PayrollTax

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2023-06-26

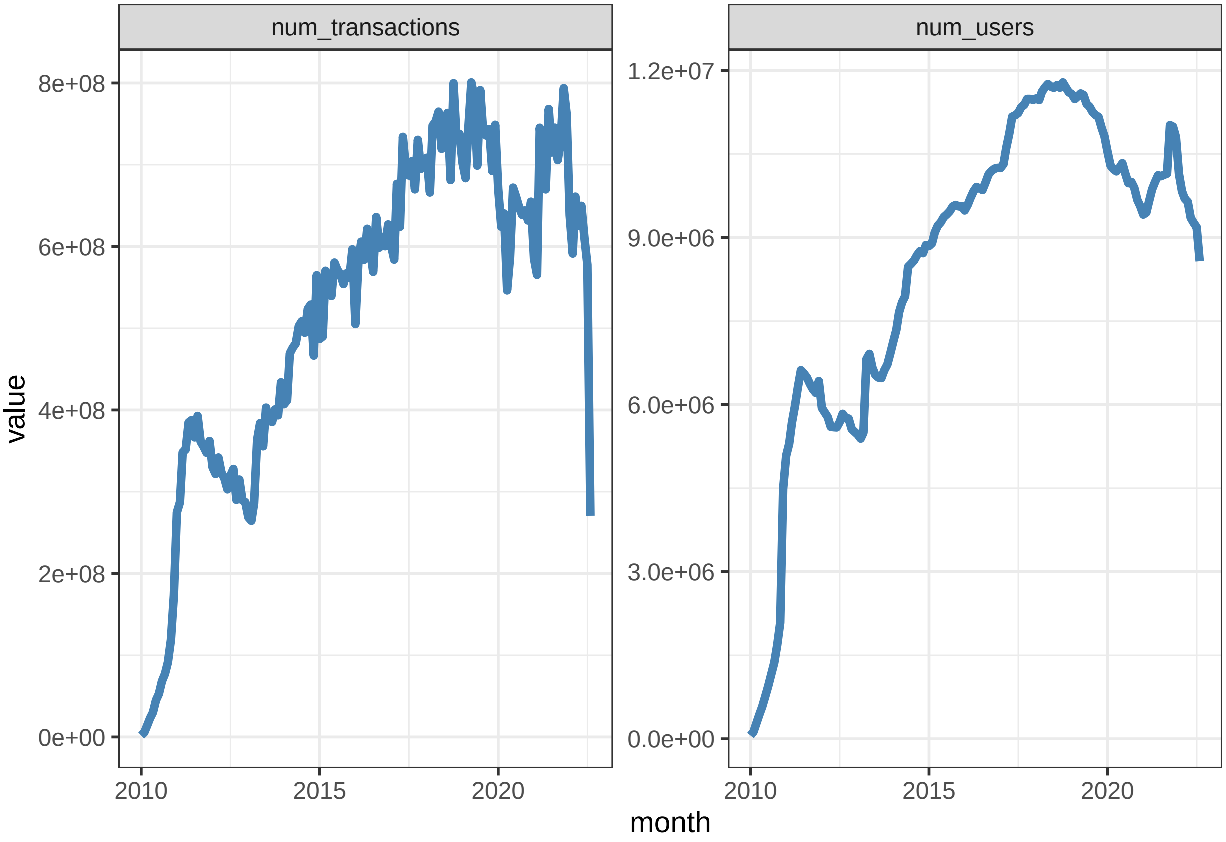
Introduction

Given the importance of carefully constructing the treatment and control groups for this research project, I figured it would be a good idea to write up the procedure and discuss the results all in one document, with particular emphasis on definitions for eligibility and sample sizes.

Simple Data Set Statistics

The Yodlee data set has unique members. We don't exactly know how the number of unique Yodlee members translates to unique human beings or households. Naturally, Yodlee doesn't reveal how they translate their raw data into unique member ids, however we will assume that each unique member id is truly one individual (or perhaps a joint account). Since Yodlee matches across datasets from different banks and credit card companies, they are likely matching on SSNs.

As of the August 2022 Yodlee batch, there are **56,474,837** distinct unique_mem_ids. Below, is the plot showing how the count of unique ids by month changes over time. The sample size grows considerably over time with a few minor dips presumably due to vendor contracts expiring. Throughout our analysis, we may have to make a trade off between length of time considered and sample size.



