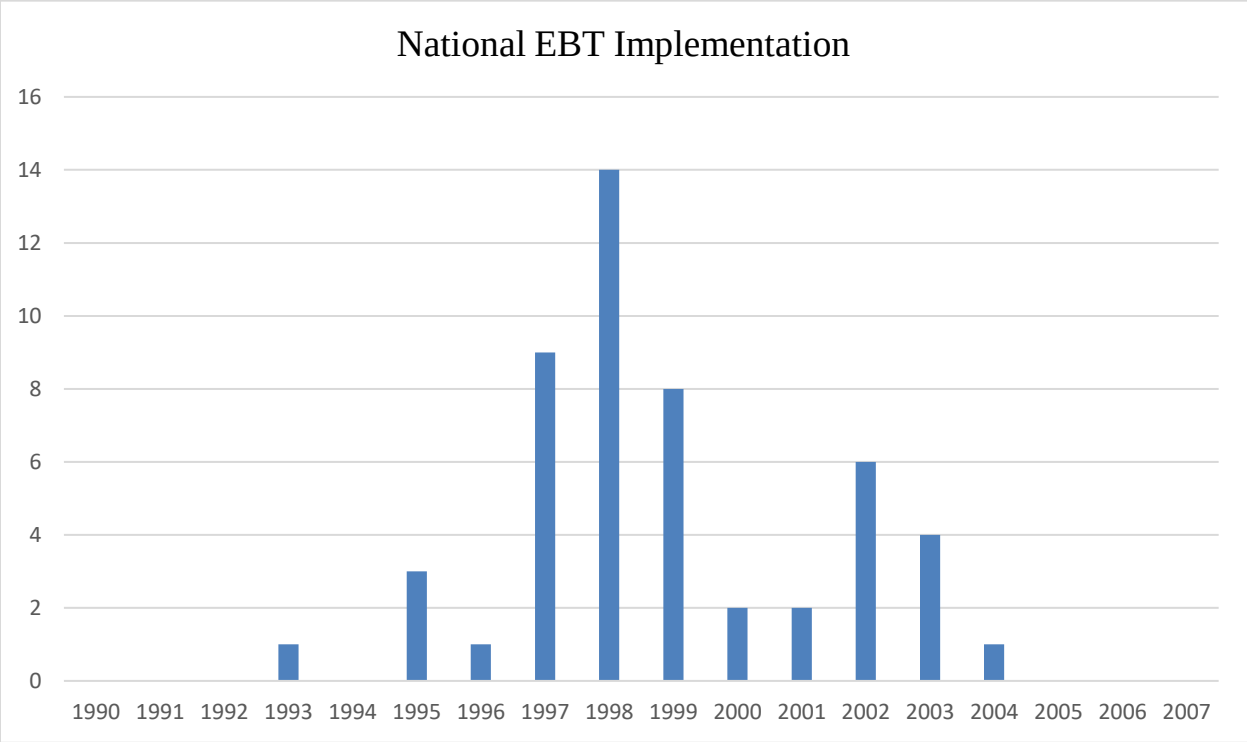


EBT (Electronic Benefit Transfer) Implementation Dates

1. June 1997
2. September 1997
3. October 1997
4. November 1997
5. January 1998
6. February 1998
7. March 1998
8. May 1998

Figure 2

National EBT implementation by number of states that implemented per year



My sample period covers the years 1990-2007. The graph depicts the number of states, including Washington D.C. that implemented an EBT program by year.

