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Across the Universe: Policy Support for Employment and Revenue in the Pandemic Recession

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Abstract

Using data from 14 government sources, we develop comprehensive estimates of U.S. economic activity by sector, legal form of organization, and firm size to characterize how four government direct lending programs — the Paycheck Protection Program, the Main Street Lending Program, the Corporate Credit Facilities, and the Municipal Lending Facilities — related to these classes of economic activity in the United States. The classes targeted by these programs are vast — accounting for 97 percent of total U.S. employment — though entity-specific financial criteria limited coverage within specific programs. We relate our estimates to those from timely alternative data sources, which do not typically cover the majority of the economic universe.

JEL codes: C83, E20, E58
Keywords: employment, activity estimates, direct lending programs, Paycheck Protection Program, PPP, Main Street, Corporate Credit Facilities, alternative data

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1 Introduction

The Pandemic Recession of 2020 has been unprecedented in its speed and severity. Firms across sectors and size classes experienced massive reductions in revenue due to government-mandated activity restrictions and behavioral changes arising from health concerns (Cajner et al., 2020; Chetty et al., 2020). To mitigate the impact of the shock on the economy and maintain financial stability, the U.S. government and Federal Reserve took the unprecedented action of provisioning direct assistance to firms and government entities across nearly the entire universe of economic activity, including categories of businesses that are not typically the focus of direct lending programs.

A key challenge for research and analysis of these policies is measuring the economic universe they target. We present estimates of economic activity in the United States that we partition by sector, legal form of organization, and firm size. Our estimates draw primarily on U.S. Census Bureau sources but also on data from the Department of Agriculture, national accounts, railroad regulators, and other sources. We then assess how four government direct lending programs — the Paycheck Protection Program (PPP), the Main Street Lending Program ("Main Street"), the Corporate Credit Facilities (CCFs), and the Municipal Lending Facilities (Muni LF) — relate to our activity estimates.

While tabulating the universe of economic activity may seem a trivial task, it is not. Indeed, this kind of descriptive exercise is rarely done. In particular, no single product of U.S. statistical agencies is able to answer the question of how much economic activity falls within the scope of each direct lending program initiated during 2020. Our partitioning of the economy is thus unique in that we can map to the four direct lending programs we consider while still capturing nearly the entirety of economic activity.

We draw on our universe data to illustrate the vast scale and scope of the economic policy response to the Pandemic Recession. The four direct-lending programs we study notionally cover the entirety of private-sector jobs as well as nearly all government employment; that is, the classes targeted include most economic activity, ignoring entity-specific financial criteria that reduce effective program coverage. This response is substantially broader than that mounted in response to the Great Recession.

A number of alternative data sources on business activity, such as those compiled by private companies, have gained prominence during the Pandemic Recession because they provide timely insights that are not available from official data sources. Unlike official statistics, however, alternative data generally come with concerns about coverage and representativeness. We provide critical context for users of several alternative data sources — in particular ADP, Compustat, Homebase, and Dun & Bradstreet — by comparing their estimates of economic activity with our universe estimates. We show that their timeliness comes at a cost of coverage; the

alternative data cover substantially smaller portions of the economy than either the Bureau of Labor Statistics (BLS) data or our universe estimates.

2 Overview of U.S. economic activity

We construct measures of the number of entities, employment, annual payroll, and gross receipts by sector, legal form of organization, and firm size for the U.S. economy in 2019, with a focus on the criteria that are relevant for the four lending programs we consider. Quantifying the universe of economic activity is a considerable undertaking, as no single data source covers all areas of the economy (e.g., nonfarm and farm businesses, railroads, employer and nonemployer businesses, and each level of government). We thus combine data from a variety of official sources. Our accounting captures virtually all economic activity, with the only exceptions being informal activity, private households, certain financial entities without employees, and businesses owned by Tribal governments. Our main data sources are the Census Bureau's Statistics of U.S. Businesses (SUSB) and Census of Governments, but our tabulations require many other sources as well. All told, to compile our universe estimates we use data from 14 separate sources along with a handful of others necessary for temporal and other adjustments (for example, we use BLS Quarterly Census of Employment and Wages (QCEW) data to translate 2017 values to 2019 estimates); the appendix provides detail on our sources and methods.

Table 1 presents our estimates of the universe of economic activity and lists all data sources. Within the private sector, businesses are divided into categories by a combination of number of employees and annual revenue:

- **Small firms** are defined as those with fewer than 500 employees, regardless of revenue, unless otherwise noted;
- **Medium firms** are defined as those with at least 500 employees, but fewer than 15,000 employees or less than $5 billion in annual gross receipts;
- **Large firms** are defined as those with at least 15,000 employees and $5 billion or more in annual receipts.[1]

We separate out private activity by size class at for-profit and nonprofit private businesses. Although farms are typically for-profit businesses, we provide their activity statistics separately since readers are accustomed to seeing the nonfarm economy in isolation. We also include information on nonemployers. Last, we separate out government activity across federal, state, and local governments.

1. Cutoffs for activity below 15,000 employees or $5 billion in receipts are not available in our source data; the appendix describes how these are estimated.

Table 1. Activity Measures at U.S. Businesses and Governments, 2019

	Class or program	*Firms or entities*	*Employment (millions)*	*Annual payroll (billions)*	*Annual receipts (billions)*
	*By class**				
1.	Private	33,895,441	159.6	7,714	42,656
2.	For-profit	5,654,239	114.7	6,517	38,468
3.	Small	5,636,791	55.2	2,729	13,765
4.	Medium	16,979	35.7	2,230	13,342
5.	Large	469	23.7	1,558	11,361
6.	Nonprofit	438,808	16.9	828	2,447
7.	Small	435,976	7.3	267	887
8.	Medium	2,796	7.5	418	1,158
9.	Large	36	2.1	142	403
10.	Farms	2,023,619	2.3	33	377
11.	Small	1,947,453	1.3	10	118
12.	Medium	76,166	1.0	23	259
13.	Nonemployers	25,778,775	25.8	336	1,364
14.	Government	90,127	24.5	2,120	6,378
15.	Federal	1	4.8	466	3,464
16.	Civilian		2.8	302	
17.	Armed forces		2.0	163	
18.	State	51	5.5	479	1,515
19.	Local	90,075	14.3	1,176	1,399
	*By program**				
20.	PPP	33,801,428	94.4	3,441	16,477
21.	Main Street	93,517	40.3	2,594	14,483
22.	CCFs	496	24.8	1,678	11,695
23.	Muni LF	90,126	19.8	1,655	2,914

Sources: Annual Survey of Public Employment and Payroll, Bureau of Transportation Statistics, County Business Patterns, Census of Agriculture, Census of Governments, Current Employment Statistics, Department of Defense Active Duty Master File, Nonemployer Statistics, national income and product accounts, Office of Management and Budget Historical Tables, Railroad Retirement Board, State & Local Government Finance Historical Datasets and Tables, Surface Transportation Board, Statistics of U.S. Businesses, and authors' calculations. See the appendix for detail on data construction.

Notes: Blue shading indicates covered primarily by the PPP. Orange shading indicates covered primarily by Main Street. Green shading indicates covered primarily by the CCFs. Yellow shading indicates covered by the Muni LF. For state and local governments, receipts refers to own-source general and utility revenue.

* Totals by program will not match the sum of shaded rows by class because nearly all medium and large for-profit firms in the accommodation and food services sector (NAICS 72) are eligible for the PPP.

In the Census Bureau data underlying the bulk of table 1, a private sector firm is defined based on operational control or ownership; both our firm counts and our firm size classes reflect this definition. However, we emphasize that, in some cases, other firm definitions may be used to determine lending program eligibility, such as definitions based on tax identifiers which may allow multiple subsidiaries of a firm to access programs independently. In this respect, our tabulations of firm counts may understate the number of entities qualifying for programs, even within the private sector.[2]

For-profit private businesses represent most non-government economic activity, as compared with nonprofits, farms, and nonemployers. There are 160 million employees at private businesses, 115 million of which are at for-profit businesses. Although entity and, to some extent, employment counts are skewed toward small firms, annual payroll and receipts are more evenly distributed across size classes.

Nonprofit businesses account for less than 10 percent of employment in most sectors; that said, they constitute a larger share of activity in certain sectors of the economy. Among employer firms, nonprofits account for 78 percent of employment in educational services, 48 percent in other services (which includes religious organizations), 42 percent in health care and social assistance, and 28 percent in arts, entertainment, and recreation (which includes museums).

The United States has about 2 million farms (including ranches) employing 2.3 million hired workers (farms are classified in North American industrial classification system (NAICS) 111 and 112).[3] Farms with less than $1 million in revenue were eligible for Small Business Administration (SBA) programs such as the PPP, so we include them in the small size class, with the remaining farms included in the medium size class.[4] *Farms* are not directly comparable to *firms*; some farms may be owned by larger firms that own other farms (such that farm counts overstate farming firms) or that also have activity in other sectors (such that they appear in the firm counts elsewhere in table 1). These possibilities would not necessarily result in misclassification of employment, payroll, or receipts, since these measures are categorized at the farm

2. Firms are notoriously difficult to define and count due to sometimes complicated structures of ownership and control. Moreover, many large firms have operations in multiple industries and may operate under any number of tax identifiers under which they might apply for government programs. There is likely some double counting of activity between farms and other classes, as many farms are nonemployers or may be subsidiaries of firms with activity in other industries. Thus, our firm-count estimates should be treated with greater uncertainty than the other activity measures. We outline our methodology for estimating firm counts in the appendix.

3. In addition to formal hired workers, farms also rely heavily on unpaid labor (e.g., family) and contract workers which we do not include in table 1; in the 2017 Census of Agriculture, farms reported roughly 2 million unpaid workers and 8 million contract workers (some of the latter may also appear in nonemployer data).

4. Farm size criteria are complicated, but the $1 million receipts cutoff is a standard SBA "small business" criterion that we can easily measure in Census of Agriculture data. The upper size category in the Census of Agriculture is $5 million in annual receipts; in discussions with Department of Agriculture staff, we determined that the existence of farms with at least $5 billion receipts is extremely unlikely. While there are likely some large *firms* that own establishments engaged in farming activities, firms of that size are likely to also have establishments in nonfarm activities, which means their firm counts are represented elsewhere on the table. That said, the farm employment, payroll, and receipts of such large firms would be misclassified as medium in the farms category on table 1.

or establishment level; but farming activity may be misclassified in terms of our size categories if, for example, a large number of small farms are owned by a firm with revenue above $1 million. In short, measurement of farms is based upon different concepts from measurement of the rest of the business universe, which suggests caution should be exercised when inferring farm eligibility for lending programs.

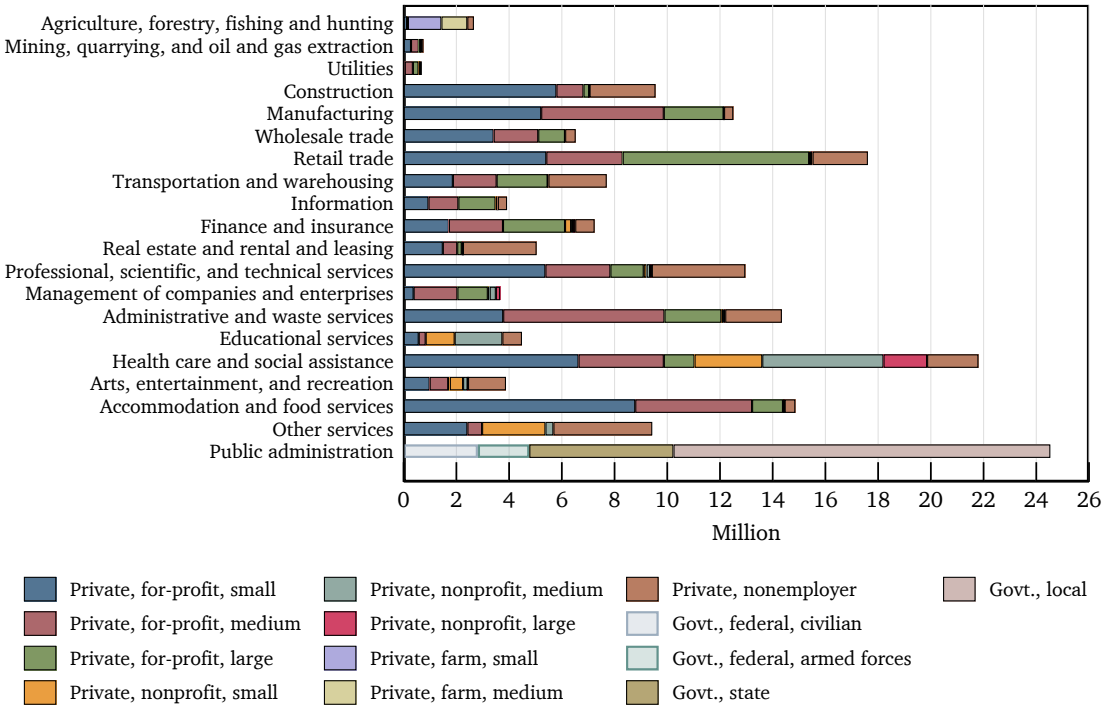
Nonemployers are businesses that produce goods or services but do not have formal employees. This includes self-employed individuals who do not employ others as well as other businesses with no employees, such as owners of rental properties. The vast majority of businesses—26 million—are nonemployer businesses; however, these businesses account for only $1.4 trillion in annual receipts, which is equivalent to about 4 percent of for-profit employer revenue.[5] Nevertheless, self-employment is an important source of income for millions of Americans. While nonemployer businesses do not technically pay wages and salaries, we estimate these businesses generated more than $300 billion in payroll equivalent in 2019; see the appendix for details.

The government activity figures on table 1 include nearly all government activity, including the Postal Service, the armed forces, and government-owned businesses in many industries. State and local governments employ nearly 20 million workers, far more than the federal government. In addition to the 50 state governments, the District of Columbia, and the federal government, there are more than 90,000 local government entities, including special purpose entities such as transit authorities and public hospitals.

In figure 1, we present sector-level employment decompositions mimicking those on table 1 (sectors roughly correspond to 2-digit NAICS codes). The largest sector is public administration, which has nearly 25 million employees, most of which are concentrated in state and local governments. Eight other sectors have close to or more than 10 million employees. Of these other sectors, employment is highest in the health care and social assistance sector, followed by retail trade. These two sectors demonstrate the substantial heterogeneity in size and legal form of organization in the economy: Health care and social assistance has a significant fraction of its employment in nonprofits and at medium and small firms, while retail trade has little employment in nonprofits and a significant fraction of employment at large firms. In appendix C we show versions of this figure based on firm counts, payroll, and receipts.

5. Counts of nonemployer businesses should not be thought of as counts of self-employed persons. Many business owners control multiple nonemployer entities (for example, some landlords may own multiple rental properties in separate nonemployer businesses). Moreover, nonemployer businesses include "side gigs" of workers with other income. We discuss nonemployer versus self-employment distinctions further below.

Figure 1. Employment at U.S. Businesses and Governments, 2019, by Sector and Class



Sources: See table 1.
Notes: Transparent bars indicate classes that are not covered by one of the four direct lending programs we consider.

3 Direct lending programs during the Pandemic Recession

The lower panel of table 1 reports tabulations of the activity targeted by each program, and the color shading of these lines can be used to identify specific classes in the upper panel of the table that are targeted by a specific program. Our categorization of program targets is based only on our size and legal form classifications, abstracting from eligibility rules within classes—for example, although some medium businesses were ineligible for Main Street due to the program's leverage requirements, they are nonetheless categorized here as being targeted by Main Street. We assign all small firm activity to the PPP because small firms were generally eligible. For example, all blue-shaded rows in the upper panel correspond to the PPP.[6] We assign all state and local government entities to the Muni LF, even though some of these organizations (e.g., public hospitals) were also eligible for the nonprofit Main Street facilities.

6. PPP eligibility was determined by *firm* size, not establishment size, with the exception of establishments in NAICS 72; see section B.2 in the appendix. SBA documentation states, "For purposes of the determining the number of employees of an applicant to the Paycheck Protection Program, the applicant is considered together with its affiliates. . . . Concerns and entities are affiliates of each other when one controls or has the power to control the other, or a third party or parties controls or has the power to control both." Affiliation is defined in a manner similar to the Census Bureau definition of firms; see U.S. Small Business Administration (2020).

It is important to note that firms of any size in the accommodation and food services sector that had an establishment with fewer than 500 employees were also eligible for the PPP.[7] We include activity of medium for-profit firms and farms as the target population for the Main Street program (line 21). Although smaller firms were also eligible for Main Street, we do not include them on line 19 for simplicity; to obtain an extreme upper bound on Main Street eligibility simply combine lines 20 and 21.[8] Similarly, there was no minimum size criterion for CCFs, but we have identified the target population as only the large for-profit firms.[9]

Most of the activity in the top panel of table 1 is covered by one of the programs listed on the bottom panel. Small organizations of any kind — for-profit and nonprofit — were included in the PPP. Medium for-profit and nonprofit businesses (as well as many small ones) were targeted by Main Street. Large businesses and nonprofits, which typically have access to the corporate bond or syndicated loan markets, were covered by the CCFs.[10] State and local governments, as well as their enterprises, were able to access the Muni LF, albeit with a potential intermediate step.[11]

Given its focus on small firms, the PPP's portion of the business universe included the vast majority of firms. However, in terms of economic activity, the other lending programs — taken together — were similarly important to the PPP. Main Street was targeted at less than 1 percent

7. We interpret the PPP eligibility criteria to imply that all firms with fewer than 500 employees were eligible, though some additional firms meeting standard industry-specific SBA "small business" definitions were eligible as well, and certain smaller firms were excluded. Tracking special industry-specific "small business" definitions is infeasible for our analysis, so we focus on the simple 500-employee firm-size cutoff, thereby potentially modestly understating the activity that is eligible for the PPP. In addition, we include the eligible portions of medium- and large-firm activity in NAICS 72 in the PPP line on table 1. We estimate that the vast majority of NAICS 72 is eligible for the PPP: More than 99 percent of establishments in that sector have fewer than 500 employees, and these account for about 94 percent of employment and payroll in the sector; see the appendix for details. The SBA published the full list of criteria making firms ineligible in the Interim Final Rule (Federal Register, 2020).

8. Main Street had eligibility criteria that could have limited take-up, especially among small firms. In particular, loan-size minimums and leverage limits varied by facility. In October 2020, the minimum loan size across facilities was changed to $100,000 (Federal Reserve Board, 2020*a*) and remained at that level until the program ceased making new loans in January 2021.

9. Among other eligibility criteria, firms needed to be rated above investment grade as of March 22, 2020 (Federal Reserve Bank of New York, 2020). Our examination of eligible firms that meet the ratings criteria suggest that almost all firms meeting these criteria are large. That said, we note that large firms are rare, representing only a tiny fraction of all firms, so there may be many firms outside the "large" category that may be in scope for the CCFs. We also note that in 2019 there were roughly 3,500 publicly traded firms in Compustat, most of which are in our medium size category.

10. According to the Federal Reserve Bank of New York's FAQs for the CCFs (Federal Reserve Bank of New York, 2020), nonprofits had access to the CCFs.

11. State and local government entities *directly* eligible for the Muni LF included all U.S. states, the District of Columbia, counties with a population of at least 500,000 residents, cities with a population of at least 250,000 residents, certain multistate entities, and revenue bond issuers and cities and counties designated by their state governors. In order to be directly eligible, governments must have also been able to satisfy minimum credit rating requirements. Government entities not directly eligible for the Muni LF were, in principal, *indirectly* eligible for the facility as any directly eligible participant may have used the proceeds from Muni LF loans to "purchase similar notes issued by, or otherwise to assist, political subdivisions and other governmental entities of the relevant State, City, or County." See Federal Reserve Board (2020*b*).

of the number of firms as the PPP but these firms have about 40 percent of the employment and almost 90 percent of the receipts of PPP firms. The 500 large firms we assign to the CCFs collectively have receipts over two-thirds as large as the millions of small firms covered by the PPP.

Thus, table 1 reveals the striking comprehensiveness of the pandemic lending facility policy response. Nearly all firms or entities fall into business categories targeted by policy, accounting for 97 percent of employment, 95 percent of payroll, and 93 percent of receipts. Policy coverage includes the *entire* private sector and a large portion of government entities, notionally omitting only the federal government itself. This implies that most limitations on program coverage existed *within* firm or entity categories; for example, many firms that met size and legal form criteria for Main Street programs may have been ineligible due to leverage requirements.

Because the effects of the Pandemic Recession have been unevenly distributed across industries, we also explore program coverage by sector. Table 2 reports the share of sector employment that is at firms targeted by each program.[12] We include nonemployers on table 2, all of which we assume were eligible for the PPP (and each of which accounts for one employee).

The distribution of sector activity across programs varies widely, with significant implications for how the programs affected different sectors. Since PPP eligibility requirements were minimal (aside from size-based criteria) and many PPP loans were actually grants, sectors with heavy concentration of activity in PPP–eligible firms (such as accommodation and food services or other services) were potentially able to benefit disproportionately from the economy-wide pandemic response. For sectors with significant activity in the Main Street category (such as utilities), policy benefits depended heavily on how well firms in those sectors met Main Street requirements on firm leverage and minimum loan sizes, as well as the costs of program loans. Those sectors with substantial activity in the CCFs category, such as information or finance and insurance, benefited only to the extent that their firms had access to corporate bond markets and were rated as investment-grade prior to March 22, 2020.[13]

4 Direct lending programs during the Great Recession

The economic policy response to the recent pandemic by the Congress and Administration and the Federal Reserve has been unprecedented in its nature and scope. As in the Pandemic Recession, in response to the Great Recession of 2007–09, the Federal Open Market Committee lowered the federal funds rate to its effective lower bound, and pursued additional policies such

12. Because industry is determined at the establishment level, large firms may have employees in multiple sectors. Importantly, however, firm size, which determines the classification by lending program, is determined at the economy-wide level.

13. Four sectors have effectively zero employment at firms in the CCFs category. Agriculture, forestry, fishing and hunting does have large firms, but their employment is within rounding error of zero percent of sector employment. We estimate that there are no firms with at least $5 billion in receipts in either educational services or other services.