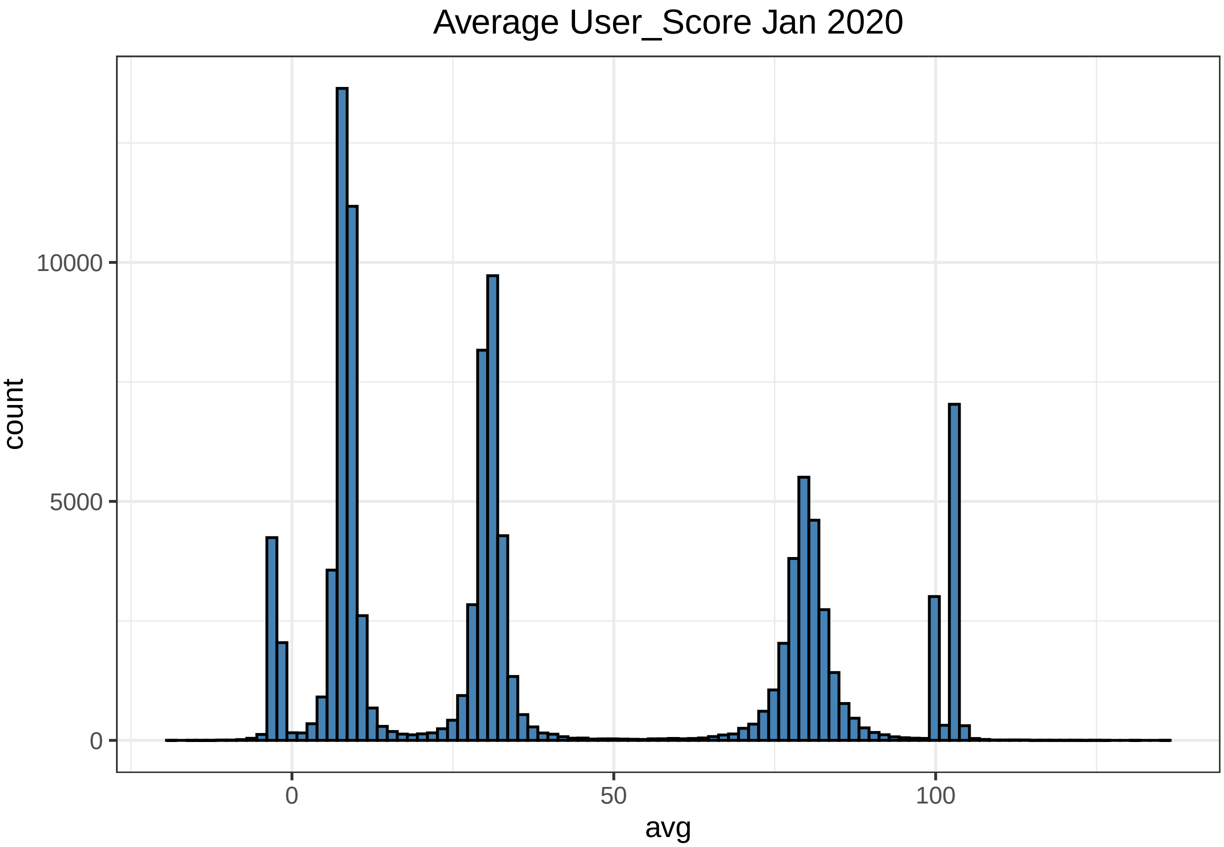
Since we are not able to directly observe whether or not a given user was eligible/enrolled in the Payroll Tax Deferment, we have to infer eligibility from the transaction data and refine our sample so that we have high-quality treatment and control groups. So far, we are working under the assumption that an eligible federal worker is one who:

1. Has an average Yodlee Score of at least 6.5 from September 2018 - present. (This is Yodlee's suggested value for a 'stable' user.) (show distribution of user scores)
2. Has qualifying payment observations (based on description, primary_merchant, and amount fields).
3. Has qualifying payment observations from a single employer at regular intervals (weekly, biweekly, or monthly) for 2 years before the deferal went into effect.
4. Makes between $2,500 - $8666.67 per month ($1,153.85 - $4,000 for biweekly).We rule out individuals making too little as they are unlikely to be engaged in stable, full-time work. Since we only observe paycheck receipts and not gross salary, we further reduce the upper limits to $7,500 and $3,461 to cushion against payroll deductions. (Get feedback on this!)
5. Observe no more than 20% volatility between paychecks to rule out employees with varying hours worked,travel reimbursements,etc.
6. Observe no more than 30% of total inflows from other sources of income (i.e. SSI, Venmo transactions, transfers from other accounts) (Get feedback on this!)
7. Be able to link all credit card payments to credit cards in the Yodlee sample. Otherwise, we will not be observe debt-funded consumption.

A state/local employee, will match the exact same definition but with a qualifying state/local string.

Sample Size Estimates

In this section, I try to estimate what percent of users are disqualified at each successive component of the definition. Starting with a 1% random sample of the 20220816 yodlee panel of transactions on or after '2018-01-01', I have **307,380** unique individuals, **619,830** bank accounts **334,199,899** transactions.



The first layer of filtering is for the user_score. Below, I plot the histogram of the average monthly user_score for January 2020 (a random month before Covid). I'm not sure how Yodlee decides these user_scores, but there are some clear clusters of user_scores. The user_score varies a lot even within a single month (average range of user_score was 45.54). I would love to know why user_scores vary so much in a short amount of time since things like "User History, presence of a linked account, and number of merchants" shouldn't change dramatically in a short amount of time.