Figure 3
Timeline of data availability and sample periods

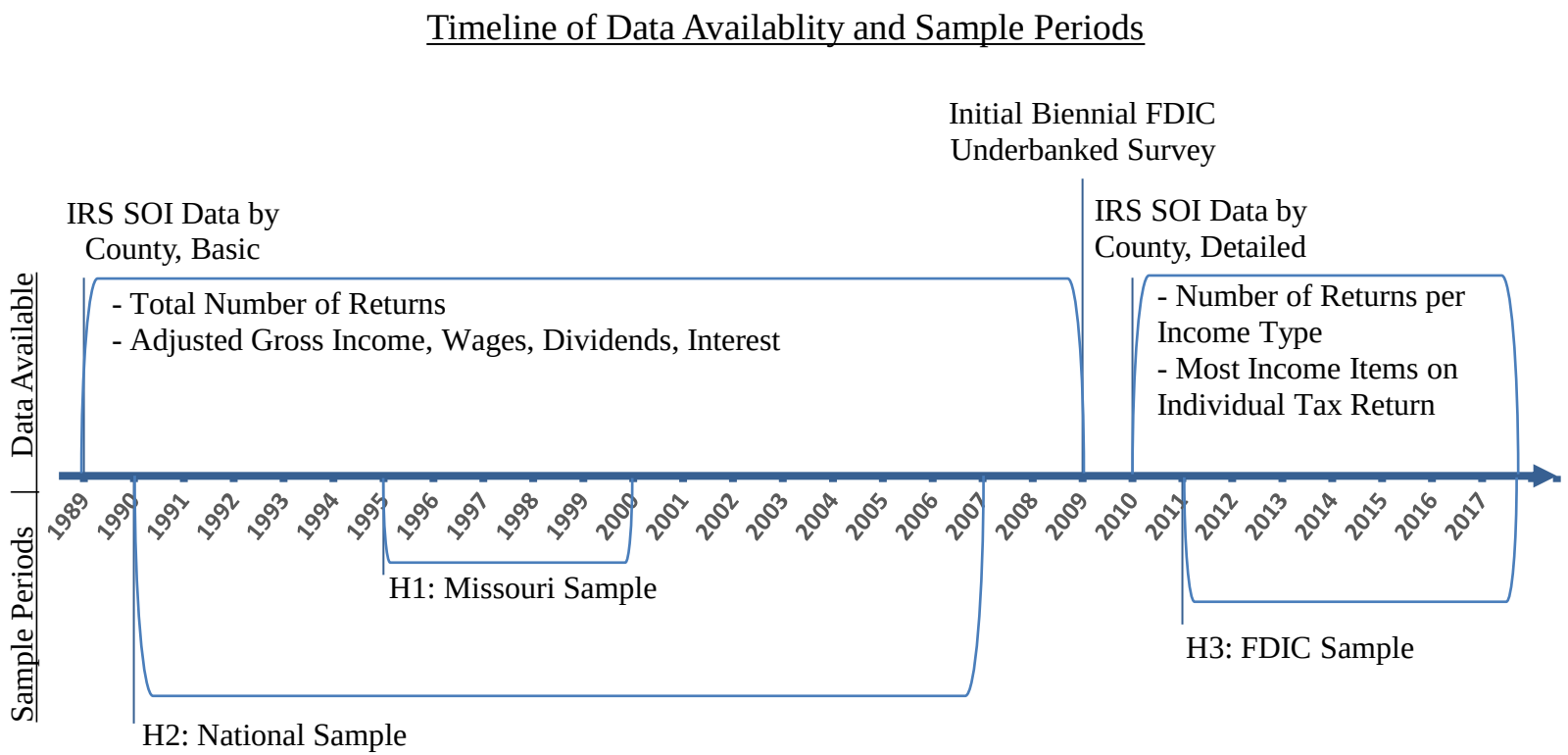


Table 1

Sample construction

Panel A: EBT Implementation, Missouri – for tests of Hypothesis 1

Total county-quarters available from the Missouri Department of Revenue	2,760
Less: missing income data from BEA	(24)
County-years used for estimation	2,736

Panel A: Sample consists of 2,736 county-quarter observations within the state of Missouri from 1995-2000 with sufficient data from the Missouri Department of Revenue and BEA for estimation. My sample contains an average of 114 counties per quarter. There are a total of 115 counties in the state of Missouri.