Table 2. Share of Employment Covered by Program

Sector		*PPP*	*Main Street*	*CCFs*	*Muni LF*
1.	Agriculture, forestry, fishing and hunting	62	38	0	0
2.	Mining, quarrying, and oil and gas extraction	49	40	11	0
3.	Utilities	19	48	33	0
4.	Construction	87	11	2	0
5.	Manufacturing	45	37	18	0
6.	Wholesale trade	59	26	16	0
7.	Retail trade	43	17	41	0
8.	Transportation and warehousing	53	22	25	0
9.	Information	34	29	36	0
10.	Finance and insurance	37	29	34	0
11.	Real estate and rental and leasing	86	11	3	0
12.	Professional, scientific, and technical services	70	20	10	0
13.	Management of companies and enterprises	12	52	36	0
14.	Administrative and waste services	42	43	15	0
15.	Educational services	54	46	0	0
16.	Health care and social assistance	51	36	13	0
17.	Arts, entertainment, and recreation	75	23	2	0
18.	Accommodation and food services	95	4	1	0
19.	Other services	91	9	0	0
20.	Public administration	0	0	0	81

Sources: See table 1.

as forward guidance and large-scale asset purchases of U.S. Treasuries and agency mortgage-backed securities. These responses were considered extraordinary at the time (Mishkin and White, 2016). Among other policy responses to improve financial stability, the Federal Reserve also established facilities to improve market functioning and financial conditions, in particular in short-term funding markets, as it did in response to the Pandemic Recession. However, the Federal Reserve did not purchase longer-term corporate bonds of, or make longer-term loans directly to, any nonfinancial firms or state and local governments as it did through the CCFs, Main Street, and the Muni LF. Moreover, most Federal government lending was targeted at the financial system and toward households, though emergency loans were granted to a few firms in the auto industry experiencing financial distress (see Blinder and Zandi, 2015; Goolsbee and Krueger, 2015).[14] Digler (2020) describes some of the programs intended to increase lending to small businesses through the SBA during and in the aftermath of the Great Recession. The

14. Importantly, even in the Pandemic Recession, the Congress and Administration created programs to assist specific industries, such as airlines, which we have omitted from our broader discussion.

appropriated sum of these small business lending programs is order of magnitudes lower than the nearly $1 trillion in mostly forgivable loans appropriated through the three rounds of the PPP.

5 Comparing our universe estimates to other sources

In this section, we compare our universe estimates to comparable tabulations from the BLS and several prominent alternative data sources on business activity.

5.1 The BLS business universe

The BLS maintains a register of businesses that is almost entirely independent of the Census Bureau sources that underlie most of our main analysis. The main BLS business universe product is the QCEW, which covers the universe of business establishments known to state (and federal) unemployment insurance systems. These data provide most of the annual benchmark used for adjusting the popular monthly payroll survey, the Current Employment Statistics (CES). A key advantage of the QCEW relative to the SUSB is its timeliness: The QCEW is released with a delay of roughly two quarters.[15] Separately, the BLS also publishes the Current Population Survey (CPS), which provides a monthly measure of employment based on a survey of *households* (thereby avoiding the industry and organizational scope restrictions that characterize business-based data). Importantly, workers who hold multiple jobs are only counted once in official CPS tallies; we use information on first and second jobs from the March 2019 CPS microdata to create a count of *jobs* (see Bowler and Morisi, 2006). This adjustment renders CPS counts more consistent with the business-based jobs counts in our universe estimates, the CES, and the QCEW.

On table 3, we tabulate BLS-based job counts and express the resulting totals as a percent of corresponding universe estimates from table 1. The first three columns report relative employment estimates, while the fourth and fifth columns report relative establishment counts and annual payroll. For example, the first column indicates that CES nonfarm employment equals 97 percent of employer jobs from table 1; the rows for farm employment and self employment are left blank since those jobs are outside of the CES scope. QCEW coverage of the nonfarm universe is just slightly smaller than CES reflecting its administrative sources in the unemployment system, which does not cover all businesses (the largest omitted group being nonprofit businesses that do not participate in state unemployment systems).[16]

15. The primary reasons we used the SUSB data for our main analysis are that SUSB has more detail on firm size along with more consistent definitions of firm concepts than the QCEW and that SUSB contains information on firms' receipts.

16. The scope of the CES is broader than the scope of the QCEW by about 3 percent; the difference between the two data products reflects activity that is not subject to unemployment insurance coverage, including many nonprofits

Table 3. Comparison of Activity Measures with the BLS Business Universe
Percent of corresponding measure from table 1

	Employment			*Estab.*	*Annual payroll*
Class	*CES*	*QCEW*	*CPS*	*QCEW*	*QCEW*
1. Wage and salary			91		
2. Nonfarm	97	95	92	122	94
3. Private	96	94	91	118	101
4. Government	101	100	95		68
5. Farm		33	47	4	92
6. Self employed			62		

Sources: Authors' calculations using Bureau of Labor Statistics data from the Current Employment Statistics, the Quarterly Census of Employment and Wages, and the Current Population Survey, as well as the sources from table 1.
Notes: Empty cells indicate data for comparison are not available.

CPS coverage is more comprehensive in terms of scope—the survey includes nonfarm and farm workers as well as self employed individuals (which we compare to the nonemployer tabulations from row 13 of table 1); however, coverage within categories appears more limited than other sources.[17] Possible reasons for lower counts in the CPS than in the CES among employer businesses include the CPS exclusion of workers in institutions (e.g., prisons) or on active military duty who might work in unemployment insurance-covered establishments, workers below the age of 16, and foreign commuters (i.e., members of foreign households that work in U.S. establishments); additionally, job-to-job transitions within the CES reference week can raise CES estimates relative to those in the CPS, and the jobs of workers with more than two jobs are not all counted in our estimates. Note also that employment in the CPS is not directly benchmarked, as it is in the CES.[18] Bowler and Morisi (2006) gives a thorough discussion of differences between the CPS and the CES even within the intersection of their intended scopes. Farm employment creates additional measurement challenges when comparing CPS with table 1, such as differ-

and religious organizations, railroads, and various other smaller categories. The CES is benchmarked annually to the QCEW with supplemental information from the RRB (the same source we use for railroad data in table 1) and the CBP (which is based on the Census Bureau's Business Register underlying the SUSB–based estimates on table 1); see Bureau of Labor Statistics (2020*b*) for detail. Our estimate that QCEW covers about 95 percent of the employment universe is broadly consistent with the BLS estimate noted in Bureau of Labor Statistics (2020*a*).

17. Doniger and Kay (2021) use CPS data to study the effects of the PPP on local employment by firm size; an advantage of using CPS data for this purpose is the inclusion of nonemployers. The authors find that PPP had positive effects overall but that delays in funding disbursement were costly in terms of jobs, particularly at the smallest firms.

18. Every year the CPS's population estimates are adjusted using information from the Decennial Census and the American Community Survey. This adjustment is done at a disaggregated demographic level but is not based on labor force (e.g., employment) status.

ing classification across the sources (the Census of Agriculture data underlying our universe estimates likely include many establishments whose primary activity is not farming).

The low count of self-employed individuals in the CPS relative to the nonemployer estimate from table 1 partly reflects differences in concepts; indeed, Bowler and Morisi (2006) explicitly caution against direct comparisons of CPS self-employment and nonemployer business counts.[19] The businesses owned by self-employed individuals may appear in employer categories in table 1; more importantly for explaining the relatively low CPS count, many nonemployer businesses are likely owned by CPS respondents who report being wage and salary workers.[20]

Notably, establishment counts in the QCEW are higher than the counts we find in our universe estimates (we do not explicitly report our establishment counts on table 1). That QCEW employment counts are lower than, while QCEW establishment counts are higher than, Census Bureau counts is a known issue.[21] Firm counts also differ somewhat between official data sources (not shown on table 3). For example, for 2017 the SUSB, which counts all firms with positive *payroll* any time in the year, reports 5,996,900 firms; for the same year the business dynamics statistics (BDS), which uses the same Census Bureau source data but counts only firms with positive *employment* in March, reports 5,252,110 firms. A third product, the BLS's Business Employment Dynamics (BED), reports 5,189,000 firms for 2017 under a similar criterion to the BDS but with firm identifier concepts and industry scope that differ from Census Bureau sources (see Handwerker and Mason, 2013, for an exploration of firm identification in BLS data).

Establishment counts aside, the BLS sources are generally below our universe estimates presented in table 1, consistent with our goal of describing the entire business universe.

5.2 Alternative data sources

A number of researchers have turned to alternative data sources on business activity during the Pandemic Recession, because they provide timely insights into economic activity that are not available from official data sources. While some of these data sources provide timely indicators

19. "The concepts and definitions used to create each of these data series are so different, however, that it is difficult to make comparisons between the two." Bowler and Morisi (2006), p. 35.

20. Abraham et al. (2018) link BLS household microdata with Internal Revenue Service (IRS) nonemployer business data and find a large number of households do not self-report as self-employed in BLS data but do have business income, a gap that has risen over time; the authors explore a number of other dimensions of self-employment activity in BLS and Census Bureau data.

21. See Becker et al. (2005) for discussion of differences between business data in BLS sources and the Census Bureau sources underlying most of table 1; discrepancies between these sources are well known. Barnatchez, Crane and Decker (2017) report time series patterns of employment and establishment counts in BLS versus Census sources for 1998–2014; the employment discrepancy is roughly stable, but for establishment counts a positive gap between BLS and Census data opened in the early 2000s and has expanded since then. The rising discrepancy appears to be driven largely by small establishments and may reflect, in part, movement between the employer and nonemployer universes.

Table 4. Comparison of Activity Measures across Alternative Data Sources
Percent of corresponding universe measure

	Employment				*Firms*	*Estab.*
Class	*ADP*	*Compu-stat*	*Home-base*	*D&B/ NETS*	*D&B/ NETS*	*D&B/ NETS*
1. Private nonfarm	20	22		120	76	78
2. Small	25	–	1	130	76	78
3. Medium	30	15		119	115	103
4. Large	10	87		84	54	49

Sources: ADP, Inc. (data for February 2020), Compustat North America (data for 2019), Homebase (data for February 2020), National Establishment Time Series (NETS) (data for 2014).

Notes: ADP, Compustat, and Homebase are expressed as a percent of nonfarm private employer universe from table 1. D&B/NETS are expressed as a percent of nonfarm private employer plus nonemployer universe. Empty cells indicate data for comparison are not available. "–" indicates a value below 1 percent. ADP values are rounded to nearest 5 percentage points for confidentiality.

of economic activity, they also face limitations in terms of coverage and representativeness. Table 4 compares activity measures from several sources with our universe estimates from table 1.

5.2.1 ADP

ADP, Inc. is the country's largest payroll processor, accounting for roughly one-fifth of private payrolls (see the first column of table 4). ADP data have been used for tracking the economy during the pandemic: Cajner et al. (2020) study employment, wages, and business shutdown during 2020, Autor et al. (2020) study the effects of the PPP on employment, and Crane et al. (2021) study business death during 2020. A key strength of ADP data is its significant coverage across business size and industry, making the data potentially appropriate for studying the entire firm size distribution described in table 1—particularly through the use of sampling weights (see Cajner et al., 2018, for an exploration of ADP's representativeness).[22] The significant coverage and the high-frequency nature of the data make ADP data well suited for studying business and employment dynamics during the pandemic.

5.2.2 Compustat

Perhaps the most popular source of business microdata is Compustat, which provides firm-level information from balance sheets, income statements and statements of cash flows.[23] These data

22. We use total active employment (i.e., number of workers in payroll databases) aggregated by parent company identifier in the payroll database used by Cajner et al. (2018). The parent company identifier differs from the control unit identifier used in that paper, which is focused on establishment characteristics. We define firm size bins using active employment.

23. We access these data from S&P Global, Compustat North America, via Wharton Research Data Services.

are highly useful due to the range of information available for firms over several decades. Compustat data are limited to publicly traded firms; therefore, in terms of the breakdown provided on table 1, Compustat data are best suited to studying the CCFs and Main Street.[24] This can be seen in the second column of table 4, where coverage of medium and, especially, large firms is substantial while coverage of small firms is negligible.[25] Notably, however, Cororaton and Rosen (2020) study publicly traded firms that received PPP assistance (of which there were 273 at the time their paper was written).

5.2.3 Small business data

Homebase is a provider of time clock services for small businesses; the rich microdata provided by Homebase have been used in key studies of the early Pandemic Recession period (e.g., Bartik et al., 2020) and in more recent work on business death (Crane et al., 2021). Kurmann, Lalé and Ta (2020) describe Homebase data in detail, including industry and size comparisons to QCEW universe data. In short, early 2020 Homebase data include about 500,000 (hourly) employees at about 60,000 establishments, almost all with fewer than 50 employees and most with fewer than 20 employees, concentrated in local service sector activities. As shown on table 4, Homebase covers only 1 percent of small firm employment. Based on tabulations from Kurmann, Lalé and Ta (2020), the industries with the strongest Homebase coverage are retail trade (NAICS 44–45) where 0.5 percent of small firm employment is covered; arts, entertainment, and recreation (NAICS 71) with 0.8 percent; and accommodation and food services (NAICS 72) with 1.9 percent. Businesses in these industries were particularly vulnerable to social distancing, so Homebase has been a valuable resource for studying effects of the pandemic on small businesses (Dvorkin, 2020).

Given the concentration in smaller establishments (and firms), businesses found in Homebase data are most relevant for the PPP — though Homebase businesses represent the small end of the distribution of PPP–eligible firms — and may lack the financial resources to benefit from Main Street programs. Granja et al. (2020) use Homebase data (among other sources) to study the effects of PPP on small business employment growth and argue that PPP disbursements were poorly targeted geographically.

Another popular source of data on small business experiences in 2020 is Womply, an aggregator of credit card transactions that provides analytical services. Small businesses are defined based on SBA criteria, which correspond roughly — but imperfectly — with our simplified approach in table 1. Womply data are used and described by Chetty et al. (2020). To our knowledge, the representativeness and coverage properties of Womply data have not been thoroughly

24. The effects of the CCFs can also be studied with bond market data or other market data (e.g., Bordo and Duca, 2020).

25. We use 2019 Compustat data. See the appendix for a discussion of these calculations, which rely on insights from Dinlersoz et al. (2018).

explored, though presumably the coverage is focused primarily on businesses that sell to consumers.

Last, we want to note that the Bureau of Economic Analysis is currently developing new small business GDP accounts based on Census Bureau and other data. Highfill et al. (2020) describes these efforts and summarizes previous efforts to comprehensively measure the small business economy.

5.2.4 D&B/NETS

Dun & Bradstreet (D&B), a business marketing company, maintains a list of U.S. establishments intended to be comprehensive and inclusive of both employers and nonemployers. D&B data have been widely used by researchers in the past, often in the form of the National Establishment Time Series (NETS). NETS is a product of Walls & Associates and focuses on the integrity of longitudinal linkages in D&B data. We have NETS data ending in 2014; we detail how we adjust the data to be comparable to our universe estimates in the appendix.

In principal, D&B/NETS data would be the primary private sector alternative to the Census Bureau and the BLS for describing the business universe, with a large sample of establishment-level data on both employment and revenue along with firm identifiers. D&B/NETS are also the only data sources shown on table 4 that include nonemployers. The specific coverage properties of these data are difficult to determine, however. As shown on table 4, D&B/NETS data have somewhat more employment but far fewer firms and establishments than our estimates of the private sector universe such that it is unclear what set of businesses are actually covered by the data.[26] Discrepancies in the distribution of activity across firm size class can arise from differing firm identifier definitions, but the overall discrepancies have not been well explained. Importantly, however, the biggest challenges to using D&B/NETS for studying policy have to do with data quality among covered businesses. D&B/NETS employment data are frequently imputed, and revenue data are almost entirely imputed such that a study of the entire universe is not feasible (Barnatchez, Crane and Decker, 2017; Crane and Decker, 2020). Moreover, Crane and Decker (2020) show that D&B/NETS data are not well suited to studying business dynamics, so the type of high-frequency analyses most useful for studying the 2020 pandemic are not feasible in these data (a challenge faced by Hubbard and Strain, 2020). However, the data may be useful for obtaining information about specific firms participating in federal programs.

26. Comparing table 4 with table 3 suggests that D&B/NETS discrepancies with BLS universe data are even larger, both in terms of employment and establishment counts. One possible explanation for excess employment in D&B/NETS is the inclusion of informal (e.g., family) workers.

5.2.5 Other alternative data sources

While we have listed the primary alternative data sources that are likely to be used for studying Pandemic Recession programs, a number of other sources have been used as well. Most notably, Chetty et al. (2020) employ data from Kronos and Paychex, combined with a D&B weighting scheme, to study the PPP; these data sources are less well understood than the ones we describe above, but the authors explore representativeness explicitly. Chetty et al. (2020) note that, like ADP, these sources are high frequency and have coverage across the business size distribution, though ADP is a larger sample (and each of Kronos, Paychex, and ADP exclude nonemployers). Other sources may be in use of which we are not aware. Our analysis above suggests that researchers should clearly outline the universe targeted by their data (e.g., "small employer firms"); address questions of representativeness (with sampling weights if necessary), frequency, and imputation; and account for excluded portions of the universe when aggregating estimated policy effects.

6 Conclusions

Our estimates of the U.S. economic universe are nearly exhaustive, omitting only a small handful of business types. Assigning this economic activity to pandemic-related policies reveals a striking fact about the pandemic response: almost every job is associated with firms or entities meeting notional eligibility criteria for a direct lending program. This implies that the dominant limitations on program coverage existed *within* entity categories defined by legal form and business size; for example, large for-profit businesses met basic qualifications for the CCFs but may nevertheless have lacked the ability to issue bonds, and medium-sized businesses met basic Main Street qualifications but may have been ineligible due to leverage criteria.

The direct lending policy response to the Pandemic Recession was substantially broader than that during the Great Recession, when such lending was largely limited to the financial sector and automakers. Nevertheless, some caution is warranted when considering the policy support, as our mapping of the support provided by specific programs to areas of the economy is not exact. For example, we assign firms to the PPP based on a 500-employee threshold even though some firms with greater than 500 employees were eligible for the PPP under industry-specific SBA criteria (though we do include all eligible activity in the accommodation and food services sector). Moreover, some small businesses may have been able to use a loan funded by Main Street rather than relying exclusively on the PPP.

Our tabulations highlight the challenges faced by statistical agencies seeking to measure the economy. Taken together, the various data sources we use illustrate steep trade-offs between timeliness and detail; for example, SUSB data provide rich detail on firm size and revenue, but these data are only available with a lag measured in years (and the revenue data only appear

in semi-decadal Economic Census years). We therefore rely heavily upon the QCEW to adjust 2017 SUSB values to 2019 estimates; QCEW data are more timely (being released with a lag of just two quarters) but lack revenue and firm size detail (the BED, a close cousin of QCEW, has firm size tabulations, but they do not reach the larger size classes we study). Universal comprehensiveness is also difficult to achieve; for example, railroads are excluded from the business lists at both the Census Bureau and the BLS for idiosyncratic historical reasons (Railroad Retirement Board, 2020), some nonprofits are excluded from the BLS lists due to laws governing unemployment insurance, farm data are the purview of the Department of Agriculture and measured with concepts and definitions that are unique to the industry, and the nonemployer and self-employment universes are inherently difficult to consistently measure across agencies. The steep trade-offs faced by the statistical agencies ultimately arise from the source data upon which they must rely, some of which (e.g., IRS data) are generated based on concepts and timelines designed for purposes other than optimal measurement.

More broadly, measurement of the economy depends heavily on the taxonomic framework available to those collecting data, with basic concepts around business objectives, industry, and location having significant implications for how the economy is measured. Alternative private sector data provide advantages in terms of timeliness and are often immune to the intricate legal constraints that govern statistical agency coverage and definitions, but such data come with substantial limitations in terms of quality and representativeness; ultimately, there is no substitute for scientifically produced statistics. The statistical agencies navigate these various trade-offs with impressive skill, ultimately producing statistics that are remarkably consistent even when based on differing source data (see table 3). Our main contribution is to combine data sources based on their respective advantages to paint a comprehensive picture of the business universe; achieving such comprehensiveness is an important goal, since crafting and evaluating business-facing policies must first begin with accurate measurement of the entire business universe.

Appendix

A Data sources

Our estimates combine various data sources to cover virtually the entire universe of U.S. economic activity. Our tabulations exclude only informal activities, private households, certain financial entities (pension, health, welfare, and vacation funds and trusts, estates, and agency accounts), and business entities owned by Tribal governments.

A.1 Employer businesses

A.1.1 Statistics of U.S. Businesses

Our main data source is the Statistics of U.S. Businesses (SUSB), which reports firm counts, employment, annual payroll, and annual receipts by firm size, where a firm is a collection of operating business locations ("establishments") under unified ownership or operational control.[27] SUSB data cover the universe of employer business establishments excluding farms (NAICS 111 and 112), railroads (NAICS 482), private households, and public administration (NAICS 92). Certain government-owned businesses (i.e., outside of NAICS 92) *are* included in the SUSB universe, though, as discussed in section A.1.2, we drop these. Nonemployer businesses — those businesses without formal W-2 employees — are excluded from SUSB.

The 2017 SUSB data include tabulations by legal form of organization (LFO). We obtain the share of activity, by sector and firm size, associated with each legal form. We observe for-profit businesses (including corporations, partnerships, and sole proprietorships), nonprofit businesses, and government-owned businesses. The latter are businesses engaged in regular business activities outside of public administration (e.g., government-owned hospitals). The SUSB LFO data have only one size category for firms with at least 500 employees, so we apply LFO shares from this group to both the "medium" and the "large" size categories on table 1. If, for example, nonprofits are less likely than for-profit businesses to be large, we overstate nonprofit activity in the large category and understate nonprofit activity in the medium category.