After removing all individuals with an average user_score of less than 6.5 over the sample period, we are down to 290,825 users, representing a 5.39 percent reduction in the sample. Perhaps it's worth exploring a higher threshold, especially since the main analysis may involve daily time coefficients.

The second layer of filtering is to sort each individual into federal/state/local based on the description and primary merchant. The full .sql used is included in the appendix, but uses all of the patterns we have found up to this point. After filtering, we are left with 17,400 individuals which represents a 94.02 percent reduction in eligible individuals. 12753 are federal, 1919 are state, and 3203 are local.

I tried to match these figures with outside estimates of the federal/state/local workforce. Despite the lack of a single definition for federal worker, this Brookings piece has similar estimates to our data (~15% in some sort of federal/state/local government, ~6% in federal).

After the third round of filtering, we are left with 3,560 individuals which represents a 79.54 percent reduction in eligible individuals. Most of the reduction is coming from the restriction on having four years of consistent paychecks from a single employer. Should we relax the definition a bit on the pre-period?

I'd be interested to hear your thoughts on whether restricting our analysis to people who do not switch jobs or take side-jobs limits the external validity of our sample. On one hand, a refined sample will allow us to cleanly estimate the effects of the deferral on individual, but on the other hand, we will not be to make strong statements about the overall impact of the program.

After the fourth layer of filtering which classes individuals by income thresholds, we are left with the following number of unique_id_mem's. The proportions seem about right, given that most government employees that have regular paychecks should make between 30,000 - 104,000 USD per year.

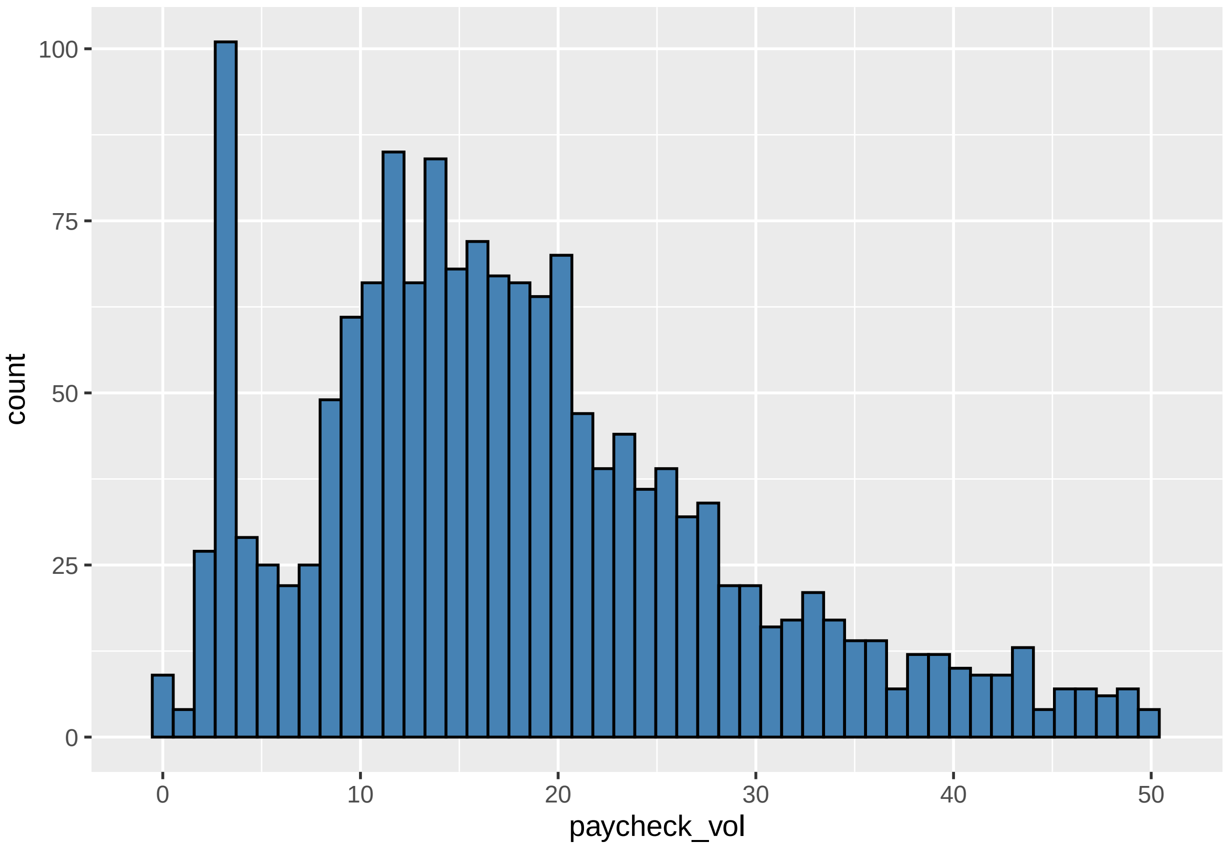
```
## `summarise()` has grouped output by 'elig'. You can override using the
## `.groups` argument.
```

```
## # A tibble: 2 x 4
##   elig   federal local state
##   <chr>    <int> <int> <int>
## 1 elig      1045   164    82
## 2 inelig     324    40    20
```