Panel B: EBT Implementation, United States – for tests of Hypothesis 2

Total county-years available from IRS	56,400
Less: missing tax return data	(40)
Less: missing economic data from BEA	(1,022)
County-years used for estimation	55,338

Panel B: Sample consists of 55,338 county-year observations from 1990-2007 with sufficient data from SOI and BEA for estimation. My sample contains an average of 3,074 counties per year. There are 3,142 counties in the United States according to the United States Geological Survey.

Panel C: Underbanked Sample – for tests of Hypothesis 3

Total MSA-years included in the FDIC survey	1,060
Less: missing underbanked data	(28)
MSA-years used for estimation	1,032

Panel C: Sample consists of 1,032 MSA-year observations from 2011, 2013, 2015, and 2017, years in which the FDIC National Survey of Unbanked and Underbanked Households was conducted. The United States Office of Management and Budget lists a total of 384 MSAs in the United States and the FDIC survey data materials list a total of 301 MSAs.

Table 2

Summary statistics

Panel A: EBT Implementation, Missouri

	Mean	St. dev.	P25	Median	P75
TAXABLE SALES	1559.944	819.192	1026.466	1345.795	1875.966
WAGE	7.420	4.177	4.605	6.320	8.940
RETIREMENT	3.605	0.719	3.100	3.601	4.115
DIVIDENDS AND INTEREST	3.843	1.022	3.109	3.860	4.355
SUPPLEMENTAL	1.821	0.890	1.212	1.585	2.200
TRANSFER RECEIPTS	4.012	0.819	3.456	4.008	4.583
EMPLOYMENT	0.507	0.112	0.429	0.494	0.577
POPULATION	48.067	119.625	10.316	18.057	34.394
N	2,736				

Panel A: Sample consists of 2,736 county-year observations within the state of Missouri from 1995-2000 with sufficient data from the Missouri Department of Revenue and BEA for estimation. Variable definitions and sources are included in Appendix D.

Panel B: EBT Implementation, National

	Mean	St. dev.	P25	Median	P75
GROSS INCOME	12.731	1.586	11.654	12.566	13.632
WAGE	9.162	6.116	5.885	8.039	10.858
RETIREMENT	3.469	0.908	2.843	3.399	4.026
DIVIDENDS AND INTEREST	4.183	2.023	3.013	3.873	4.895
SUPPLEMENTAL	2.287	1.453	1.510	2.046	2.751
TRANSFER RECEIPTS	3.945	1.009	3.261	3.880	4.572
EMPLOYMENT	0.505	0.149	0.410	0.494	0.581
POPULATION	88.500	288.719	10.863	24.289	61.275
N	55,338				

Panel B: Sample consists of 55,338 county-year observations from 1990-2007 with sufficient data from SOI and BEA for estimation. Variable definitions and sources are included in Appendix D.

Table 2 continued

Panel C: Underbanked Sample

	Mean	St. dev.	P25	Median	P75
BUSINESS INCOME	12.355	3.573	10.036	11.831	14.026
UNDERBANKED	0.105	0.053	0.067	0.098	0.133
SALARY AND WAGE	49.502	10.360	43.385	47.746	53.317
INTEREST	1.854	1.014	1.318	1.612	2.080
DIVIDENDS	7.040	4.804	4.834	6.122	7.826
AGE GROUP	4.050	0.314	3.858	4.043	4.227
EMPLOYMENT RATE	0.569	0.090	0.518	0.577	0.626
EDUCATION	2.724	0.234	2.593	2.742	2.868
STATE GDP	664.511	664.389	221.897	432.718	772.477
N	1,032				

Panel C: Sample consists of 1,032 MSA-year observations from 2011, 2013, 2015, and 2017, years in which the FDIC National Survey of Unbanked and Underbanked Households was conducted. Variable definitions and sources are included in Appendix D.