Since SUSB data are for 2017, we adjust all activity measures to 2019 estimates. For establishment counts, employment, and payroll, we apply the sector-level growth rates of establishment counts, employment, and payroll in QCEW from 2017:Q1 to 2019:Q1 (we apply these growth rates to each firm size class; that is, we assume that activity rose by the same amount for each firm size class). For firm counts, we use the ratio of firm counts in 2019:Q1 to firm counts in 2017:Q1 from BED data, which are available only at the economy-wide level (i.e., not by sector). We obtain sector-level firm count growth rates with a two-step process: we begin by adjusting firm counts using the growth rate of *establishment* counts at the sector level (from QCEW, 2017 to 2019); we then revise these sector growth rates to ensure that sector-level firm count growth rates are consistent with the aggregate firm count growth obtained from BED (i.e., we multiply sector-level establishment count growth rates by the ratio of the economy-wide firm count growth rate to the economy-wide establishment count growth rate). In other words, we assume that firm count growth is distributed across sectors in the same way that establishment count growth is distributed across sectors. We adjust revenue using the ratio of national income and product accounts (NIPA) value added by sector in 2019 to that in 2017. Importantly, our method for "growing" our economic activity estimates from 2017 to 2019 estimates abstracts from the possibility of individual firm movements across size classes; essentially we assume that the proportional distribution of activity across firm size classes is unchanged.

A.1.2 Government-owned businesses in SUSB

As just noted, SUSB data include government-owned businesses in certain industries: wholesale liquor establishments, retail liquor stores, tobacco stores, book publishers, monetary authorities–

27. The SUSB data are available on the Census Bureau website at `https://www.census.gov/data/tables/2017/econ/susb/2017-susb-annual.html`.

central bank, federally-chartered savings institutions, federally-chartered credit unions, hospitals, gambling industries, and casino hotels. In discussions with Census Bureau staff, we determined that most government-owned businesses present in SUSB are also counted in the Census of Governments and Annual Survey of Public Employment and Payroll figures underlying our measures of government activity. Therefore, we drop government-owned businesses from SUSB–based tabulations. This leads to a small amount of undercounting of activity, however, because certain government-owned businesses are not included in the Census of Governments and Annual Survey of Public Employment and Payroll figures. The main omissions are those businesses owned by Tribal governments as well as some banks and credit unions (except the Bank of North Dakota, which is noted in U.S. Census Bureau, 2006).[28]

The omission of businesses owned by Tribal governments is unfortunate and, to our knowledge, represents an area of economic activity that is particularly difficult to quantify. These businesses are included in published SUSB totals but are not separated from other government-owned businesses in any recent public tabulations of which we are aware. A (dated) U.S. Treasury report suggests that gaming and gambling hotel businesses represent a significant — and rapidly growing — share of these activities; gaming industries accounted for about 93 percent of federal tax returns of, and about 79 percent of tax dollars paid by, Tribe-owned businesses in 2004, but other businesses are also significant contributors, such as agriculture, fishing, gasoline stations, smoke shops, restaurants, and banks (Treasury Inspector General for Tax Administration, 2007).

A.1.3 Railroads

As noted above, SUSB excludes railroads (NAICS 482), so we estimate railroad activity as follows. We obtain total railroad employment and payroll data from the Railroad Retirement Board (RRB), which also provides railroad data for CES.[29] We use March 2019 employment figures (to be consistent with QCEW–adjusted estimates used elsewhere), but payroll data for 2019 are not yet available. To be consistent with our SUSB methodology, we use 2017 payroll data, which we adjust to 2019 values using 2017–19 payroll-per-worker growth for NAICS 48–49 (transportation and warehousing) from QCEW; in other words, we assume that payroll per railroad worker grew at the same pace as payroll per worker in the transportation and warehousing sector more broadly.

We distribute employment and payroll across firm size classes as follows. Employment data for Class I railroads, most of which have more than 15,000 employees and more than $5 billion in revenue, are available from the Surface Transportation Board (STB); and data for Amtrak are available from the Bureau of Transportation Statistics.[30] We construct employment of large railroad firms as the sum of employment for the large Class I firms. The difference between this sum and the totals obtained from RRB represents the activity of medium and small firms; we

28. We confirmed these exclusions from the Census of Government with Census Bureau staff. We could not find them spelled out in Census of Government technical documentation.

29. `https://www.rrb.gov/sites/default/files/2020-06/selectdt.pdf`.

30. STB data are from `https://www.rrb.gov/node/5129`. The Class I railroads are Burlington Northern - Santa Fe, CSX Transportation, CN/Grand Trunk Corporation, Kansas City Southern, Norfolk Southern, Soo Line, and Union Pacific. We classify CN/Grand Trunk Corporation, Kansas City Southern, and Soo Line as medium firms in our taxonomy, while the remaining Class I railroads are classified as large firms.

share out this residual employment using corresponding shares for NAICS 48–49 from SUSB.[31] We then assign payroll to size classes by sharing out total payroll with the assumption that payroll per worker is distributed across railroad firm size classes in the same manner as payroll per worker is distributed across firm size classes for NAICS 48–49 as a whole.

We obtain 2019 revenue data for Class I railroads from STB; this provides total revenue for the large railroads (the four Class I railroads that count as large). We impute small and medium railroad revenue using the ratio of revenue per worker for the three Class I firms that are medium along with Amtrak, which is a medium firm as well.

The RRB also provides a listing of all covered railroad firms, which we use to obtain a 2018 firm count; given employment trends in the sector, we assume the firm count was constant from 2018 to 2019 (Amtrak is not in this RRB listing, so we add it). We assign four of these firms to the large category (these are the Class I firms that count as large), and we assign 25 of these firms to the medium category.[32] Remaining railroad firms count as small. Finally, we estimate establishment counts using the ratio of establishments to firms, by firm size, from SUSB data for NAICS 48–49. Railroad numbers are included as part of NAICS 48–49 (transportation and warehousing) data in our main calculations. Our railroad methodology likely excludes some passenger railroad firms.

A.1.4 Farms

Both farms (NAICS 111, crop production) and ranches (NAICS 112, livestock production) are omitted from most Census and BLS data products. We obtain farm data from the 2017 Census of Agriculture produced by the Department of Agriculture. We use the number of farms to indicate the number of "firms" and establishments, though we emphasize that farm statistical concepts do not map well into Census Bureau firm taxonomy. Moreover, many farms may be owned by firms that also have establishments in nonfarm industries, in which case those firms are also counted in our SUSB tabulations. We use "hired workers" as our farm employment measure, omitting the large categories of contract workers and unpaid workers to be consistent with the methodology used by other statistical agencies (note that some contract workers may appear in the nonemployer data). Our farm payroll measure is labor costs for hired workers. Receipts data are also available in the Census of Agriculture. We adjust farm counts, employment, and payroll to 2019 levels using biennial Department of Agriculture survey data (National Agricultural Statistics Services, 2021), and we adjust receipts using NIPA gross output data for the agricultural sector. Note that our farm data include both employers (i.e., farms with hired workers) and nonemployers (i.e., farms with no hired workers); Census of Agriculture data suggest that roughly three-fourths of farms have no formally hired workers.

Importantly, the Census of Agriculture counts as a farm any business producing at least $1,000 worth of crops or livestock, regardless of whether farming is the primary activity of that business location (whereas Census Bureau data assign establishments to industries based on the primary activity of each establishment).[33] On the one hand, this means that there may be

31. We define small railroads as those with fewer than 1,500 employees, consistent with SBA criteria.

32. It is difficult to determine how many firms belong in the medium category. Various internet sources indicate that there are roughly 20 Class II railroads; we adopt this figure then add Amtrak and the four Class I railroads that are medium to produce an estimate of 25 medium railroad firms.

33. See `https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Volume_1,_Chapter_1_US/usintro.pdf`

some double counting in table 1; that is, there may be some establishments (and, therefore, firms) classified in nonfarm industries in the SUSB that also appear as farms in the Census of Agriculture. On the other hand, some establishments engaged in agricultural support services may not be counted in *any* of our data sources, a more general measurement lacuna described by Dunn and Hueth (2017).

A.2 Nonemployers

Nonemployers are those businesses that sell goods or services but do not have formal W-2 employees as recognized by the Social Security Administration. For example, ride-sharing drivers and freelance journalists are likely to count as nonemployer businesses for statistical purposes. The Census Bureau's Nonemployer Statistics (NES) report the number and receipts of nonemployer businesses based on IRS data. The Bureau first drops businesses with negligible sales, typically defined at $1,000 but varying by industry (the threshold is just $1 in construction), as well as businesses that can be identified as out of scope (such as estates and trusts). The NES data report the establishment count, which we use for a firm count under the assumption that each nonemployer establishment is its own firm. We also use the establishment count as an "employment" count under the assumption that each nonemployer has one business owner working at the business, though it is important to note that we do not include nonemployed business owners in employment counts for employer businesses. Similarly, though nonemployers do not have payroll, owners of nonemployer businesses qualified for PPP assistance to cover their own compensation; to estimate nonemployer "payroll" we obtain sector-level ratios of payroll to receipts among *employer* firms with less than $5 million in annual revenue (SUSB data), then we apply these ratios to NES receipts figures.[34]

Our nonemployer data are for 2017; we adjust these to 2019 values using the growth rate of unincorporated self-employment in the CPS. We note that measurement of the nonemployer (and self-employed) universe is difficult, with diverging estimates between Census Bureau and BLS data sources (Abraham et al., 2018).

A.3 Government

Data on government economic activity is obtained from a number of sources. Federal civilian payroll is obtained from the NIPA and is equal to federal nondefense compensation plus federal civilian defense compensation; federal civilian employment is from the CES; federal revenues are from the OMB Historical Tables, Table 2.1. Armed forces employment is obtained from the Department of Defense Active Duty Master File and is the sum of active duty military, National Guard, and armed forces reserve employment. Armed forces payroll is obtained from the NIPA and is equal to federal military compensation. State and local government own source general and utility revenue comes from the 2017 State & Local Government Finance Historical Datasets and Tables, and state and local employment and payrolls come from the Individual Unit File of

34. We use the payroll-to-receipts ratio for firms with less than $5 million in receipts because more than 99 percent of nonemployer businesses have receipts below $5 million. Choosing a lower size cut-off would typically result in a higher ratio, though the ratio is fairly stable in the $100,000 to $5 million range (between 30 and 27 percent among all sectors combined in 2017). An alternative would be to look only at employers with receipts below $100,000, which have a payroll-to-receipts ratio of about 39 percent; nonemployers in this revenue category account for about 89 percent of all nonemployers, but they are likely to account for a far smaller share of total nonemployer receipts.

the 2017 Annual Survey of Public Employment and Payroll. These payroll figures include only wages and salaries. In order to capture benefits, and thus be comparable to the private sector payroll figures, we inflate these figures by the inverse of the percent of total compensation from wages. The percent of total compensation from wages is obtained from the Employer Costs for Employee Compensation, Historical Listing, National Compensation Survey. We inflate all 2017 values to 2019 values. For state and local own source general and utility revenue, we inflate by the ratio of 2019:Q1 to 2017:Q1 current tax revenue from the NIPA. For state and local payroll, we inflate by the ratio of 2019:Q1 to 2017:Q1 NIPA state and local government compensation. For state and local employment, we inflate by the ratio of March 2019 to March 2017 CES employment.

A.4 Alternative measures of the business universe

A.4.1 QCEW

The QCEW is the BLS counterpart to the Census Bureau's Business Register that underlies the bulk of our main universe estimates (Bureau of Labor Statistics, 2019). QCEW is based on state unemployment insurance (UI) records and therefore provides an independent measure of the *employer* universe defined by the UI system. QCEW is a high-quality count of U.S. business establishments.

The industry scope of QCEW is slightly different from the Census Bureau's universe coverage. In addition to excluding many (but not all) farms and all railroads, QCEW also excludes some religious groups (in NAICS 813), some domestic workers (NAICS 814), and some nonprofits; some of these exclusions vary by state. But QCEW *includes* most government-owned establishments at the local, state, and federal level. For the most part, QCEW defines establishments similarly to Census Bureau data products; however, in some cases establishments engaged in activities corresponding with multiple industries appear as multiple establishments in QCEW (if separate payroll records are kept and available).

A.4.2 CES

Current Employment Statistics (CES) is the workhorse monthly BLS payroll survey (Bureau of Labor Statistics, 2020*b*). While the monthly CES estimate is derived from a sample, rather than the universe of businesses, the series is benchmarked annually to reflect the total nonfarm business universe as measured by QCEW, supplemented with data on industries that are out of scope for QCEW. In particular, data on railroads (NAICS 482) are taken from the Railroad Retirement Board, and data on nonprofits without unemployment insurance coverage are eventually taken from County Business Patterns (CBP) (Bureau of Labor Statistics, 2020*b*). The annual benchmark is focused on March of a given year and is available in February of the following year; this makes CES the most timely official measure of total nonfarm employment. Importantly, CES scope excludes proprietors, the unincorporated self-employed, and domestic workers but includes government establishments (except the military and certain national security agencies).

A.4.3 CPS

The CPS is a monthly survey of roughly 60,000 U.S. households that is published by the BLS (U.S. Census Bureau, 2019). As a household survey, CPS differs substantially from other data sources that are based on surveys or censuses of businesses. The CPS measures employment of workers at any kind of business, including self-employed individuals, agricultural workers, and unpaid family workers who are excluded from the CES, QCEW, SUSB, and CBP. Importantly, workers who hold multiple jobs are only counted once in official CPS tallies, even though each job would, in theory, be counted separately in the business surveys. We use information on first and second jobs from the March 2019 CPS microdata to create a count of *jobs* for the purposes of table 3.

A.4.4 Compustat

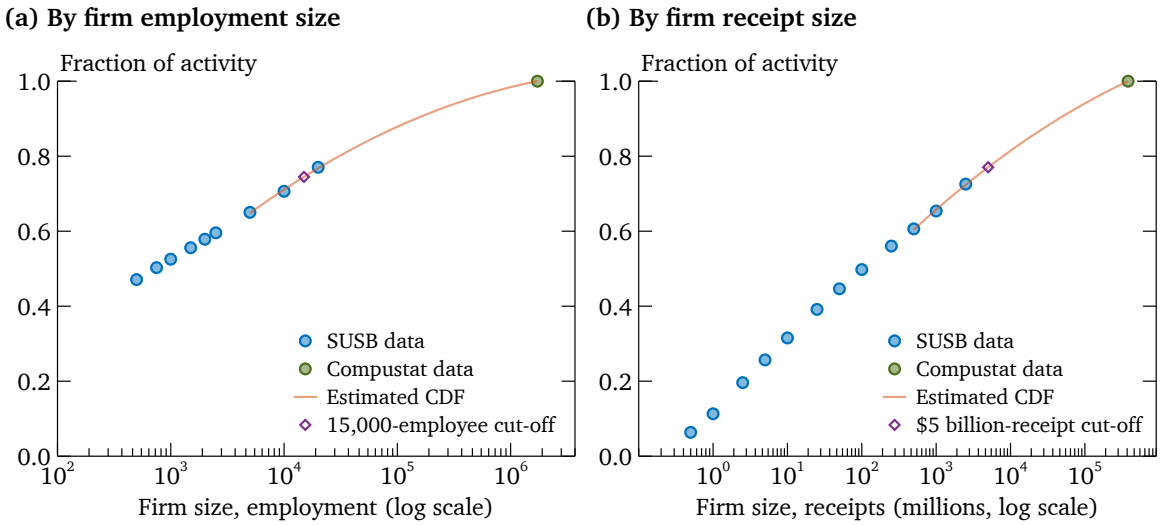
Compustat is a widely used panel data set containing balance sheet, cash flow and income statement data for public firms. We access these data from S&P Global, Compustat North America, via Wharton Research Data Services.[35] For our analysis, we clean the data as follows. We drop firms that do not have a headquarters of "USA" or a currency code of "USD." We drop firms that have a 2-digit NAICS code of 92 or 99, a 3-digit NAICS code of 325, or do not have a NAICS code. We also drop observations with missing or negative sales or employment. After performing these steps, we identify the year of the observations and drop observations that are duplicates for a given firm (`gvkey`) for a given year. Finally, we scale the employment and sales values by 0.75 and 0.79, respectively, following Dinlersoz et al. (2018) who find that Compustat employment figures appear to overstate firms' U.S. activity.

A.4.5 D&B/NETS

We use raw NETS data from 2014 to construct the estimates of employment (`emp14`), firm (`hqduns`), and establishment (`dunsnumber`) counts. To be comparable to the nonfarm private sector, we drop from NETS farms (NAICS 111 and 112), public administration (NAICS 92), and the postal service (NAICS 491110), but we keep any government-owned businesses outside NAICS 92 because they cannot be identified. We do not perform additional cleaning steps common in the literature (e.g., Barnatchez, Crane and Decker, 2017), which would further reduce firm and establishment counts. We render NETS data equivalent to our universe estimates by first adjusting firm size cut-offs to be equivalent to 2017 SUSB firm size cut-offs. We adjust employment cutoffs using CES employment growth for 2014–17; the 500-employee and 15,000-employee cutoffs in 2017 translate to 470-employee and 14,085-employee cut-offs in 2014. We adjust the receipts cut-off using nominal GDP growth for 2014–17; the $5 billion cut-off in 2017 translates to $4.48 billion in 2014. After tabulating employment and establishment counts by firm size, we adjust these quantities to 2019 equivalent using our usual method of applying CES employment growth rates and QCEW establishment count growth rates.

35. `https://wrds-www.wharton.upenn.edu/pages/about/data-vendors/sp-global-market-intelligence/`

Figure B1. CDF of Employment (all sectors)



Sources: See table 1.

B Program-specific adjustments to data

B.1 Estimating Main Street firm size cut-offs

For firms to have qualified for the Main Street programs they needed to have had fewer than 15,000 employees or less than $5 billion in annual revenue in 2019. Alas SUSB tabulations by firm size do not include cut-offs at these values. For firm employment size, SUSB includes a category bounded by 9,999 employees and 19,999 employees, while for firm revenue size, sector-level tabulations are reported only for firms with greater than $2.5 billion in revenue. We estimate the Main Street employment and revenue thresholds for each NAICS sector by estimating cumulative density functions (CDFs) for each activity measure.

SUSB data provide the firm size distribution in terms of both employment and revenue by NAICS sector; the blue circles in figure B1 plot the cumulative fraction of employment by firm size from the SUSB tabulations for all sectors. As shown by the purple diamond in panel (a), the 15,000 employee cut-off lies between two firm-size categories in SUSB, whereas in panel (b), the $5 billion receipts cut-off lies entirely inside the "$2.5 billion or higher" receipts size category. To improve our estimates, we augment the SUSB data with the size of the top firm in each sector, shown by the green circle at the upper-right of each panel.

In the absence of microdata for the entire firm universe, it is not obvious how best to measure the largest firm in each sector; this observation is not provided with SUSB data but is necessary for CDF estimation. We assume that the largest firm in each sector is publicly traded and obtain each firm and its employment and revenue from Compustat, using Compustat's industry codes to match top firms with sectors (scaling each firm's size according to the rules of thumb found by Dinlersoz et al., 2018).[36] A limitation of this method is that it relies upon firm-level industry

36. No firms in Compustat are in NAICS 55, so we apply the NAICS 54 maximum to NAICS 55. We do not apply the Dinlersoz et al. (2018) rule of thumb in the agriculture sector for reasons of convenience: the top firm we identify would have fewer than 20,000 employees after the adjustment (but greater than 20,000 before the adjustment), and

codes, whereas industry should actually be defined at the establishment level; the largest firm in a sector as labeled by Compustat data may not actually be the largest firm with establishments in that sector.[37]

We separately estimate the employment-based CDFs (i.e., $P(E < e)$, where e is firm employment size) and the revenue-based CDFs (i.e., $P(R < r)$ where r is firm revenue size). To estimate the share of activity at firms with fewer than 15,000 employees, we calculate the empirical CDF by employment size provided by SUSB data (which includes points at 9,999 and 19,999 employees) by NAICS sector then, omitting categories of firms with fewer than 5,000 employees (to improve fit in the area of focus), we fit the empirical CDF with both a linear quadratic (in firm size) form and a logit form (also quadratic in firm size).[38] For each of firm counts, employment, payroll, and revenue CDFs, we select either the linear quadratic or the logit form based on root mean square error.[39] In practice, we always choose the logit form for the firm CDFs and the quadratic form for all others. (In a few cases, the quadratic specification produces a CDF that is not monotonic in the area of the cut-off, in which case we simply specify a linear function instead.)

The orange line on figure B1, panel (a) shows — for the whole economy — the resulting employment CDF by firm employment size. With estimated sector-level CDF curves (in terms of employment size) in hand, we identify the share of firms, employment, payroll, and revenue associated with firms with fewer than 15,000 employees; this is illustrated by the purple diamond.

To estimate the share of activity at firms with less than $5 billion in revenue, we use the same methodology on SUSB revenue size categories, omitting categories below $100 million in revenue. The orange line on figure B1 shows — for the whole economy — the resulting employment CDF by firm receipts size, with the purple diamond showing the $5 billion cutoff. We then have sector-level estimates of (a) the share of firms, employment, payroll, and revenue that is at firms with fewer than 15,000 employees, and (b) the share of firms, employment, payroll, and revenue that is at firms with less than $5 billion in revenue. In line with the Main Street criteria, we identify the top of the medium size class by sector based on the higher of either 15,000 employees or $5 billion in annual receipts. In two sectors, education services and other services, the largest firm has annual receipts below $5 billion, so we assign no activity to the large class for those sectors.

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the procedure is simpler if the top firm has more than 20,000 employees since SUSB data provide a size bin cutoff at 20,000. We view this discretionary intervention as small relative to the overall measurement error present in our approach.

37. An alternative method would be to assume that all extremely large firms have establishments in every NAICS sector, such that the largest firm with activity in each sector is simply the largest firm in the United States. In other words, perhaps Walmart is the largest firm in every sector. But attaching Walmart to each sector leads to highly irregular CDFs in some cases, so we judge that our method of using Compustat industry codes to identify top firms by sector generates less error.

38. While we could, in principle, estimate the entire CDF (i.e., across the entire firm size distribution), in practice we find this to be excessively difficult. For example, when fitting these distributions with a lognormal density assumption, it is difficult to obtain a tight fit across the size distribution such that the researcher must choose which areas to fit most closely (see Kondo, Lewis and Stella, 2018, for evidence on the firm and establishment size distribution). Given these difficulties, we found it more productive to focus on tightly fitting the neighborhood of the distribution close to the Main Street–based cut-offs at 15,000 employees or $5 billion in revenue with a nonparametric approach.