Below is a histogram of percentage volatility (std(paycheck_amt)*100/mean(paycheck_amt)). The threshold of 20% is entirely arbitrary, so I wanted to show the general distribution. I need to examine these individuals more to see why they have such volatility, but I think it's better to exclude them for now until we can better understand the trends. I'm guessing the common causes for paycheck volatility are pay raises, bonuses (are these common for government employees), changes in withholding, reimbursements, etc.

```
## Warning: Removed 88 rows containing non-finite values (stat_bin).
```

```
## Warning: Removed 2 rows containing missing values (geom_bar).
```



After the fifth round of filtering which removes individuals with high volatility in paychecks, we are left with the following number of individuals in each category.

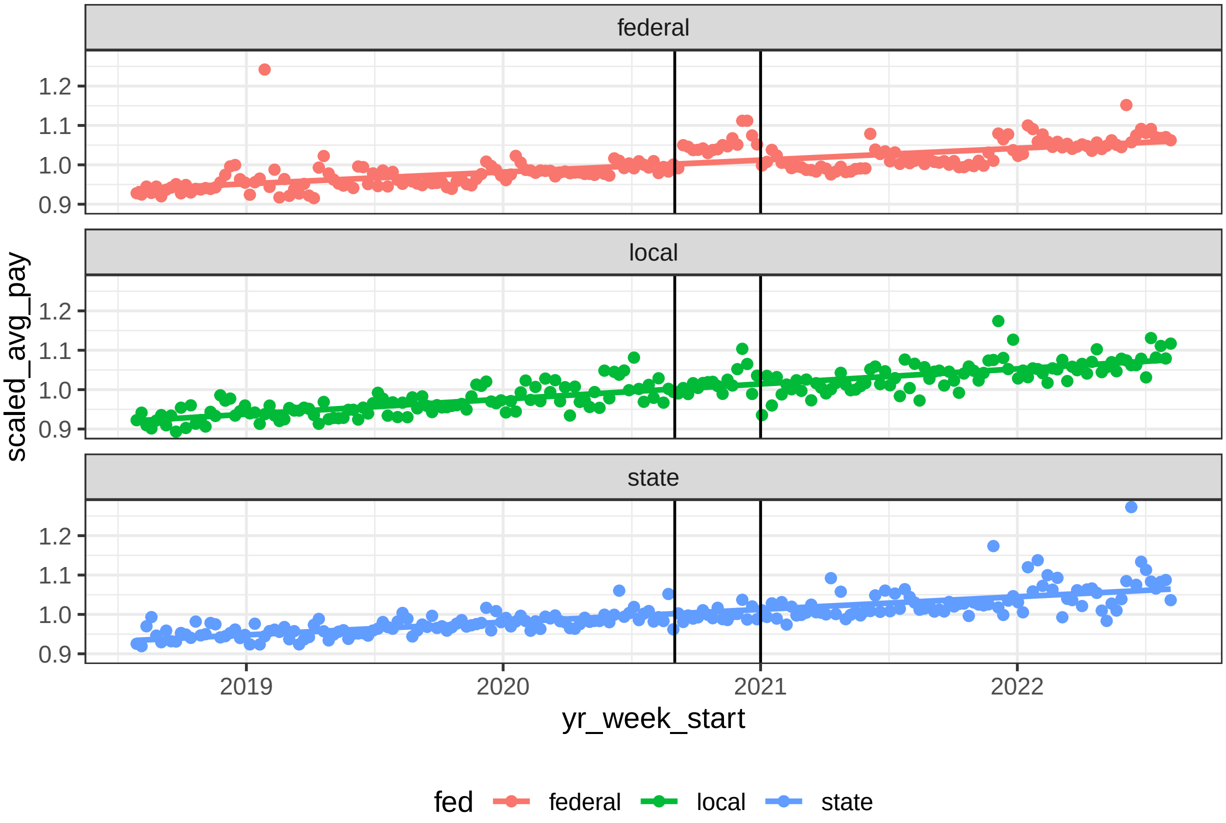
```
## ‘summarise()‘ has grouped output by ’elig’. You can override using the
## ‘.groups‘ argument.
```