Table 3

Correlation tables

Panel A: EBT Implementation, Missouri

Variable		1	2	3	4	5	6	7	8
1	*TAXABLE SALES*		0.64	-0.07	0.43	0.60	-0.08	0.60	0.37
2	*WAGE*	0.77		-0.08	0.55	0.98	-0.07	0.81	0.64
3	*RETIREMENT*	-0.05	-0.04		0.06	-0.08	0.99	-0.02	-0.19
4	*DIVIDENDS AND INTEREST*	0.34	0.43	0.10		0.52	-0.03	0.61	0.48
5	*SUPPLEMENTAL*	0.73	0.98	-0.04	0.41		-0.07	0.82	0.56
6	*TRANSFER RECEIPTS*	-0.06	-0.06	0.99	0.01	-0.05		-0.05	-0.18
7	*EMPLOYMENT*	0.56	0.78	0.03	0.60	0.78	-0.01		0.37
8	*POPULATION*	0.68	0.59	-0.39	0.09	0.55	-0.37	0.23	

Panel A: This table presents correlations for all variables used in the main regression analysis. Sample consists of 2,736 county-year observations within the state of Missouri from 1995-2000 with sufficient data from the Missouri Department of Revenue and BEA for estimation. Pearson (Spearman) correlations are presented above (below) the diagonal.

Panel B: EBT Implementation, National

Variable		1	2	3	4	5	6	7	8
1	*GROSS INCOME*		0.44	-0.17	0.20	0.38	-0.16	0.15	0.53
2	*WAGE*	0.60		-0.11	0.34	0.93	-0.11	0.80	0.29
3	*RETIREMENT*	-0.19	-0.11		-0.05	-0.06	0.98	-0.05	-0.07
4	*DIVIDENDS AND INTEREST*	0.18	0.38	-0.06		0.27	-0.12	0.48	0.16
5	*SUPPLEMENTAL*	0.56	0.96	-0.03	0.35		-0.06	0.76	0.23
6	*TRANSFER RECEIPTS*	-0.19	-0.13	0.98	-0.16	-0.05		-0.11	-0.05
7	*EMPLOYMENT*	0.16	0.72	-0.02	0.62	0.69	-0.09		0.13
8	*POPULATION*	0.98	0.55	-0.19	0.08	0.51	-0.16	0.09	

Panel B: This table presents correlations for all variables used in the main regression analysis. Sample consists of 55,338 county-year observations from 1990-2007 with sufficient data from SOI and BEA for estimation. Pearson (Spearman) correlations are presented above (below) the diagonal.

Table 3 continued

Panel C: Underbanked Sample

Variable	1	2	3	4	5	6	7	8	9
1 *BUSINESS INCOME*		-0.23	0.65	0.27	0.24	0.11	0.09	0.27	0.29
2 *UNDERBANKED*	-0.22		-0.23	-0.02	-0.06	-0.27	0.09	-0.24	0.00
3 *SALARY AND WAGE*	0.54	-0.24		0.33	0.34	-0.05	0.29	0.47	0.10
4 *INTEREST*	0.08	0.05	0.13		0.60	-0.04	0.10	0.11	0.08
5 *DIVIDENDS*	0.27	-0.12	0.44	0.62		-0.04	0.13	0.13	0.11
6 *AGE GROUP*	0.10	-0.25	-0.07	-0.15	-0.04		-0.49	-0.12	-0.07
7 *EMPLOYMENT RATE*	0.12	0.08	0.38	0.12	0.15	-0.47		0.32	-0.05
8 *EDUCATION*	0.28	-0.20	0.53	0.12	0.24	-0.10	0.31		-0.11
9 *STATE GDP*	0.20	-0.06	0.01	0.03	0.17	0.02	-0.11	-0.12	

Panel C: This table presents correlations for all variables used in the main regression analysis. Sample consists of 1,032 MSA-year observations from 2011, 2013, 2015, and 2017, years in which the FDIC National Survey of Unbanked and Underbanked Households was conducted. Pearson (Spearman) correlations are presented above (below) the diagonal.