39. We also estimate the CDFs for establishment counts for each sector.

Figures B2–B21 show results for each NAICS sector. In each figure, panel (a) — the top four charts — reports CDFs in terms of firm employment size, while panel (b) — the bottom four charts — reports CDFs in terms of firm receipt size. We show CDFs for each of firm counts (top left), employment (top right), payroll (bottom left), and receipts (bottom right). Each figure has the same legend as figure B1: blue circles indicate firm size cutoffs reported in SUSB data, green circles indicate the size of the largest firm in the sector as inferred from Compustat data, purple diamonds show Main Street-relevant cutoffs (15,000 employees or $5 billion in receipts), and orange lines show estimated CDFs.

After allocating activity to size bins using this sector-specific CDF estimation methodology, we sum employment, payroll, and receipts across sectors to obtain the figures shown on table 1 (we also obtain unreported establishment counts in this manner). However, this method cannot be used to obtain all-sector firm counts, since in SUSB data firms with establishments in multiple sectors appear in each sector and would therefore be double counted in simple sums across sectors. This problem is particularly salient among larger firms; for example, in 2017 SUSB tabulations, firms with at least 20,000 employees operate in an average of roughly five NAICS sectors. Therefore, to obtain economy-wide firm counts by firm size categories, we estimate an economy-wide CDF in terms of firm counts. After all other processing (described in appendix A), we adjust final firm counts for each size category using the ratio of firms in the two methods (economy-wide CDF estimation and summation across sector CDF estimations) to adjust totals.

B.2 PPP adjustments for NAICS 72

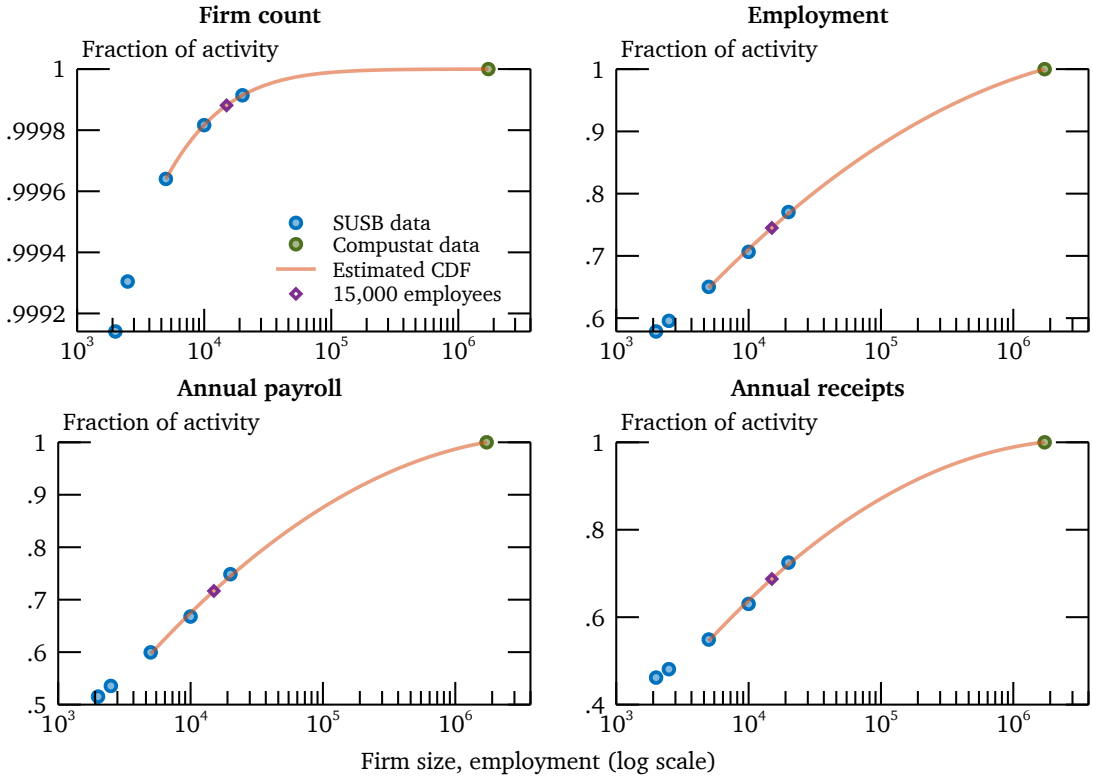
As noted in the main text, PPP was available to firms of any size with establishments in the accommodation and food services sector (NAICS 72) that have fewer than 500 employees. SUSB data provide activity measures by firm size but not establishment size. We use the Census Bureau's CBP for 2017 to calculate the activity of large firms which qualified for PPP under this special criterion. CBP data rely on the same microdata as SUSB (the Business Register) but provide tabulations of establishments, employment, and payroll by *establishment* size (data on firm counts or receipts are not present in CBP). We obtain counts of establishments, employment, and payroll at *establishments* with fewer than 500 employees in NAICS 72 (from 2017 CBP) then subtract the establishments, employment, and payroll of *firms* with fewer than 500 employees (from 2017 SUSB) to obtain the establishments, employment, and payroll among establishments with fewer than 500 employees that are controlled by firms with at least 500 employees. We express the resulting activity in terms of shares of total activity for firms with at least 500 employees. We assume that the share of receipts associated with the relevant establishments is equal to the payroll share; in other words, we assume that the ratio of receipts to payroll is the same for establishments with fewer than 500 employees and larger establishments. We distribute the resulting activity between medium- or large-firm size bins using the share of establishments, employment, payroll, and receipts in the two size classes from SUSB. Distributing firm counts is more difficult; we simply assume that all medium and large firms have at least one establishment with fewer than 500 employees, such that all medium and large firms should be assigned to the PPP since they each had access to it through at least on establishment (by assumption).

C Extra material

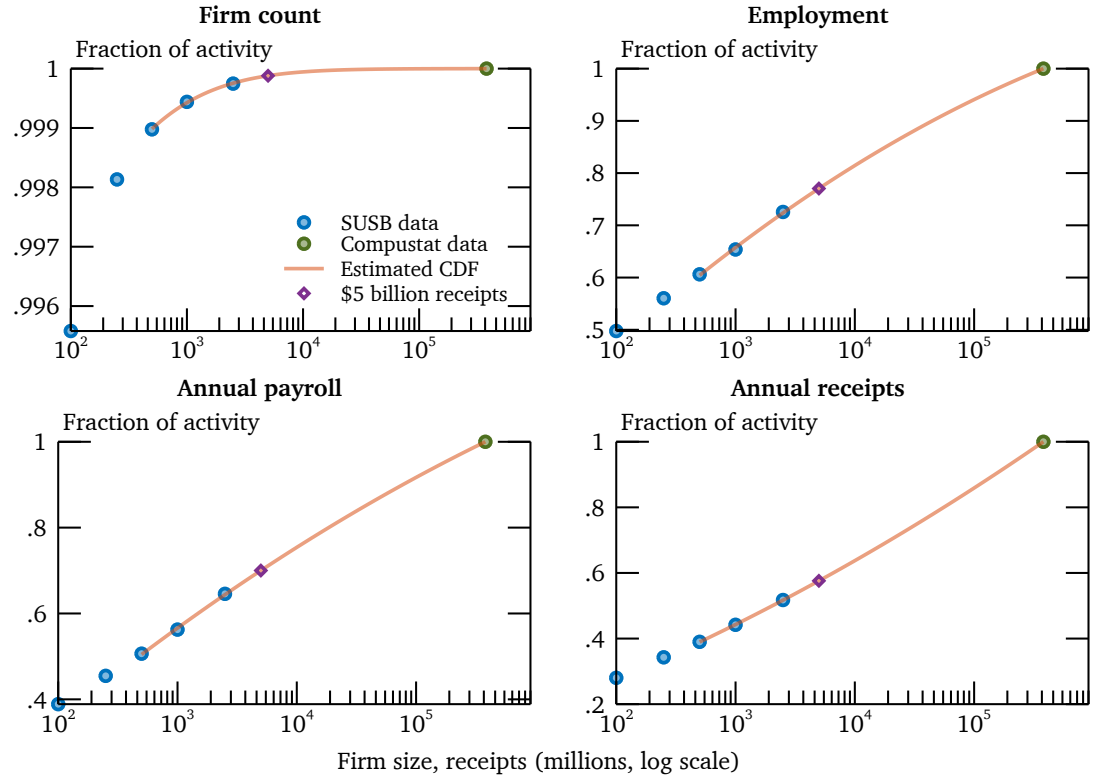
Figure 1 in the main text shows total employment by sector broken down into firm size and legal form categories. Figure C1 does the same for total firm counts, illustrating the extreme skewness of the firm size distribution even within sectors. The vast majority of firms are nonemployers, and most employer firms are small for-profit enterprises (or, in the case of the agriculture sector, small farms). Figure C2 reports these decompositions for annual payroll, revealing the markedly high payroll of the public administration sector relative to other sectors. Finally, figure C3 shows these decompositions for annual receipts; wholesale trade shows extremely disproportionate receipts. Importantly, in sectors like wholesale trade, receipts can be high while value added is much lower.

Figure B2. All sectors

(a) By firm employment size



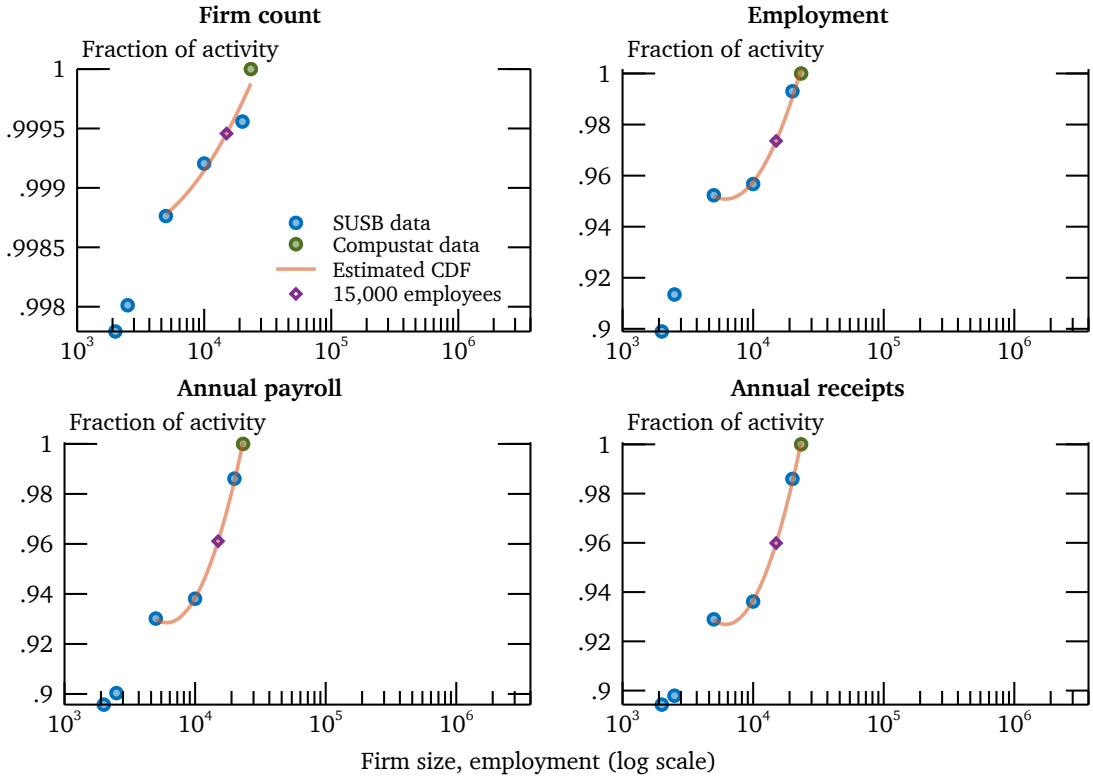
(b) By firm receipt size



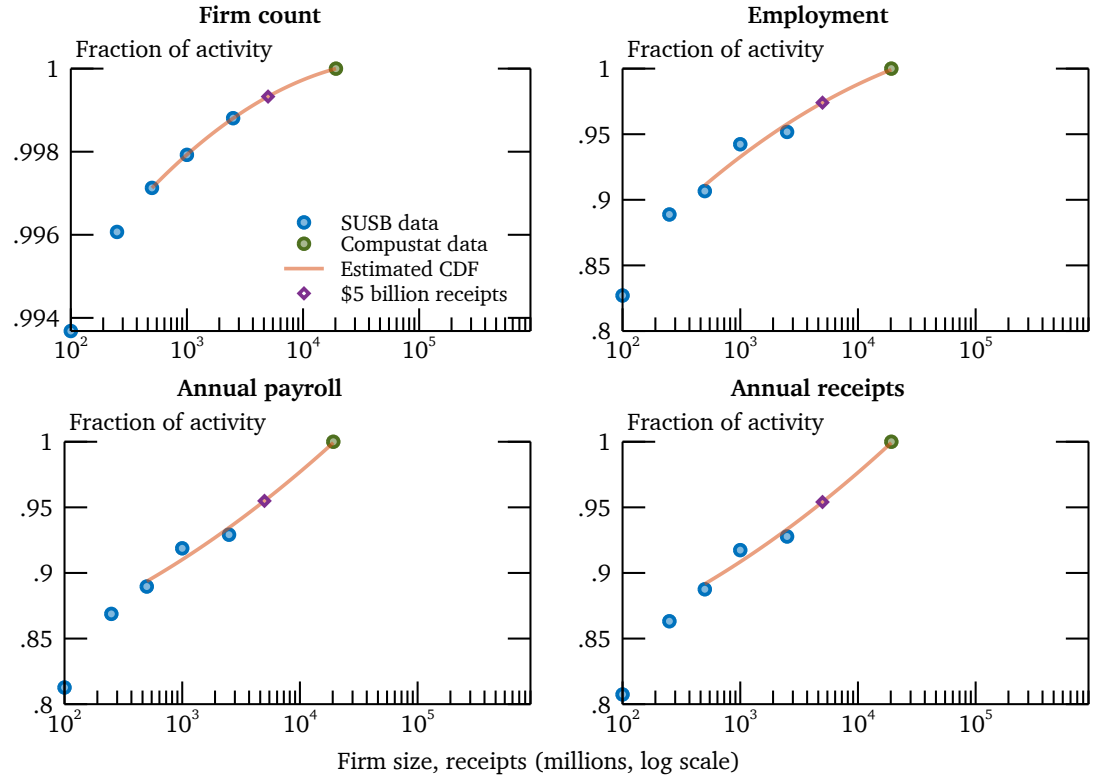
Sources: See table 1.

Figure B3. NAICS 11 – Agriculture, forestry, fishing and hunting

(a) By firm employment size



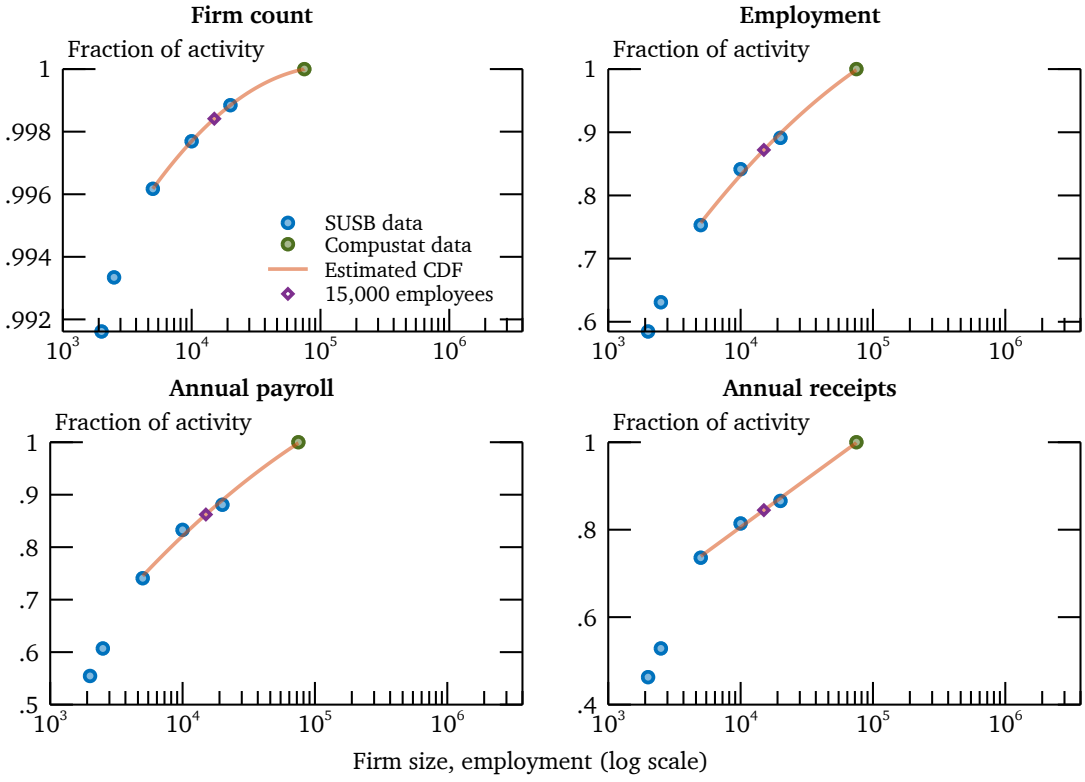
(b) By firm receipt size



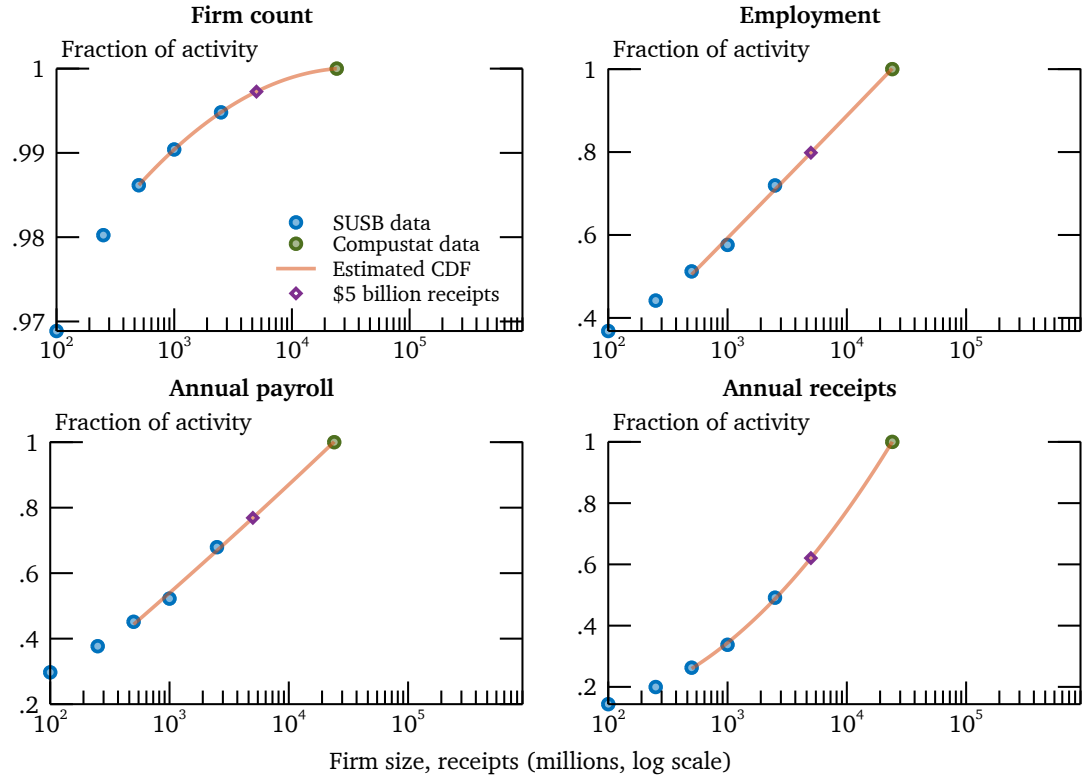
Sources: See table 1.