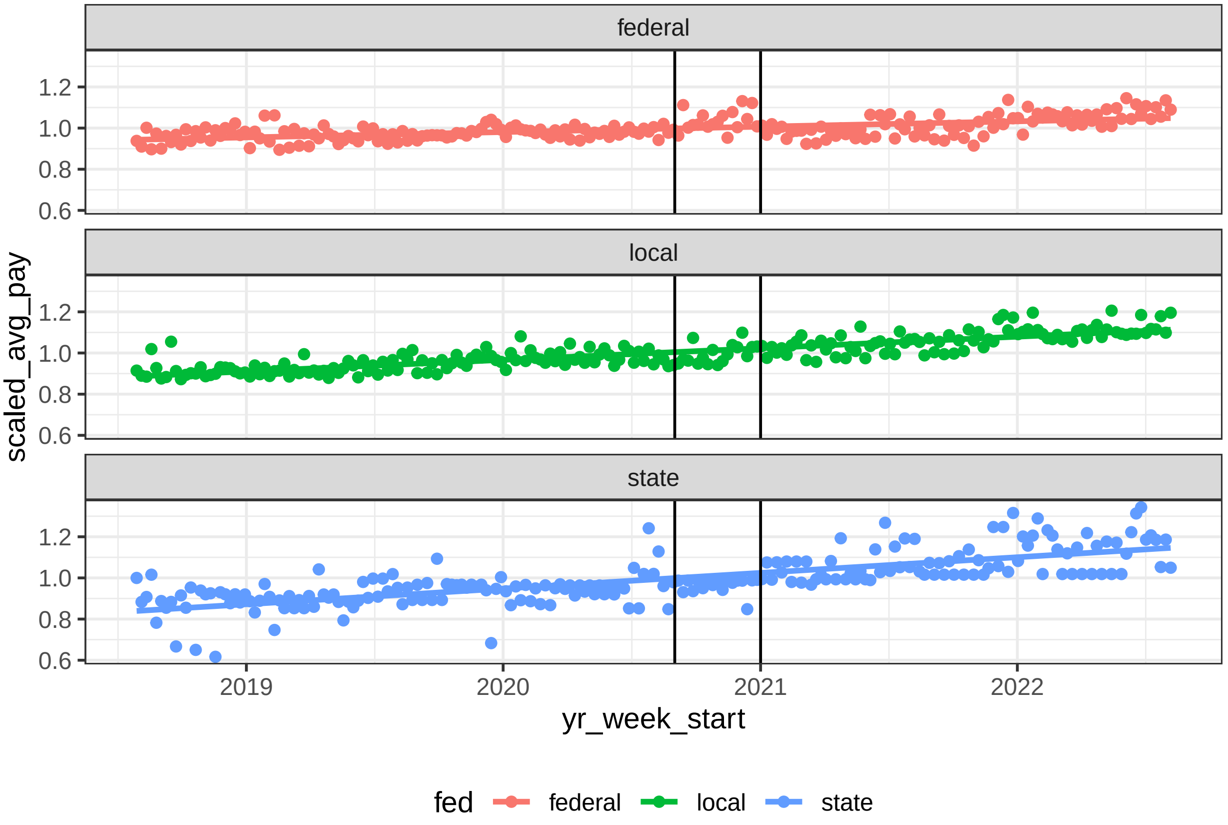
```
## # A tibble: 2 x 4
##   elig    federal local state
##   <chr>     <int> <int> <int>
## 1 elig        649    88    56
## 2 inelig      190    20    13
```

There are two more layers of filter: one for ruling out other sources of income and another for ensuring linkability of Yodlee data. I have some ideas on how to do this efficiently, but I'd like your feedback first.

Key graph

Here is the most important piece of the whole exercise. After all of this cleaning, we need to see if the deferral is visible in a simple weekly aggregate plot, and I think it looks pretty good. The trend is clearly visible for eligible federal employees but absent for state and local employees. However, I'm concerned to see a small increase in the ineligible (due to the salary cutoff) federal employees during the payroll period.