Table 4

Reported taxable sales after staggered electronic benefit transfer implementation in Missouri

	(1) TAXABLE SALES	(2) TAXABLE SALES
EBT	60.221***	116.650***
	(5.912)	(6.095)
WAGE	89.680***	81.345***
	(4.303)	(4.710)
RETIREMENT	152.638	54.254
	(0.898)	(0.312)
DIVIDENDS AND INTEREST	0.543	4.479
	(0.016)	(0.160)
SUPPLEMENTAL	-33.385	-59.243
	(-0.555)	(-0.887)
TRANSFER RECEIPTS	-140.067	9.112
	(-0.871)	(0.052)
EMPLOYMENT	341.540	56.674
	(1.138)	(0.304)
POPULATION	0.709*	8.998***
	(1.938)	(5.686)
Observations	2,736	2,736
R-squared	0.408	0.907
County fixed effects	No	Yes
Year fixed effects	No	Yes

This table presents the results of OLS estimates of equation (1), which tests the impact of the staggered EBT program implementation within the state of Missouri on reported taxable sales. My sample consists of 2,736 county-quarter observations from January 1995 to December 2000 with sufficient data for estimation. See Appendix D for all variable definitions and sources. Robust standard errors are clustered at the county level. *, **, and *** indicate statistical significance at the two-tailed 10%, 5%, and 1% level.

Table 5

Reported county income after staggered national electronic benefit transfer implementation

	(1) GROSS INCOME	(2) GROSS INCOME	(3) GROSS INCOME
EBT	0.098***	0.005*	0.054***
	(21.183)	(1.857)	(5.572)
WAGE	0.010*	0.003	0.013***
	(1.658)	(0.988)	(3.536)
*EBT*WAGE*			-0.005***
			(-5.362)
RETIREMENT	0.420***	0.232***	0.214***
	(13.641)	(7.820)	(7.142)
DIVIDENDS AND INTEREST	0.033***	0.027***	0.028***
	(3.086)	(2.911)	(2.998)
SUPPLEMENTAL	0.004	-0.005	-0.012**
	(0.725)	(-0.821)	(-2.131)
TRANSFER RECEIPTS	-0.346***	-0.312***	-0.297***
	(-12.291)	(-11.314)	(-10.582)
EMPLOYMENT	0.277***	0.205***	0.072
	(2.876)	(3.217)	(1.164)
POPULATION	0.002***	0.001***	0.001***
	(5.272)	(4.680)	(4.749)
Observations	55,338	55,338	55,338
R-squared	0.302	0.996	0.996
County fixed effects	No	Yes	Yes
Year fixed effects	No	Yes	Yes

This table presents the results of OLS estimates of equation (2), which tests the impact of the national staggered EBT program implementation on reported taxable income. My sample consists of 55,338 county-year observations from 1990 to 2007 with sufficient data for estimation. See Appendix D for all variable definitions and sources. Robust standard errors are clustered at the county level. *, **, and *** indicate statistical significance at the two-tailed 10%, 5%, and 1% level.

Table 6

The association between the underbanked and income types

	(1) BUSINESS INCOME	(2) SALARY AND WAGE	(3) INTEREST	(4) DIVIDENDS
UNDERBANKED	-2.827**	-1.055	-0.254	1.031
	(-2.195)	(-0.275)	(-0.544)	(0.574)
SALARY AND WAGE	0.139***		0.023***	0.024
	(14.681)		(3.527)	(1.356)
INTEREST	0.549***	2.130***		2.498***
	(3.341)	(4.595)		(11.853)
DIVIDENDS	0.055**	0.073*	0.084***	
	(2.203)	(1.879)	(3.315)	
AGE	0.772***	-1.598**	0.033	-0.050
	(3.501)	(-2.385)	(0.570)	(-0.206)
EMPLOYMENT RATE	0.527	7.923***	0.373	2.476**
	(0.717)	(3.163)	(1.363)	(2.200)
EDUCATION	1.561***	8.627***	-0.525***	-0.019
	(4.864)	(9.428)	(-5.169)	(-0.049)
STATE GDP	-0.002**	0.009**	-0.000**	0.001
	(-2.289)	(2.376)	(-2.087)	(1.253)
BUSINESS INCOME		1.633***	0.071***	0.211***
		(9.904)	(3.393)	(4.668)
Observations	1,032	1,032	1,032	1,032
R-squared	0.790	0.706	0.664	0.555
State fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes

This table presents the results of OLS estimates of equation (3), which tests the association between underbanked households and reported taxable incomes. My sample consists of 1,032 MSA-year observations from the years 2011, 2013, 2015, and 2017, years in which the underbanked survey data are available. See Appendix D for all variable definitions and sources. Robust standard errors are clustered at the MSA level. *, **, and *** indicate statistical significance at the two-tailed 10%, 5%, and 1% level.

Table 7

Falsification tests using randomized iterations of pre/post treatment assignment

Panel A: Randomized iterations of EBT Implementation – Missouri | Table 4, Column 2

Iterated equation	Iterations	Percent of iterations not significant at			
		10%	5%	1%	level of baseline comparison: < 0.01% Table 4, Column 2
Equation (1): **[Hypothesis 1]** Reported taxable sales increase after EBT implementation	1,000	93.10%	97.20%	99.60%	99.90%

Panel A: This is a falsification test for the results presented in Table 4, Column 2 on the EBT Implementation within the state of Missouri. I randomly assign pre and post periods to county-quarter observations and re-estimate Equation 1. I repeat this process for 1,000 iterations and measure the percentage of estimations that were significant at 10%, 5%, 1%, and baseline comparison level. My sample consists of 2,736 county-quarter observations from January 1995 to December 2000 with sufficient data for estimation.

Panel B: Randomized iterations of EBT Implementation – National | Table 5, Column 2

Iterated equation	Iterations	Percent of iterations not significant at			
		10%	5%	1%	level of baseline comparison: 6.3% Table 5, Column 2
Equation (2): **[Hypothesis 2]** Reported taxable income increases after EBT implementation	1,000	88.80%	95.10%	99.20%	93.10%

Panel B: This is a falsification test for the results presented in Table 5, Column 2 on the EBT Implementation nationally. I randomly assign pre and post periods to state-year observations and re-estimate Equation 2. I repeat this process for 1,000 iterations and measure the percentage of estimations that were significant at 10%, 5%, 1%, and baseline comparison level. My sample consists of 55,338 county-year observations from 1990-2007 with sufficient data for estimation

Table 8

Reported county income after electronic benefit transfer implementation

	States where SNAP and TANF are available through EBT	*States where SNAP is available and TANF is <u>not</u> available through EBT*
	(1)	(2)
	GROSS INCOME	GROSS INCOME
EBT	0.005**	0.006
	(2.256)	(1.025)
WAGE	-0.001	0.014*
	(-1.412)	(1.895)
RETIREMENT	0.208***	0.368***
	(11.360)	(7.881)
DIVIDENDS AND INTEREST	0.040***	0.017*
	(9.653)	(1.872)
SUPPLEMENTAL	-0.005	-0.008
	(-1.480)	(-0.201)
TRANSFER RECEIPTS	-0.293***	-0.417***
	(-16.311)	(-9.757)
EMPLOYMENT	0.322***	-0.020
	(7.815)	(-0.164)
POPULATION	0.001***	0.004***
	(13.092)	(4.182)
Observations	41,300	16,954
R-squared	0.996	0.995
County fixed effects	Yes	Yes
Year fixed effects	Yes	Yes

This table presents the results of OLS estimates of equation (2), which tests the impact of the national staggered EBT program implementation on reported taxable income. Column (1) reports the results for observations in states where TANF payments are available through the EBT program. Column (2) reports the results for observations in states where TANF payments are not available through the EBT program. My total sample consists of 55,338 county-year observations from 1990 to 2007 with sufficient data for estimation. See Appendix D for all variable definitions and sources. *, **, and *** indicate statistical significance at the two-tailed 10%, 5%, and 1% level.