Figure B4. NAICS 21 – Mining, quarrying, and oil and gas extraction

(a) By firm employment size



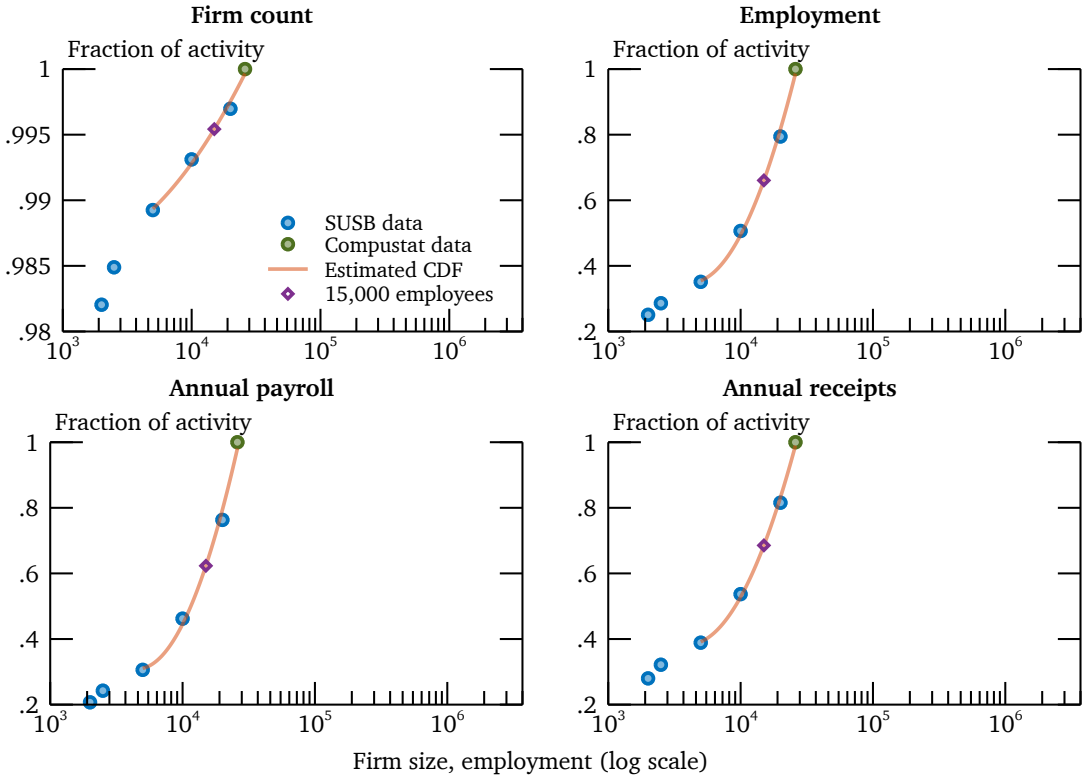
(b) By firm receipt size



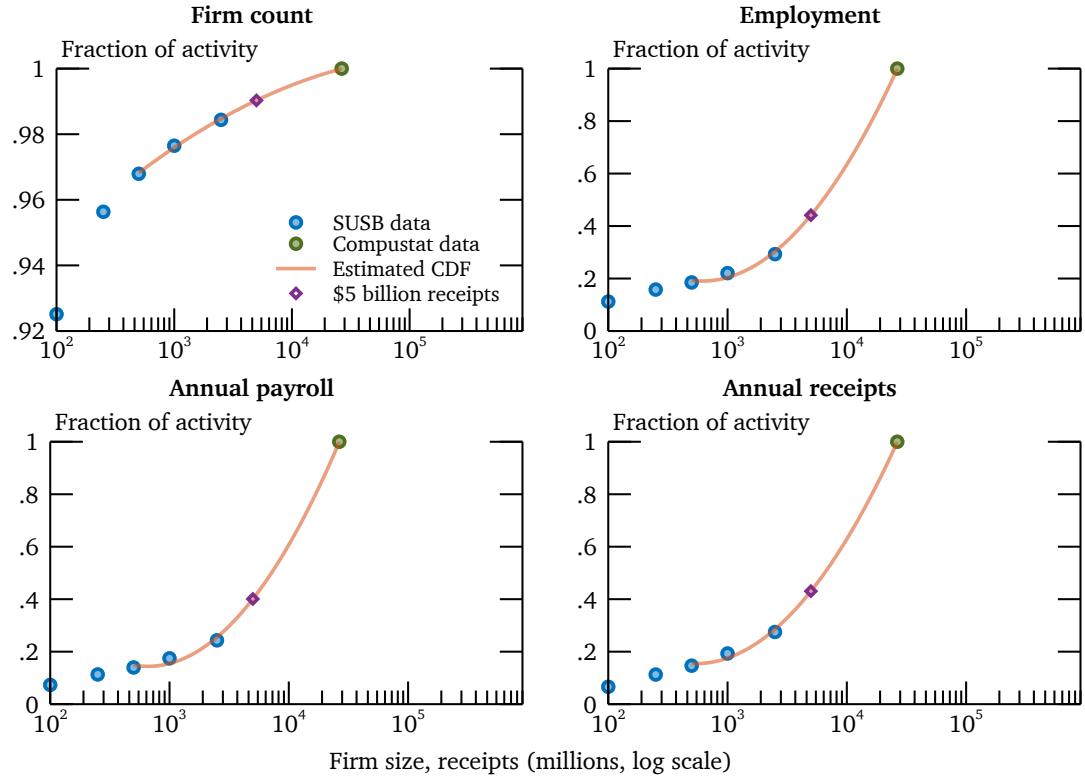
Sources: See table 1.

Figure B5. NAICS 22 – Utilities

(a) By firm employment size



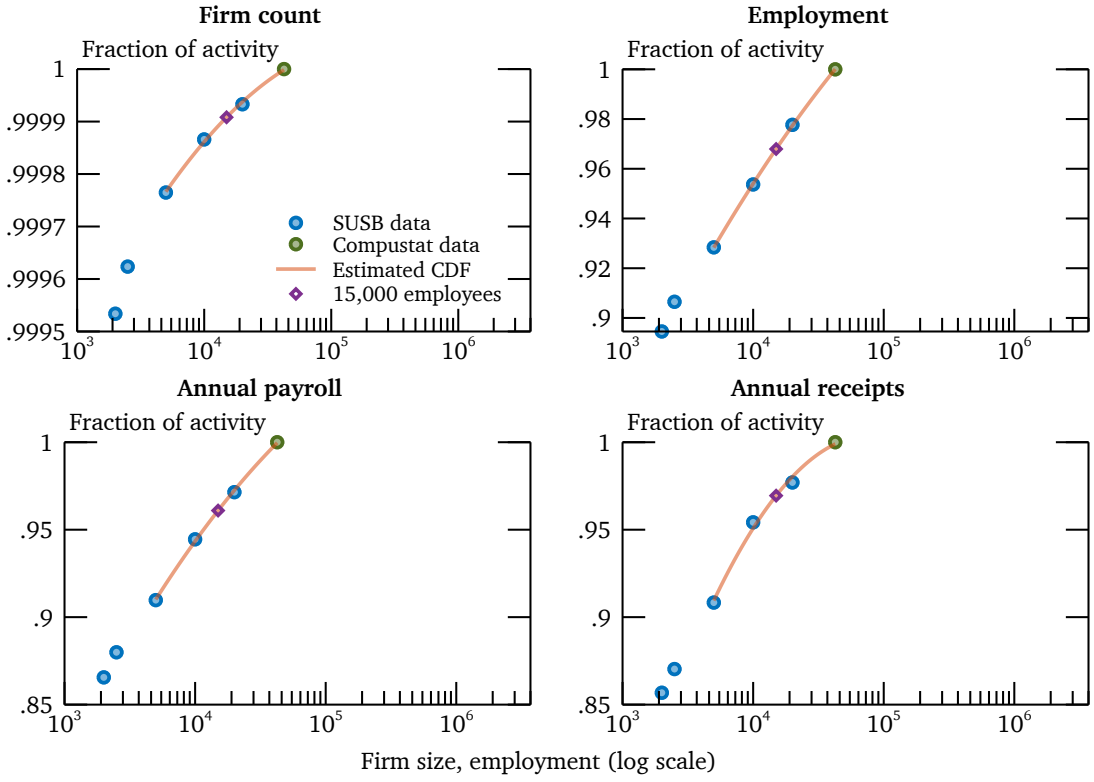
(b) By firm receipt size



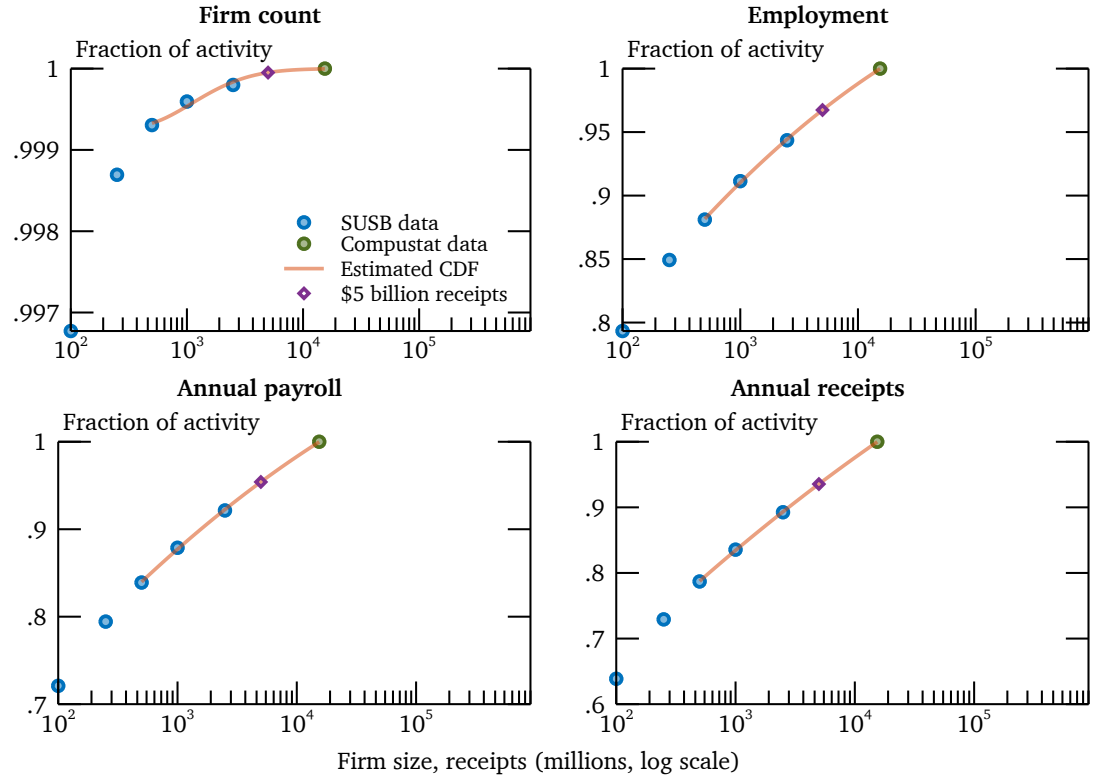
Sources: See table 1.

Figure B6. NAICS 23 – Construction

(a) By firm employment size



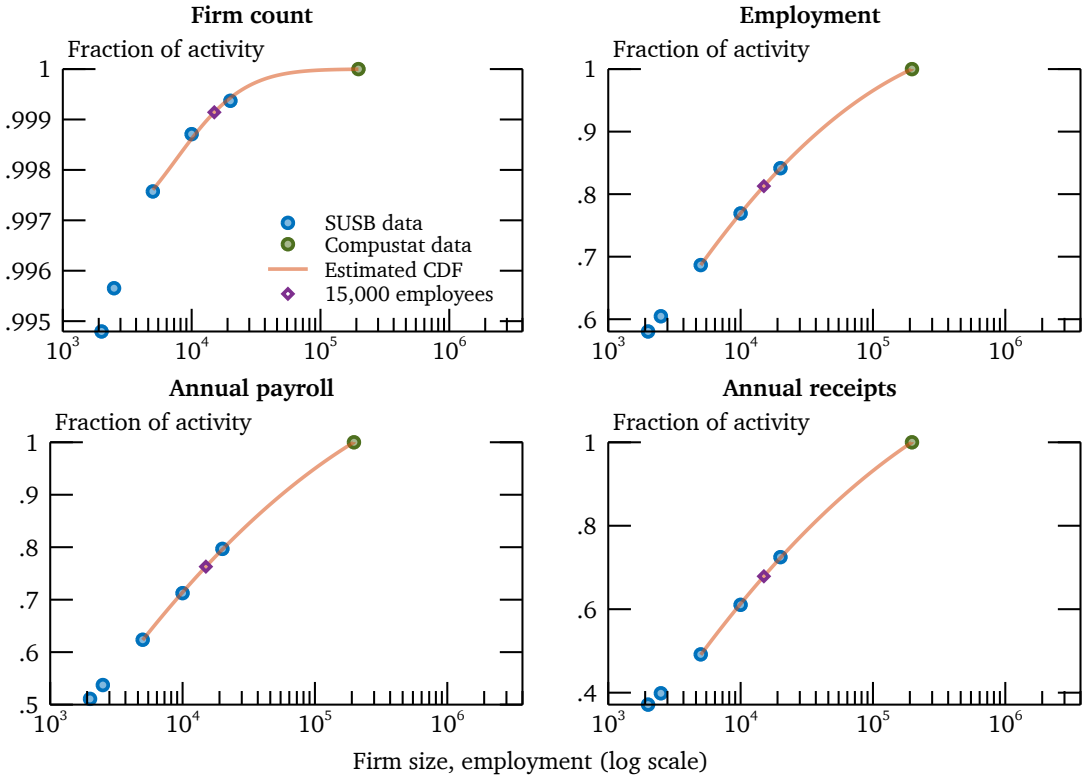
(b) By firm receipt size



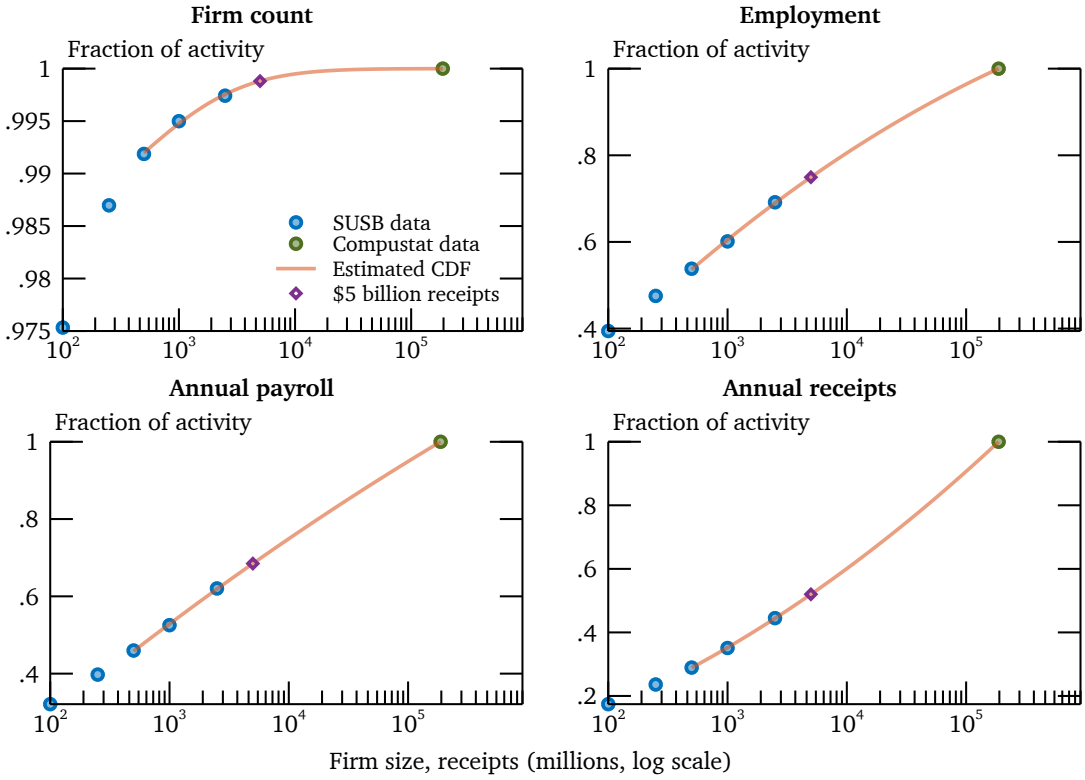
Sources: See table 1.

Figure B7. NAICS 31–33 – Manufacturing

(a) By firm employment size



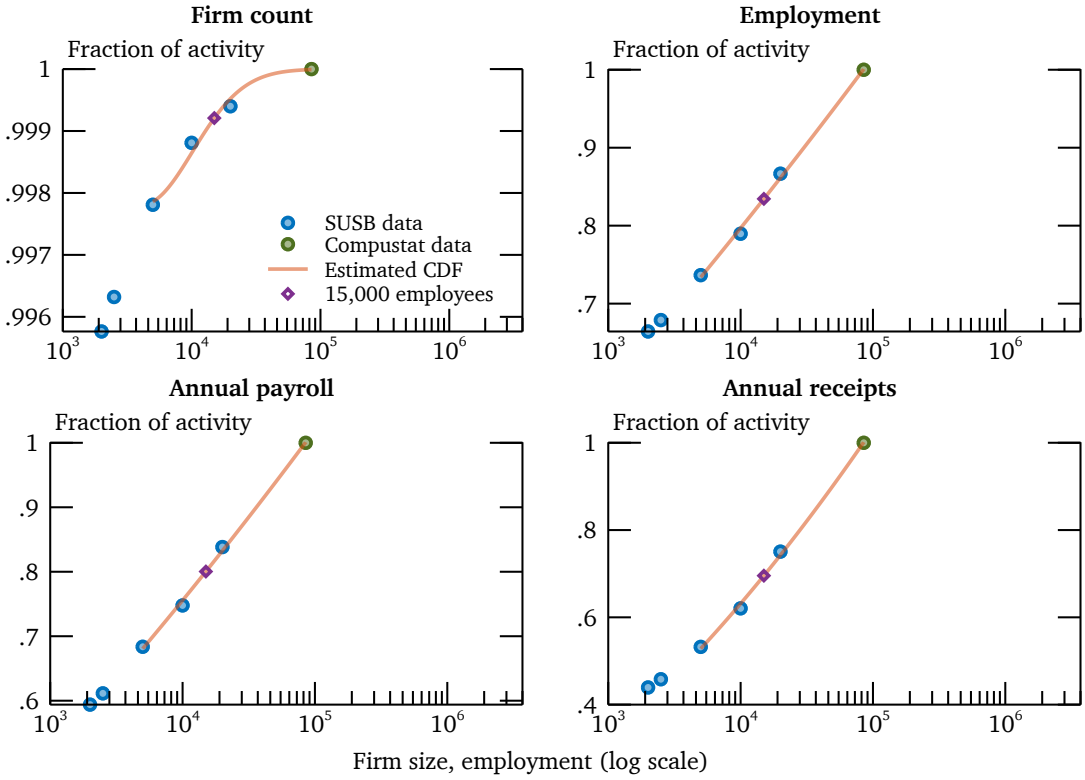
(b) By firm receipt size



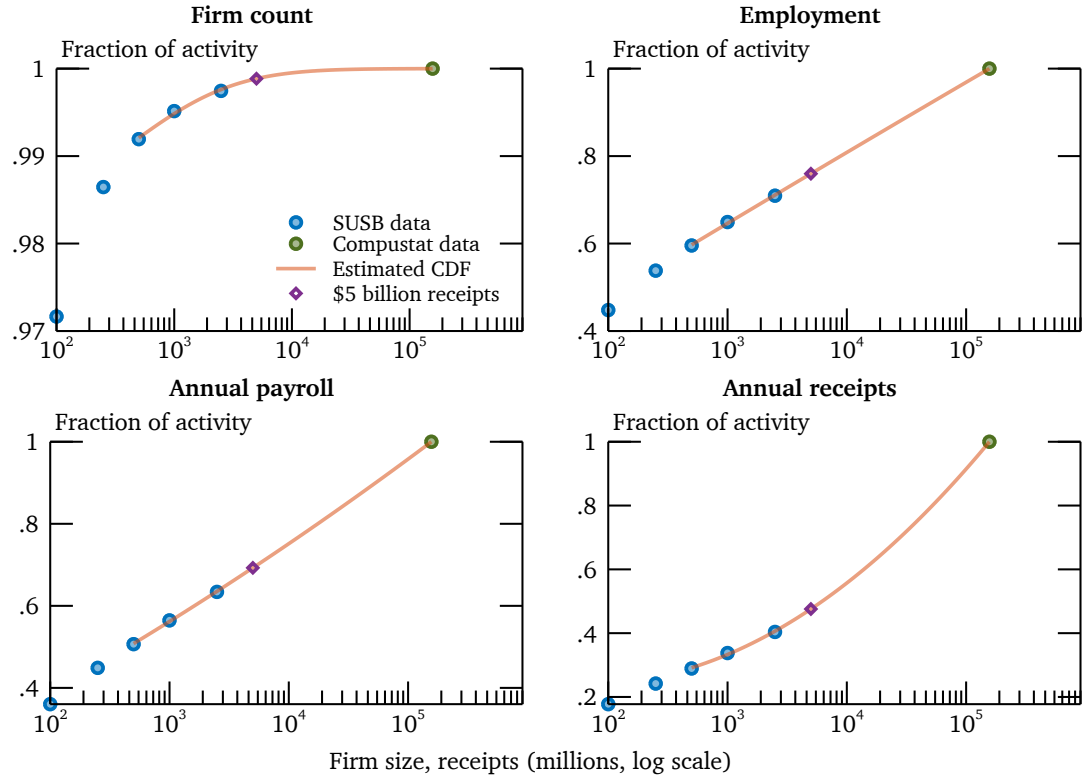
Sources: See table 1.