Appendix

```
-- Simple Count for Total Population
select count(distinct unique_mem_id) as num_users
from yi_xpanelov6_20220816.bank_panel

-- Count By Month (saved to count_by_month.csv)
select count(distinct unique_mem_id) as num_users, count(*) as num_transactions, month
from (select substring(optimized_transaction_date, 1, 7) as month, unique_mem_id
      from yi_xpanelov6_20220816.bank_panel) as month_create
GROUP BY month
ORDER BY month

-- Checking if IDs are truly random. They are
select count(*), enddigits
from (select mod(unique_mem_id, 100) as enddigits from yi_xpanelov6_20220816.bank_panel)
GROUP BY enddigits
ORDER BY enddigits

-- Create 1% sample and store in my temp directory
CREATE TABLE temp_132.onepercsample AS (SELECT *
                                        FROM yi_xpanelov6_20220816.bank_panel
                                        WHERE mod(unique_mem_id, 100) = 1
                                          AND optimized_transaction_date >= '2018-08-01')
```

```
-- Count Users/Transactions in the 1% sample
select count(distinct unique_mem_id) as num_users,
       count(distinct unique_bank_account_id),
       count(*)                      as num_transactions
from temp_132.onepercsample

-- User Score Dist (saved to user_score_dist.csv)
select unique_mem_id, avg(user_score), min(user_score), max(user_score), count(*)
from temp_132.onepercsample
where optimized_transaction_date >= '2020-01-01'
  AND optimized_transaction_date < '2020-02-01'
group by unique_mem_id


-- Filter By User Score
-- NB: Next round of filtering uses filter1 as a base table
create table temp_132.filter1 as (SELECT b.*
                                  from (select unique_mem_id,
                                               avg(user_score)                                  as avg,
                                               min(user_score)                                  as min,
                                               substring(min(optimized_transaction_date), 1, 7) as min_
                                               substring(max(optimized_transaction_date), 1, 7) as max_
                                        from temp_132.onepercsample
                                        group by unique_mem_id) a
                                           inner join temp_132.onepercsample b
                                                      on a.unique_mem_id = b.unique_mem_id
                                  where avg > 6.5)


select count(distinct unique_mem_id)
from temp_132.filter1


-- Find all Qualifying Federal/State/Local Payroll Transactions
select *
from (select *,
             CASE
                 WHEN ((upper(primary_merchant_name) like '%DFAS%' OR
                        upper(primary_merchant_name) like '%U.S. DEPARTMENT OF THE TREASURY%' OR
                        upper(primary_merchant_name) like '%US TREASURY%' OR
                        upper(primary_merchant_name) like '%GOVERNMENT%' OR
                        upper(primary_merchant_name) like '%GSA%' OR
                        upper(primary_merchant_name) like '%THE GENERAL SERVICES ADMINISTRATION%' OR
                        upper(primary_merchant_name) like '%THE U.S. OFFICE OF PERSONNEL MANAGEMENT%' O
                        upper(primary_merchant_name) like '%UNITED STATES COAST GUARD%' OR
                        upper(primary_merchant_name) like '%U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICE
                        upper(primary_merchant_name) like '%AGRICULTURAL TREASURY OFFICE%' OR
                        upper(primary_merchant_name) like '%CENSUS%' OR
                        upper(primary_merchant_name) like '%SOCIAL SECURITY ADMINISTRATION%' OR
                        upper(primary_merchant_name) like '%FARM SERVICE AGENCY%' OR
                        description ilike '%FED SAL%'
                     or description ilike '%FAA TREAS 310%'
                     or description ilike '%EPA TREAS 310%'
                     or description ilike '%GSA TREAS 310%'
                     or description ilike '%DOI1 TREAS 310%'
                     or description ilike '%DOT4 TREAS 310%'
                     or description ilike '%NIH  TREAS 310%' or description ilike '%NIH. TREAS 310%'
                     or description ilike '%OPM1 TREAS 310%'
                     or description ilike '%DHS  TREAS 310%'
                     or description ilike '%LOC1 TREAS 310%'
                     or description ilike '%USSS TREAS 310%'
                     or description ilike '%CBP  TREAS 310%'
                     or description ilike '%DOJ  TREAS 310%'
                     or description ilike '%USSS TREAS 310%'
                     or description ilike '%US HOUSE OF REPR%'
                     or description ilike '%US SENATE FED SAL%'
                     or description ilike '%TENN VALLEY AUTH TRPDFEDSL%'
                     or description ilike '%TENN VALLEY AUTH ACH: TRPDFEDSL%'
                     or description ilike '%US SENATE FED SAL%'
                     or description ilike '%USPS%'
                     or description ilike '%IN AF PAY%'
                     or description ilike '%IN ARMY ACT%'
                     or description ilike '%IN AF PAY%'
                     or description ilike '%IN AF RES%'
                     or description ilike '%IN ARMY RC%'
                     or description ilike '%NAVY ACT%'
                     or description ilike '%NAVY ALT%'
                     or description ilike '%NAVY RES%')
                     AND description not ilike '%SSA  TREAS 310%'
                     AND description not ilike '%SOC SEC%'
                     AND description not ilike '%VA BEN%'
                     AND description not ilike '%TREASURY PMN%'
                     AND description not ilike '%SERV F%'
                     AND description not ilike '%SUPP SEC%'
                     AND description not ilike '%US TREASURY CF%'
                     AND description not ilike '%TAX%'
                     AND description not ilike '%RET%'
                     AND description not ilike '%FED PAYMENT%'
                     AND description not ilike '%ALLT%'
                     AND description not ilike '%PPTAS%'
                     AND description not ilike '%BENEFIT PAYMENT%'
                     AND description not ilike '%TRAVEL PAY%'
                     AND description not ilike '%UI BEN%'
                     AND description not ilike '%USCIS%'
                     AND description not ilike '%VACP%'
                     AND description not ilike '%DCPS%'
                     AND description not ilike '%CASH%'
                     AND description not ilike '%IATS PAY%'
                     AND description not ilike '%MISC PAY%'
                     AND description not ilike '%NJ SDU%'
                     AND description not ilike '%TREAS 449%'
                     AND description not ilike '%SDP%'
                     AND description not ilike '%CHILD%'
                     AND description not ilike '%FAIRFAX%'
                     AND description not ilike '%GOVERNMENT SOLUTIONS%'
                     AND description not ilike '%GOVERNMENT SERVICES%'
```

```
                    AND description not ilike '%GOVERNMENT VI%'
                    AND description not ilike '%COUNTY%'
                    AND description not ilike '%EITX%'
                    AND description not ilike '%CITY%'
                    AND description not ilike '%ASI GOV%'
                    AND description not ilike '%STUDENT LN%'
                    AND description not ilike '%STATE%'
                    AND description not ilike '%POLICE%'
                    AND description not ilike '%NY %'
                    AND description not ilike '%OHIO%'
                    AND description not ilike '%AR.GOV%'
                    AND description not ilike '%NJMONT%'
                    AND description not ilike '%EDUCATION%'
                    AND description not ilike '%KANSAS%'
                    AND description not ilike '%NEWYORK%'
                    AND description not ilike '%SSA TREAS 310%'
                    AND description not ilike '%SBAD TREAS 310%'
                    AND description not ilike '%RRB  TREAS 310%'
                    AND description not ilike '%RRB TREAS 310%'
                    AND description not ilike '%DOEP TREAS%'
                    AND description not ilike '%DFEC TREAS 310%'
                    AND primary_merchant_name not ilike '%COUNTY%'
                    AND primary_merchant_name not ilike '%USPS%'
                    AND primary_merchant_name not ilike '%LOUISIANA%'
                    AND primary_merchant_name not ilike '%ACCO BRANDS%'
                    AND primary_merchant_name not ilike '%KEYPOINT GOVERNMENT SOLUTIONS%'
                    AND primary_merchant_name not ilike '%ASCENSUS TRUST%'
                    AND primary_merchant_name not ilike '%US NAVY NSA PC MORALE WELFARE & RECREATION%'
                    AND primary_merchant_name not ilike '%SOCIAL SEC%'
                    AND primary_merchant_name not ilike '%NATIONAL GOVERNMENT SERVICES%'
                    AND primary_merchant_name not ilike '%FEDERAL RESERVE%') THEN 'federal'
                WHEN ((upper(primary_merchant_name) like '%STATE TREASUR%' or
                       upper(primary_merchant_name) like '%STATE COMPTROL%' or
                       upper(primary_merchant_name) like '%STATE CONTROLLER%' or
                       upper(primary_merchant_name) like '%ST OF%' or
                       upper(primary_merchant_name) like '%STATEOF%' or
                       upper(primary_merchant_name) like '%STATE OF%' or
                       upper(primary_merchant_name) like '%COMMONWEALTH OF%' or
                       upper(primary_merchant_name) like '%DEPARTMENT OF%' or
                       upper(primary_merchant_name) like '%STATE DEPARTMENT%' or
                       (upper(primary_merchant_name) like '%STATE OF COLORADO' and
                        description not ilike '%COLORADO STATE U%') or
                       (upper(primary_merchant_name) like '%STATE OF ILLINOIS' and description ilike '%
                       upper(primary_merchant_name) like '%LOUISIANA GOVERNMENT%')
                    and description not ilike '%TAX%'
                    and description not ilike '%UI%'
                    and description not ilike '%UNEMP%'
                    and description not ilike '%DSS%'
                    and description not ilike '%REFUND%'
                    and description not ilike '%BENEFIT%'
                    and description not ilike '%CHILD%'
                    and description not ilike '%EITX%'
                    and description not ilike '%SUPP%'
```

```
                     and upper(primary_merchant_name) not like '%U.S. DEPARTMENT OF THE TREASURY%'
                     and upper(primary_merchant_name) not like '%US TREASURY%'
                     and upper(primary_merchant_name) not like '%US DEPARTMENT OF EDUCATION%'
                     and upper(primary_merchant_name) not like '%U.S. DEPARTMENT OF HEALTH AND HUMAN SE
                     and upper(primary_merchant_name) not like '%DEPARTMENT OF VETERAN%'
                     and upper(primary_merchant_name) not like '%UNITED STATES%'
                     and upper(primary_merchant_name) not like '%STAR OF%'
                     and upper(primary_merchant_name) not like '%TAX%'
                     and upper(primary_merchant_name) not like '%BLUE CROSS%'
                     and upper(primary_merchant_name) not like '%POWER%'
                     and upper(primary_merchant_name) not like '%HEALTH%'