Figure B8. NAICS 42 – Wholesale trade

(a) By firm employment size



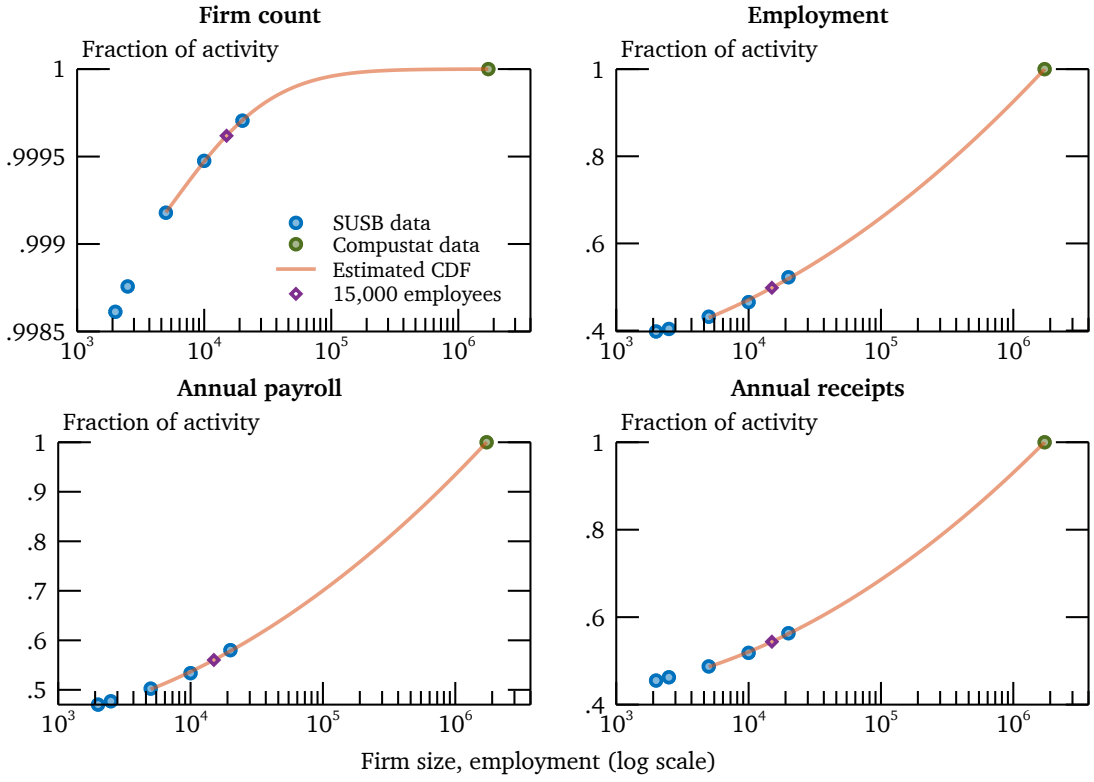
(b) By firm receipt size



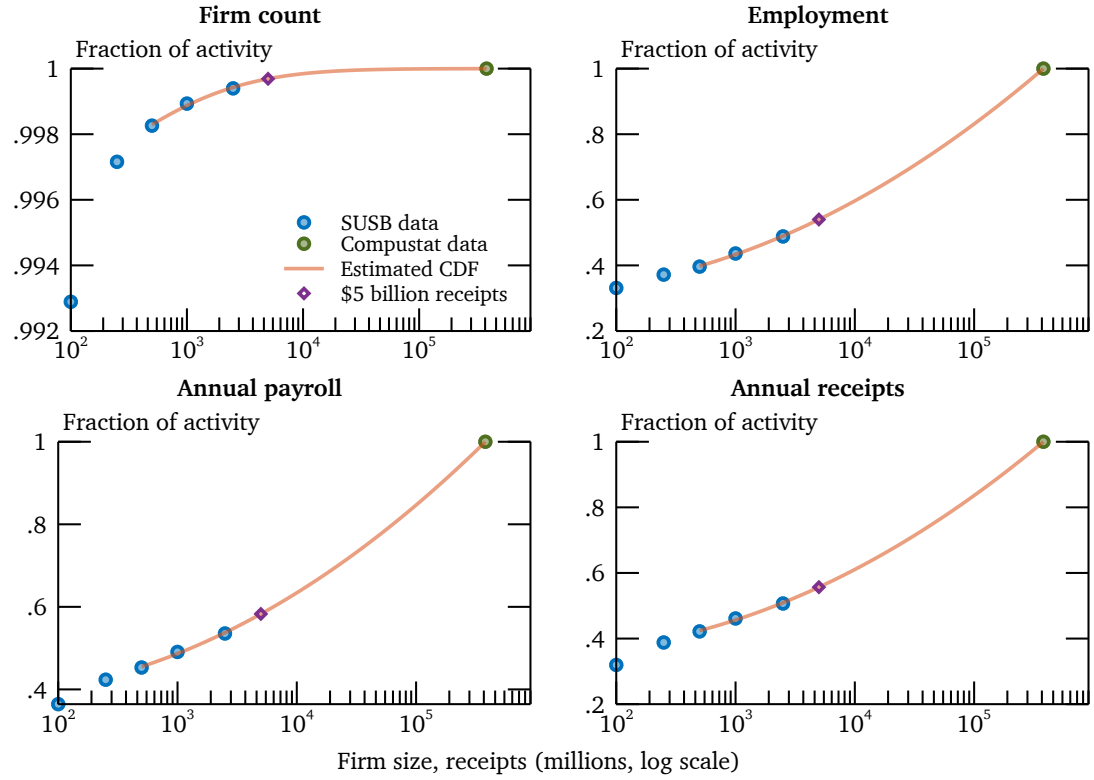
Sources: See table 1.

Figure B9. NAICS 44–45 – Retail trade

(a) By firm employment size



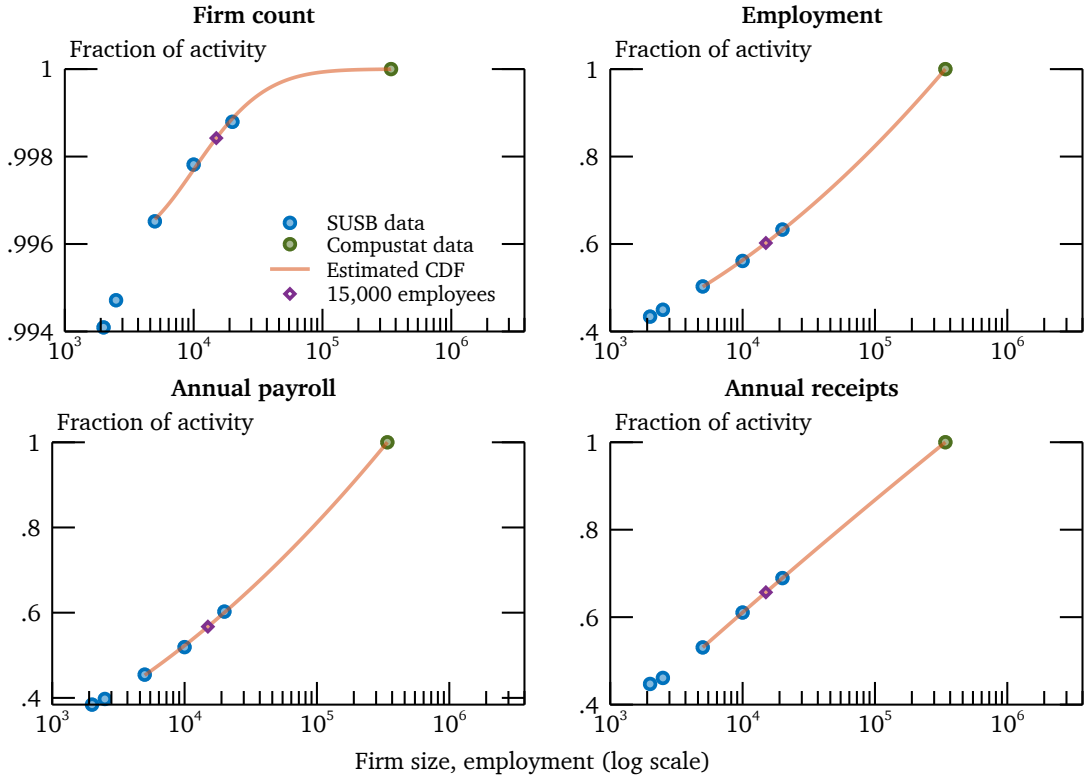
(b) By firm receipt size



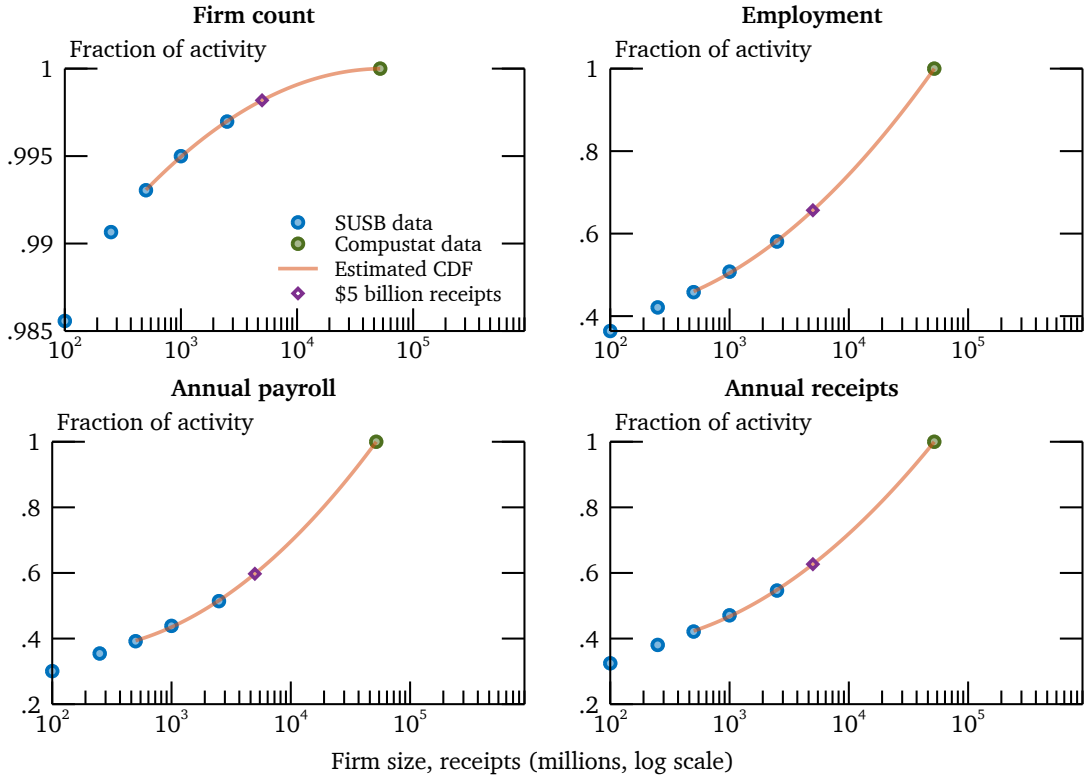
Sources: See table 1.

Figure B10. NAICS 48–49 – Transportation and warehousing

(a) By firm employment size



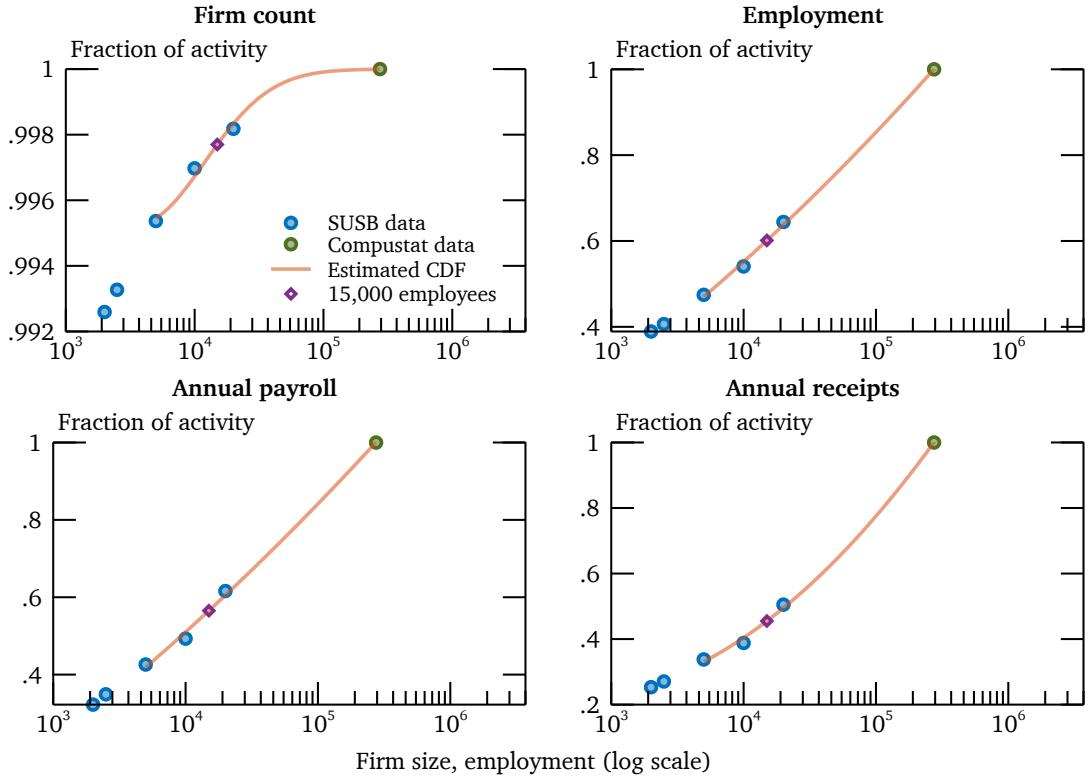
(b) By firm receipt size



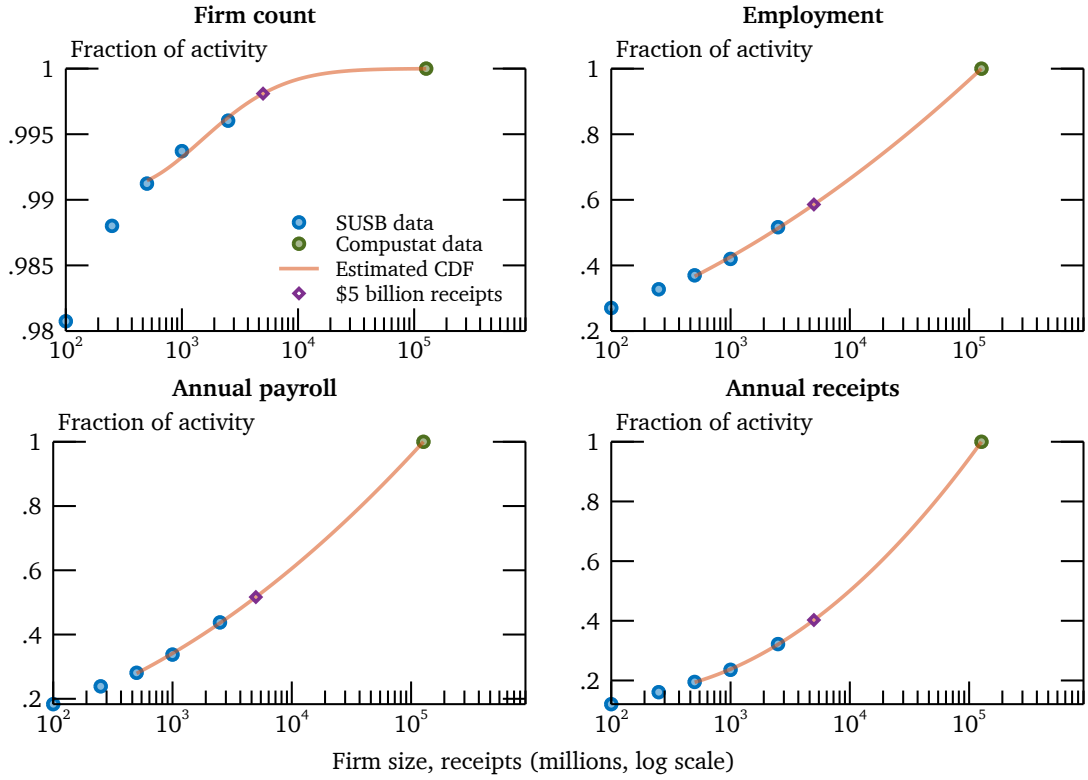
Sources: See table 1.

Figure B11. NAICS 51 – Information

(a) By firm employment size



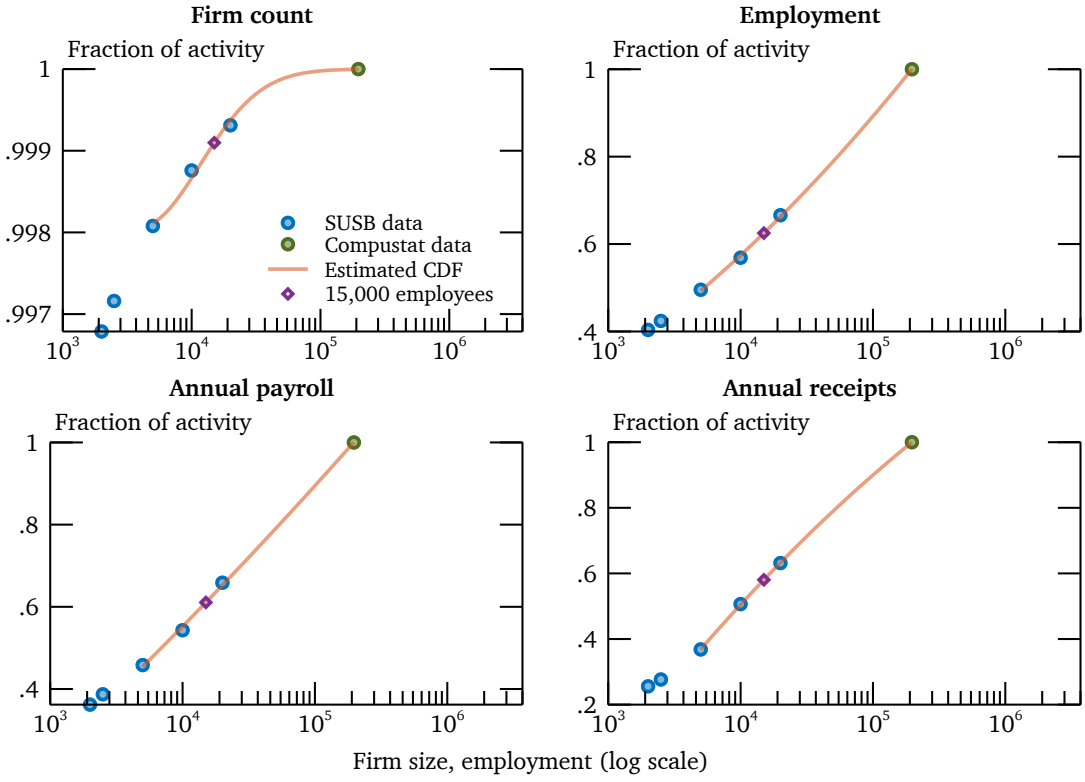
(b) By firm receipt size



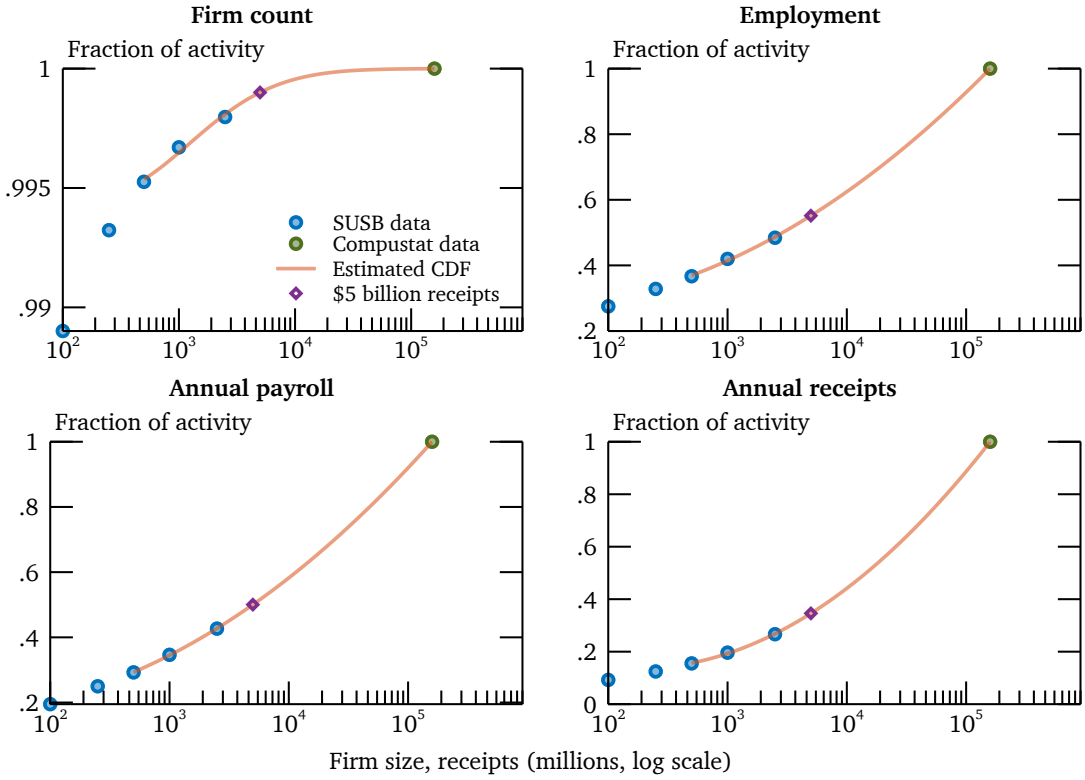
Sources: See table 1.

Figure B12. NAICS 52 – Finance and insurance

(a) By firm employment size



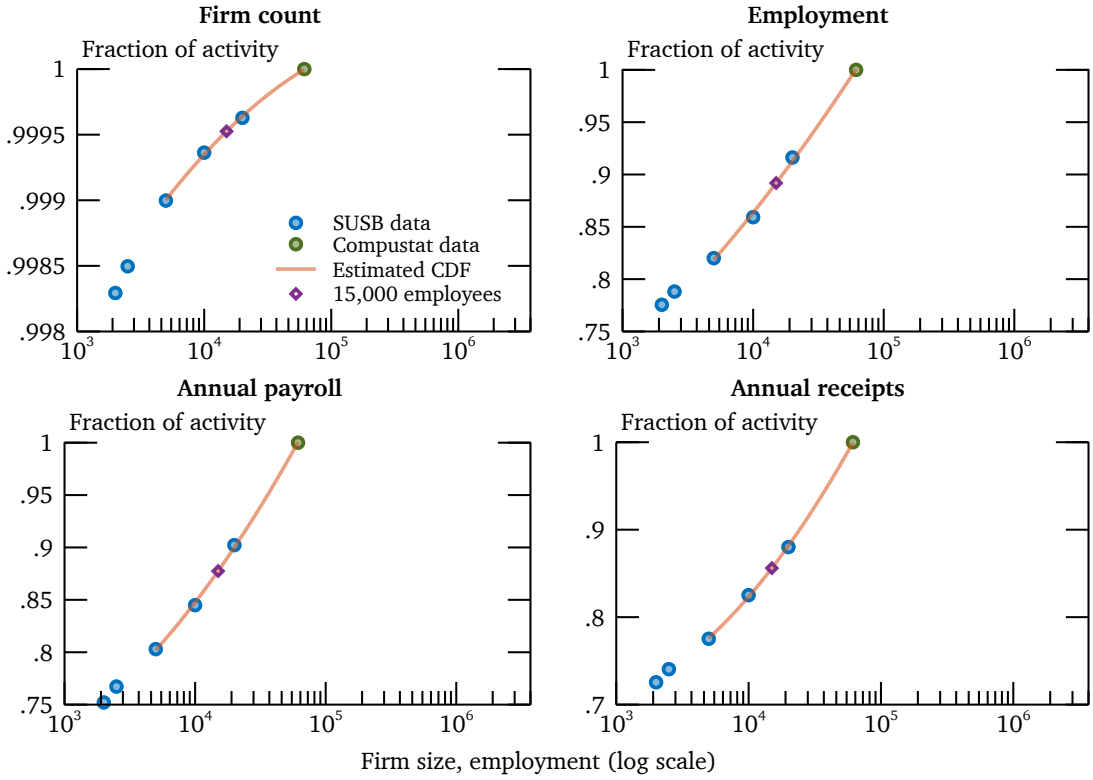
(b) By firm receipt size



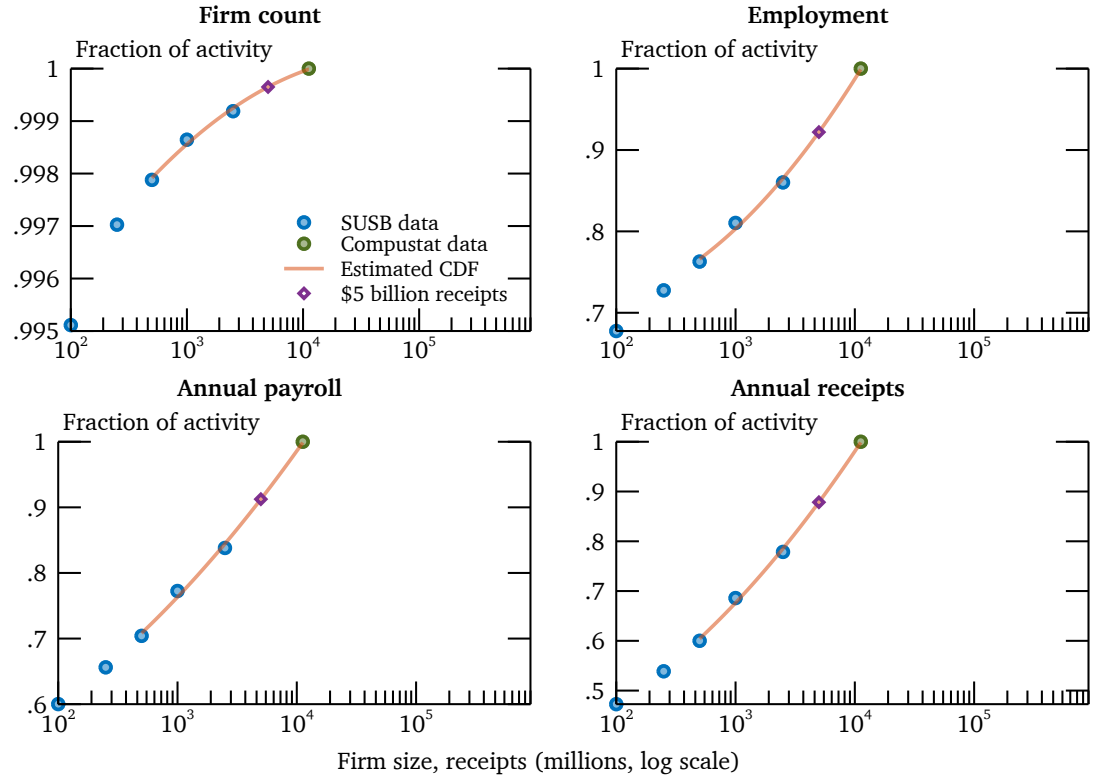
Sources: See table 1.