                     and upper(primary_merchant_name) not like '%MEDIC%'
                     and upper(primary_merchant_name) not like '%UNIV%'
                     and upper(primary_merchant_name) not like '%ELECTRIC%'
                     and upper(primary_merchant_name) not like '%CORP%'
                     and upper(primary_merchant_name) not like '%AIRLINE%'
                     and upper(primary_merchant_name) not like '%PACIFIC%'
                     and upper(primary_merchant_name) not like '%TOOL%'
                     and upper(primary_merchant_name) not like '%CLEANER%'
                     and upper(primary_merchant_name) not like '%DINER%'
                     and upper(primary_merchant_name) not like '%EDISON%'
                     and upper(primary_merchant_name) not like '%EXPRESS%'
                     and upper(primary_merchant_name) not like '%SOUTHERN%'
                     and upper(primary_merchant_name) not like '%LOTTERY%'
                     and upper(primary_merchant_name) not like '%PRIME%'
                     and upper(primary_merchant_name) not like '%VISION%'
                     and upper(primary_merchant_name) not like '%EMC%'
                     and upper(primary_merchant_name) not like '%CENTRAL%'
                     and upper(primary_merchant_name) not like '%LIFE%'
                     and upper(primary_merchant_name) not like '%INSUR%'
                     and upper(primary_merchant_name) not like '%BERGEN%'
                     and upper(primary_merchant_name) not like '%ROADHOUSE%'
                     and upper(primary_merchant_name) not like '%CHILD%'
                     and upper(primary_merchant_name) not like '%TECH%'
                     and upper(primary_merchant_name) not like '%SPCA%'
                     and upper(primary_merchant_name) not like '%TOYOTA%'
                     and upper(primary_merchant_name) not like '%TIMES%'
                     and upper(primary_merchant_name) not like '%ZOO%'
                     and upper(primary_merchant_name) not like '%CENTER%'
                     and upper(primary_merchant_name) not like '%MADE%'
                     and upper(primary_merchant_name) not like '%DENT%'
                     and upper(primary_merchant_name) not like '%CNG%'
                     and upper(primary_merchant_name) not like '%SOURCE%'
                     and upper(primary_merchant_name) not like '%HOTEL%'
                     and upper(primary_merchant_name) not like '%RAILR%'
                     and upper(primary_merchant_name) not like '%FRESH%'
                     and upper(primary_merchant_name) not like '%YORKER%'
                     and upper(primary_merchant_name) not like '%THEATRE%'
                     and upper(primary_merchant_name) not like '%GRILL%'
                     and upper(primary_merchant_name) not like '%GENESEE%'
                     and upper(primary_merchant_name) not like '%FURNITURE%'
                     and upper(primary_merchant_name) not like '%EAST%'
                     and upper(primary_merchant_name) not like '%COLLEGE%'
                     and upper(primary_merchant_name) not like '%GAS%'
                     and upper(primary_merchant_name) not like '%UTILIT%'
                     and upper(primary_merchant_name) not like '%COFFEE%'
                     and upper(primary_merchant_name) not like '%HOSPITAL%'
                     and upper(primary_merchant_name) not like '%RETIR%'
                     and upper(primary_merchant_name) not like '%REVENUE%') THEN 'state'
                 WHEN ((upper(primary_merchant_name) like '%COUNTY OF%' or
                        upper(primary_merchant_name) like '%COUNTY%' or
                        upper(primary_merchant_name) like '%CITY OF%' or
                        upper(primary_merchant_name) like '%DEPARTMENT OF%' or
                        upper(primary_merchant_name) like '%CITY DEPARTMENT%' or
                        upper(primary_merchant_name) like 'PUBLIC SCHOOLS')
                     and description not ilike '%TAX%'
                     and description not ilike '%UI%'
                     and description not ilike '%DSS%'
                     and description not ilike '%UNEMP%'
                     and description not ilike '%REFUND%'
                     and description not ilike '%BENEFIT%'
                     and description not ilike '%CHILD%'
                     and upper(primary_merchant_name) not like '%U.S. DEPARTMENT OF THE TREASURY%'
                     and upper(primary_merchant_name) not like '%US DEPARTMENT OF EDUCATION%'
                     and upper(primary_merchant_name) not like '%U.S. DEPARTMENT OF HEALTH AND HUMAN SE
                     and upper(primary_merchant_name) not like '%US TREASURY%'
                     and upper(primary_merchant_name) not like '%DEPARTMENT OF VETERAN AFFAIRS%'
                     and upper(primary_merchant_name) not like '%DEPARTMENT OF VETERANS AFFAIRS%'
                     and upper(primary_merchant_name) not like '%ELECTRIC%'
                     and upper(primary_merchant_name) not like '%GAS%'
                     and upper(primary_merchant_name) not like '%UTILIT%'
                     and upper(primary_merchant_name) not like '%Prince William County Service Authorit
                     and upper(primary_merchant_name) not like '%UNIVERSITY%'
                     and upper(primary_merchant_name) not like '%HOSPITAL%'
                     and upper(primary_merchant_name) not like '%RETIR%'
                     and upper(primary_merchant_name) not like '%REVENUE%') THEN 'local'
                 ELSE 'other' END as fed
      from temp_132.filter1
      where transaction_base_type = 'credit'
        and transaction_category_name = 'Salary/Regular Income'
        and amount > 500
        and is_duplicate = 0)
where fed not like 'other'
```