Figure B13. NAICS 53 – Real estate and rental and leasing

(a) By firm employment size



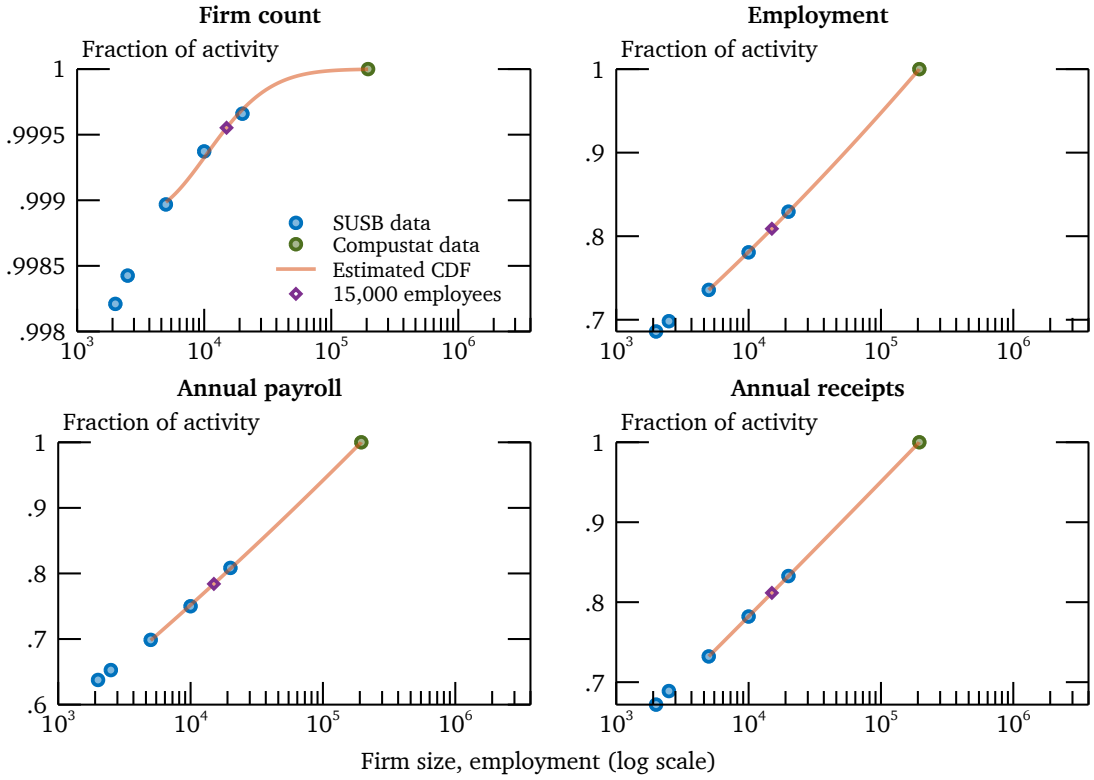
(b) By firm receipt size



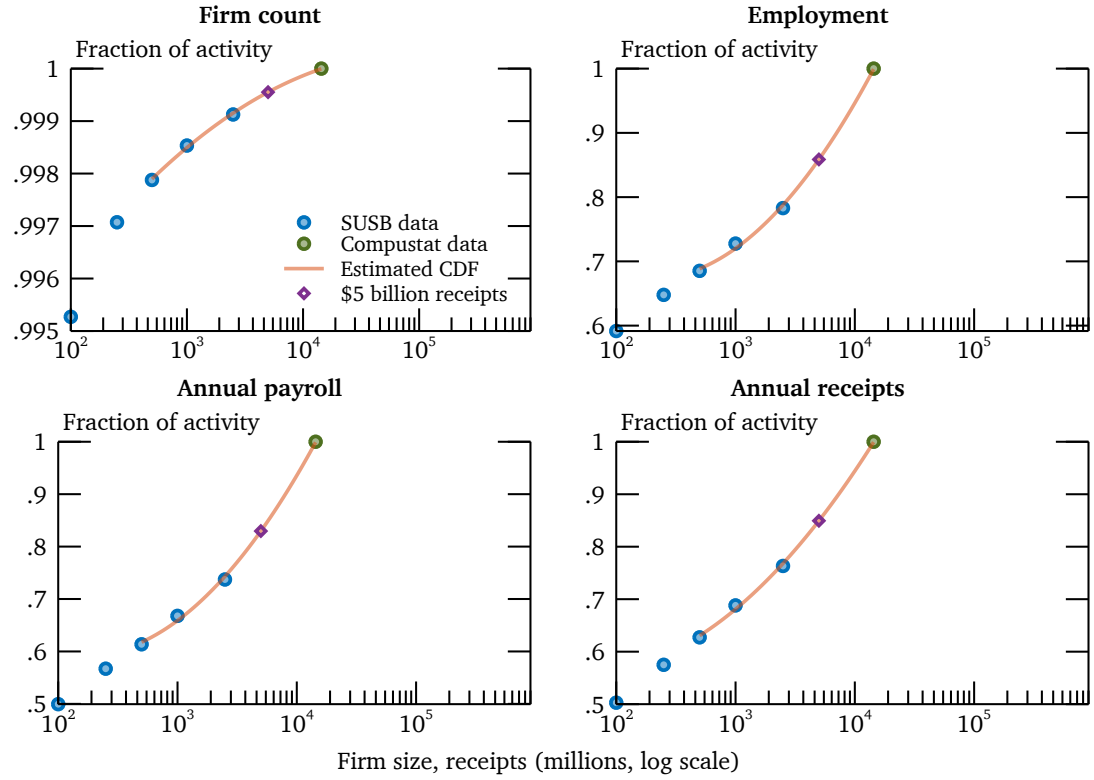
Sources: See table 1.

Figure B14. NAICS 54 – Professional, scientific, and technical services

(a) By firm employment size



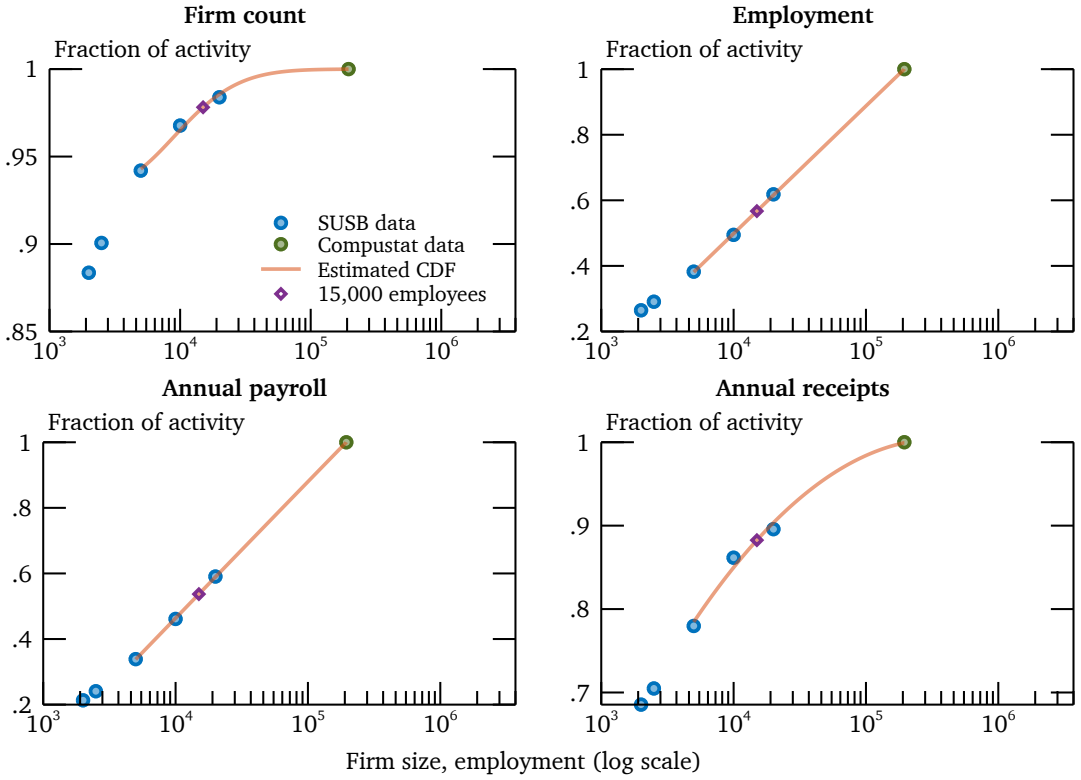
(b) By firm receipt size



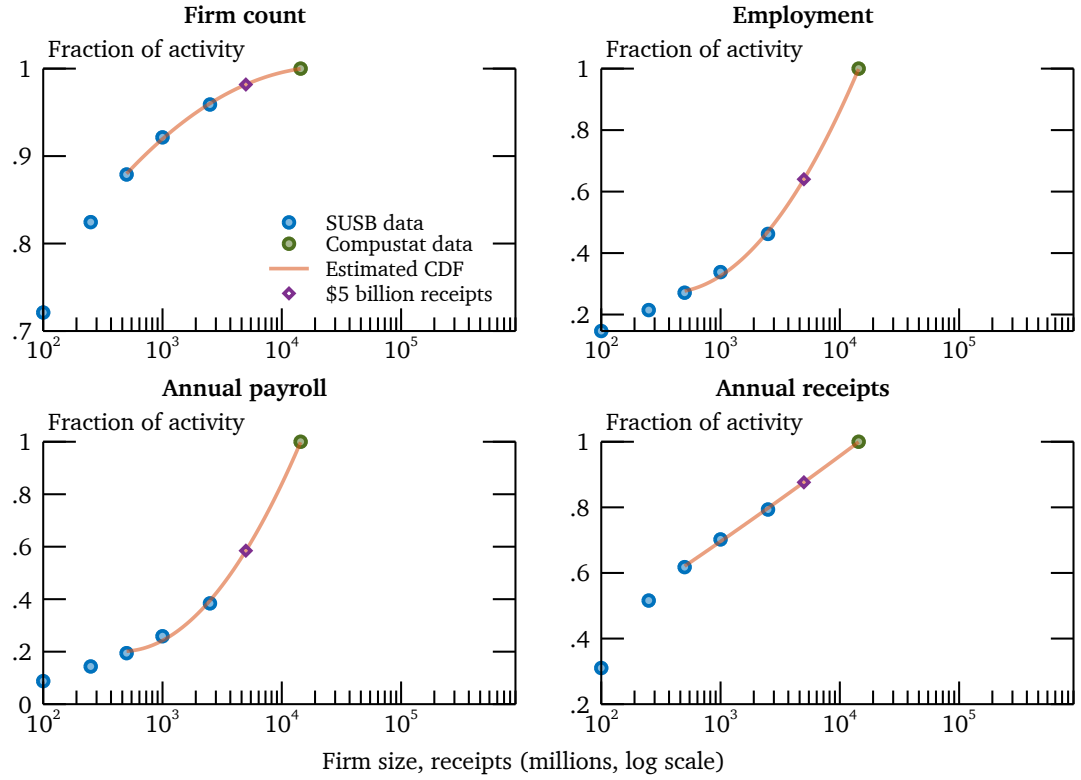
Sources: See table 1.

Figure B15. NAICS 55 – Management of companies and enterprises

(a) By firm employment size



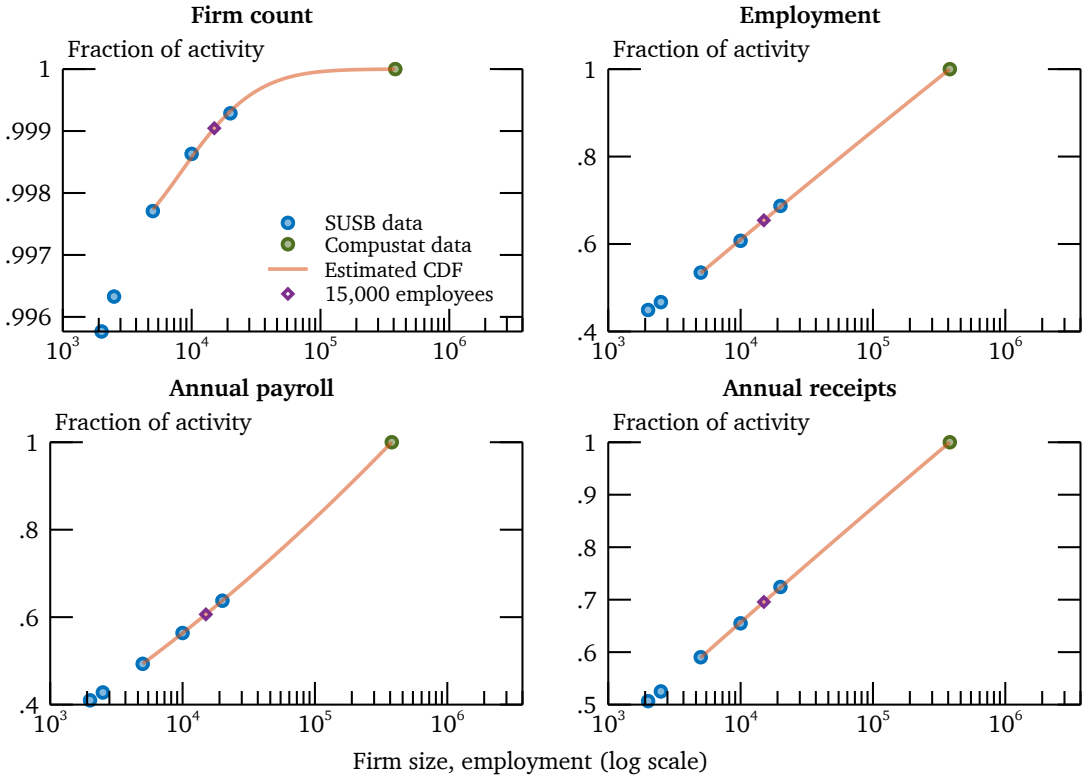
(b) By firm receipt size



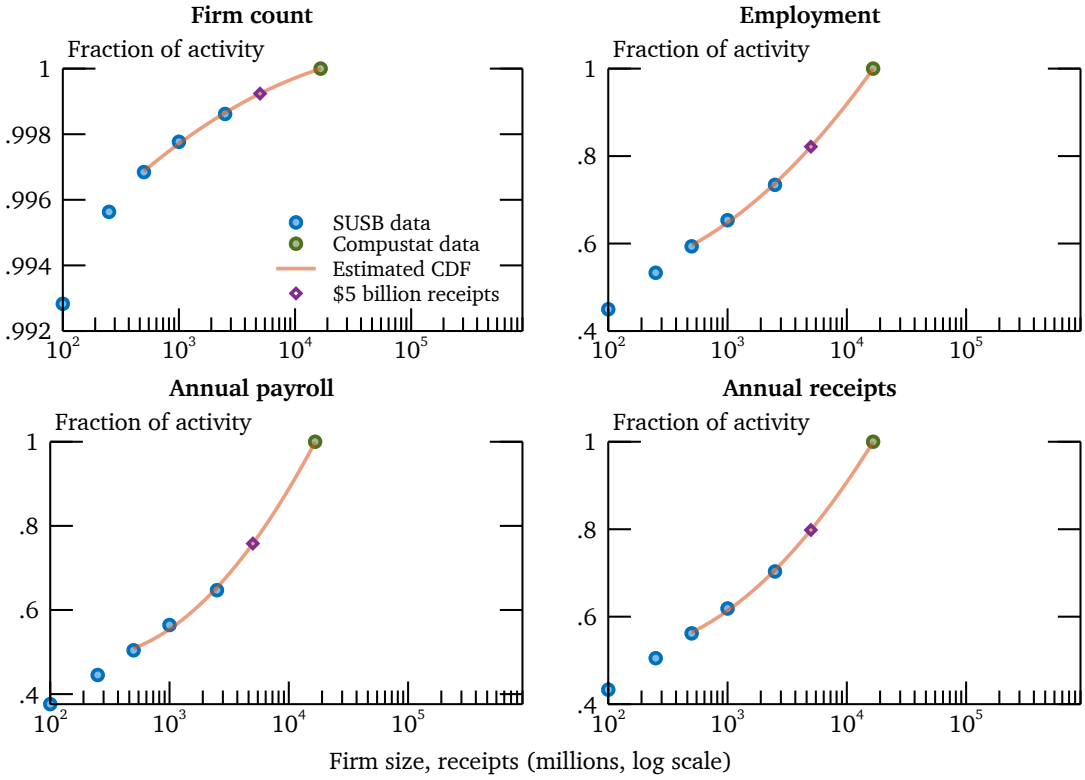
Sources: See table 1.

Figure B16. NAICS 56 – Administrative and waste services

(a) By firm employment size



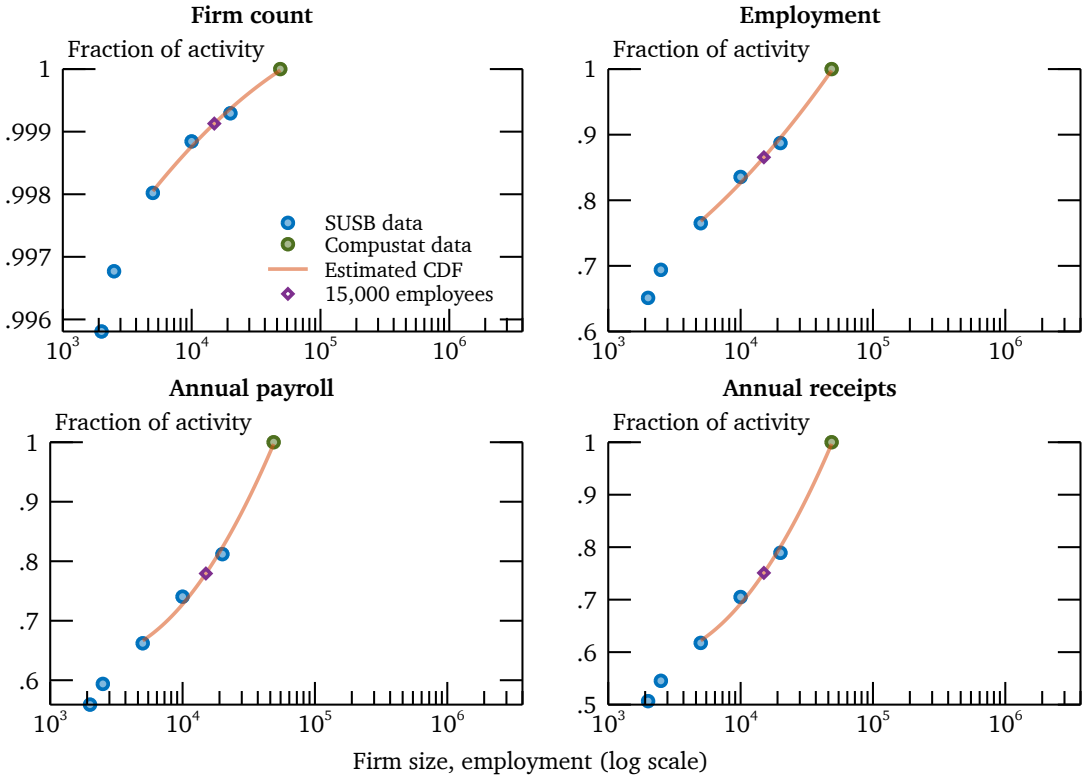
(b) By firm receipt size



Sources: See table 1.

Figure B17. NAICS 61 – Educational services

(a) By firm employment size

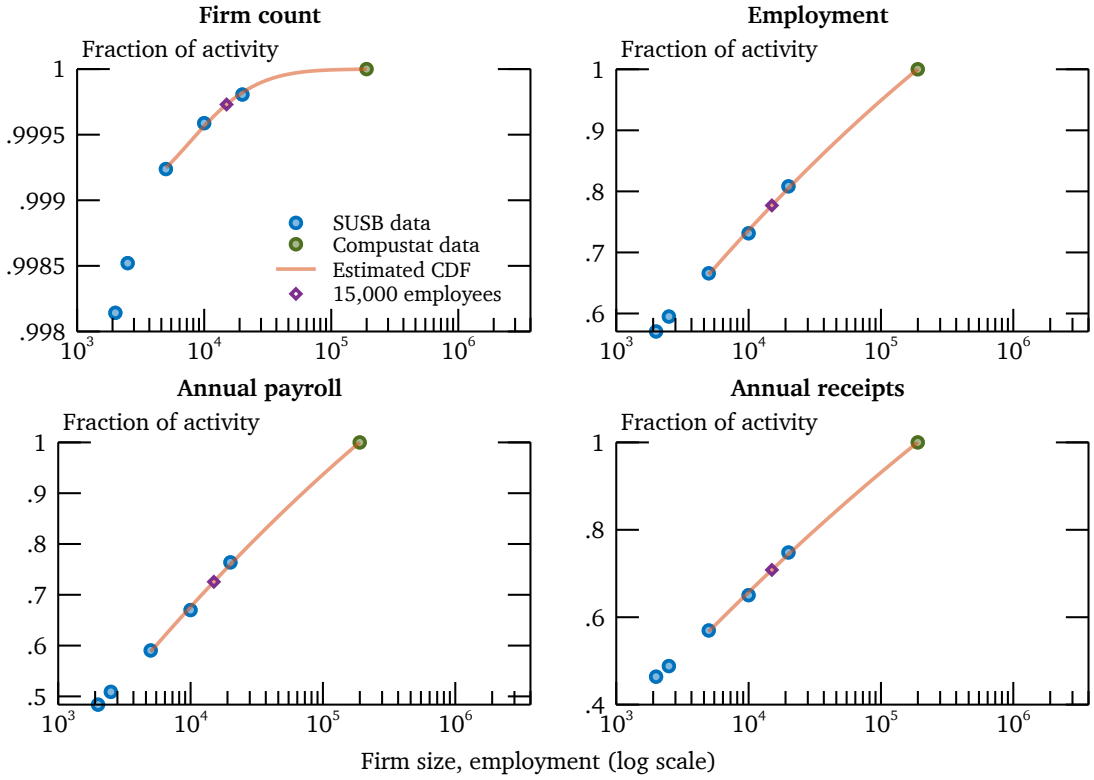


Sources: See table 1.

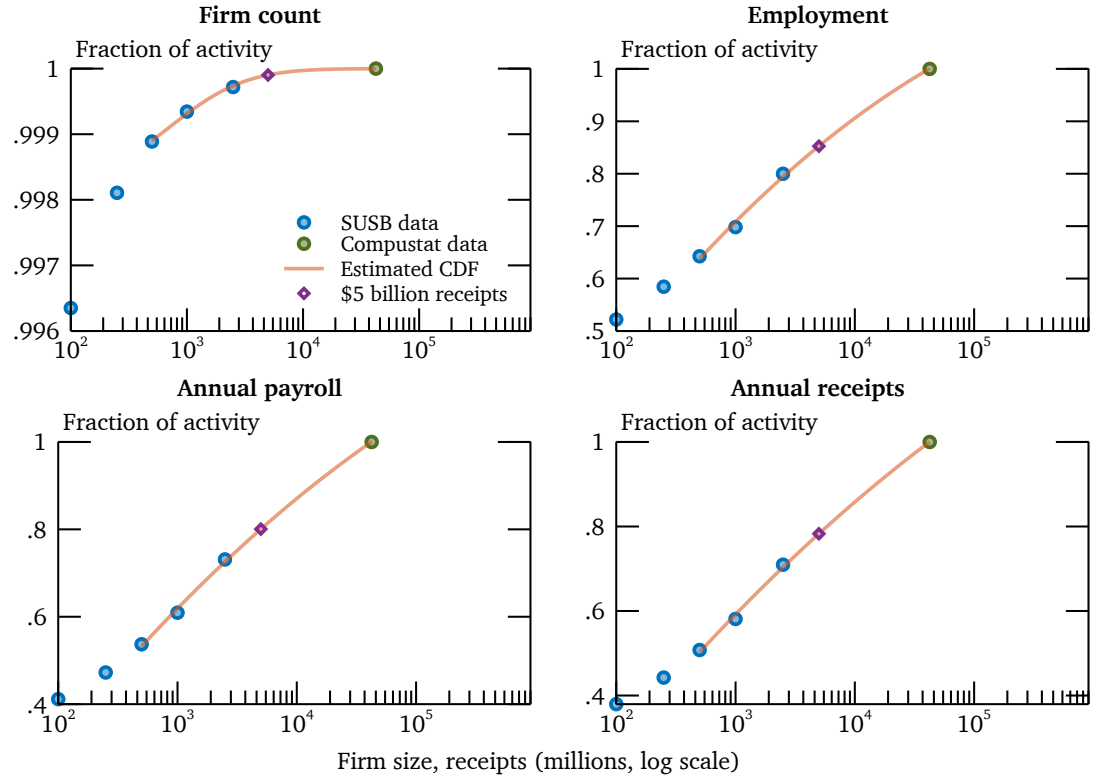
Note: There are no firms in this sector with greater than $5 billion in annual receipts.

Figure B18. NAICS 62 – Health care and social assistance

(a) By firm employment size



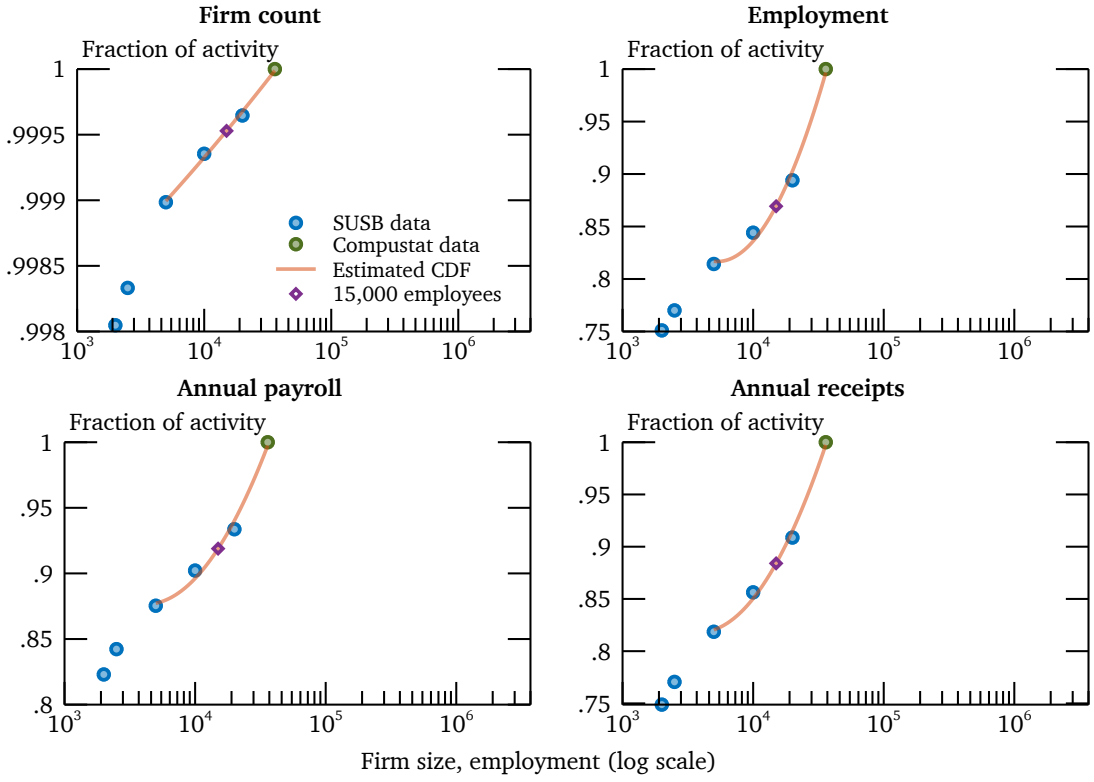
(b) By firm receipt size



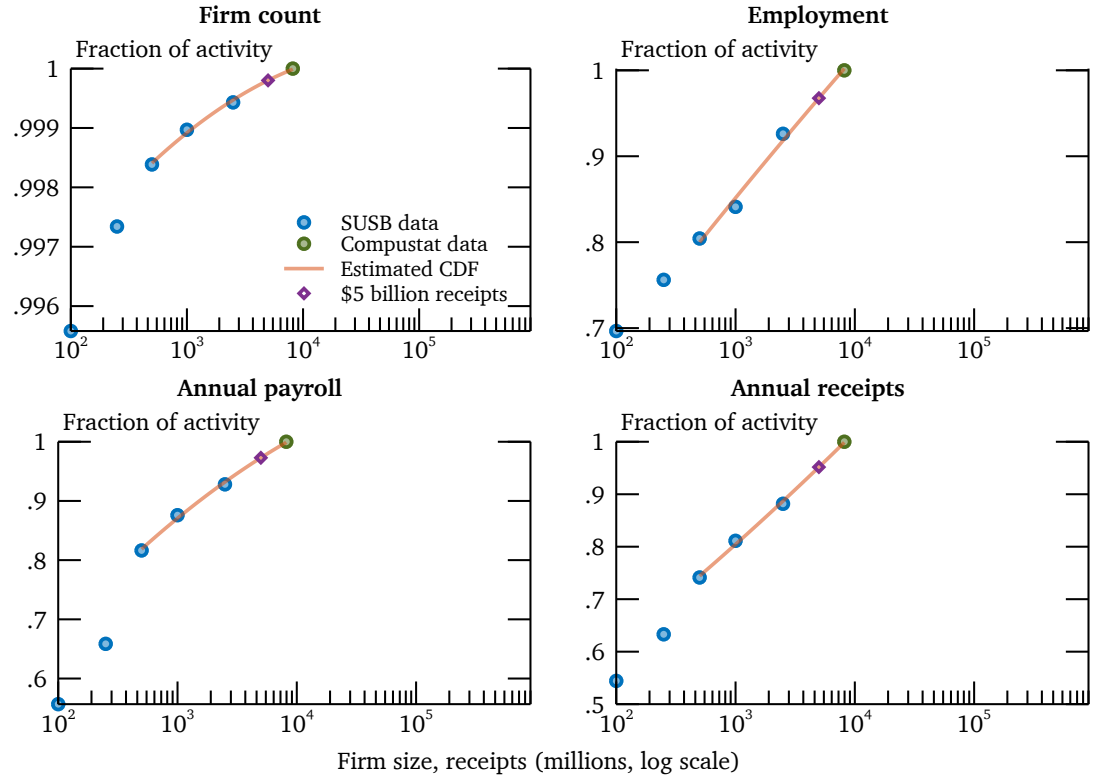
Sources: See table 1.

Figure B19. NAICS 71 – Arts, entertainment, and recreation

(a) By firm employment size



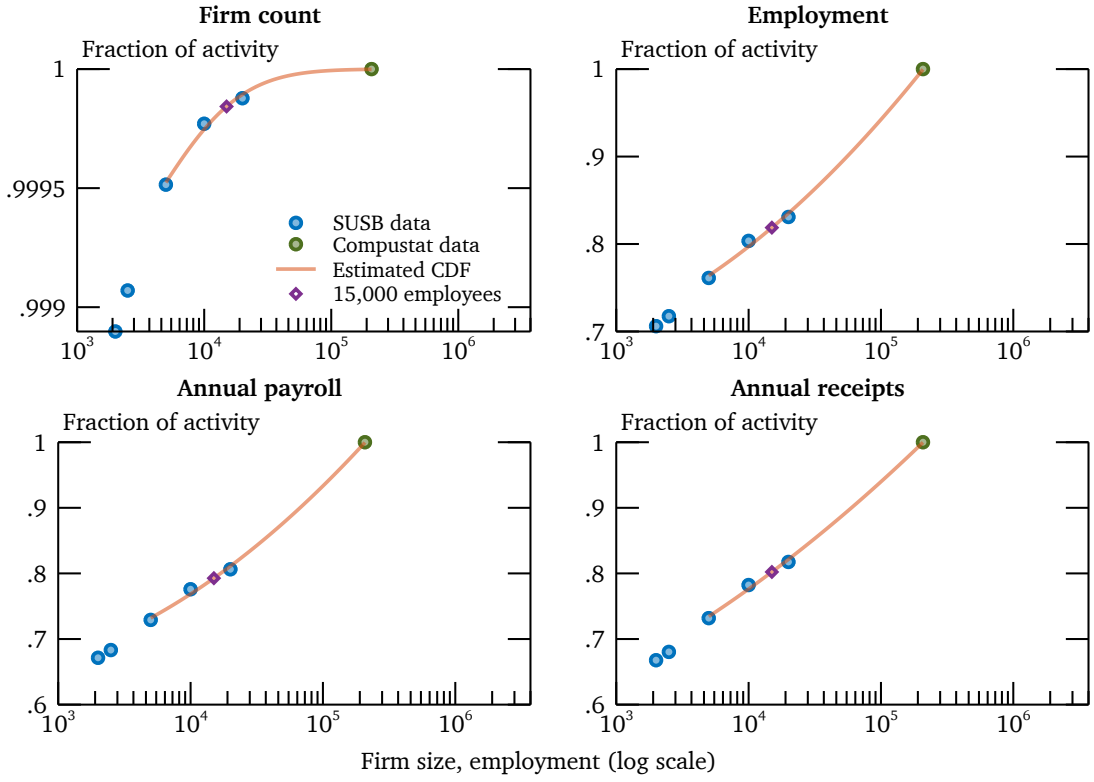
(b) By firm receipt size



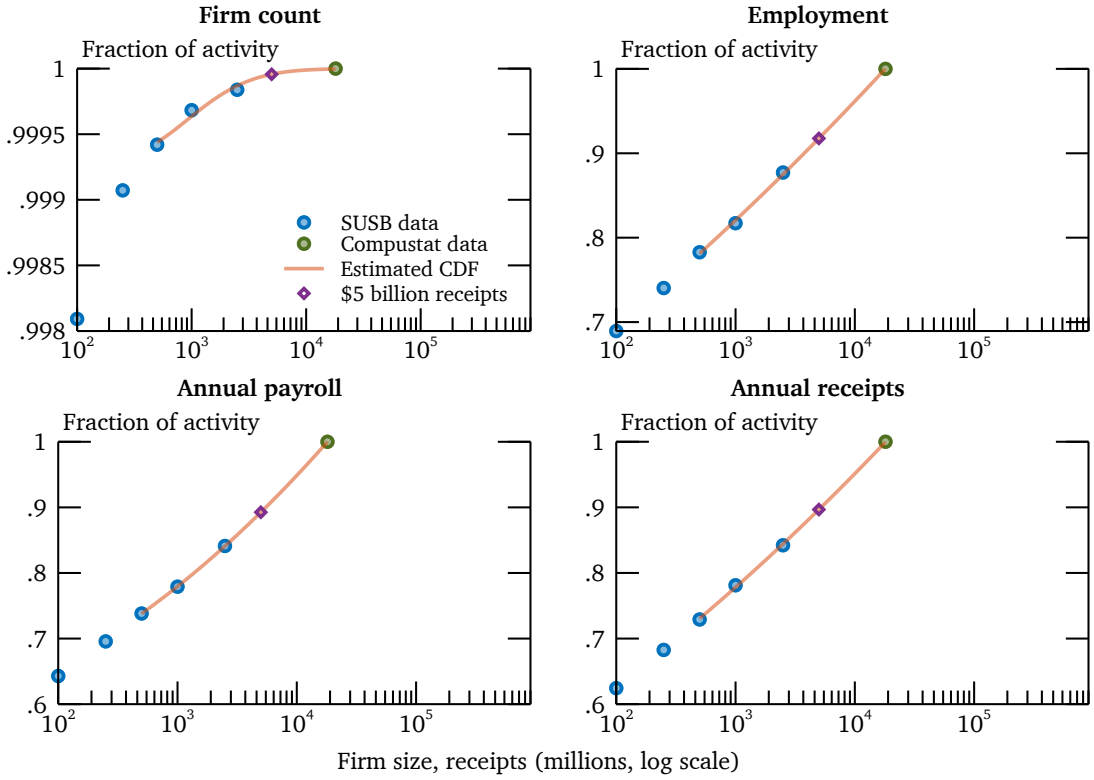
Sources: See table 1.

Figure B20. NAICS 72 – Accommodation and food services

(a) By firm employment size



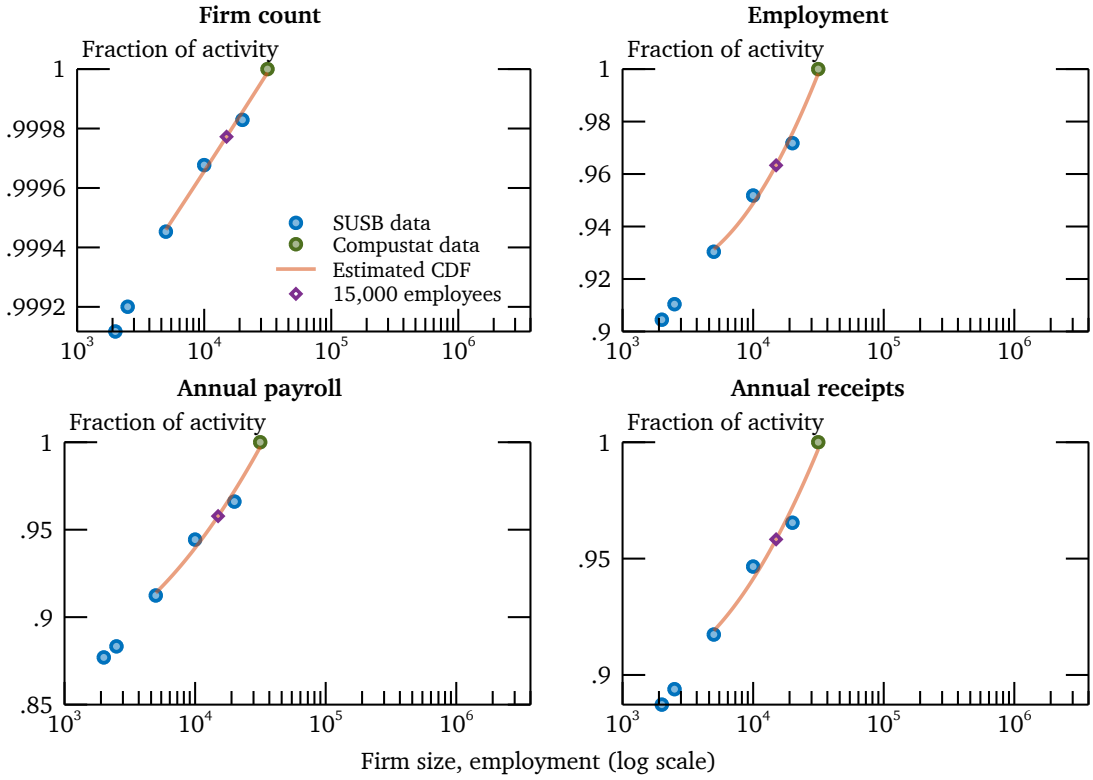
(b) By firm receipt size



Sources: See table 1.

Figure B21. NAICS 81 – Other services

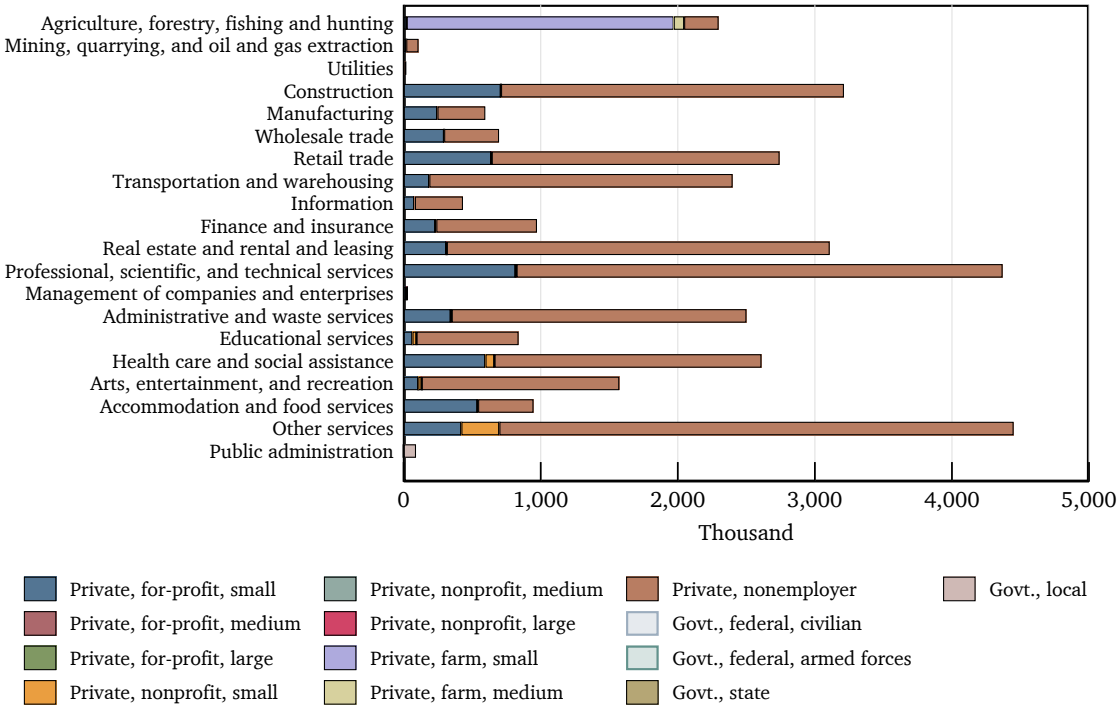
(a) By firm employment size



Sources: See table 1.

Note: There are no firms in this sector with greater than $5 billion in annual receipts.

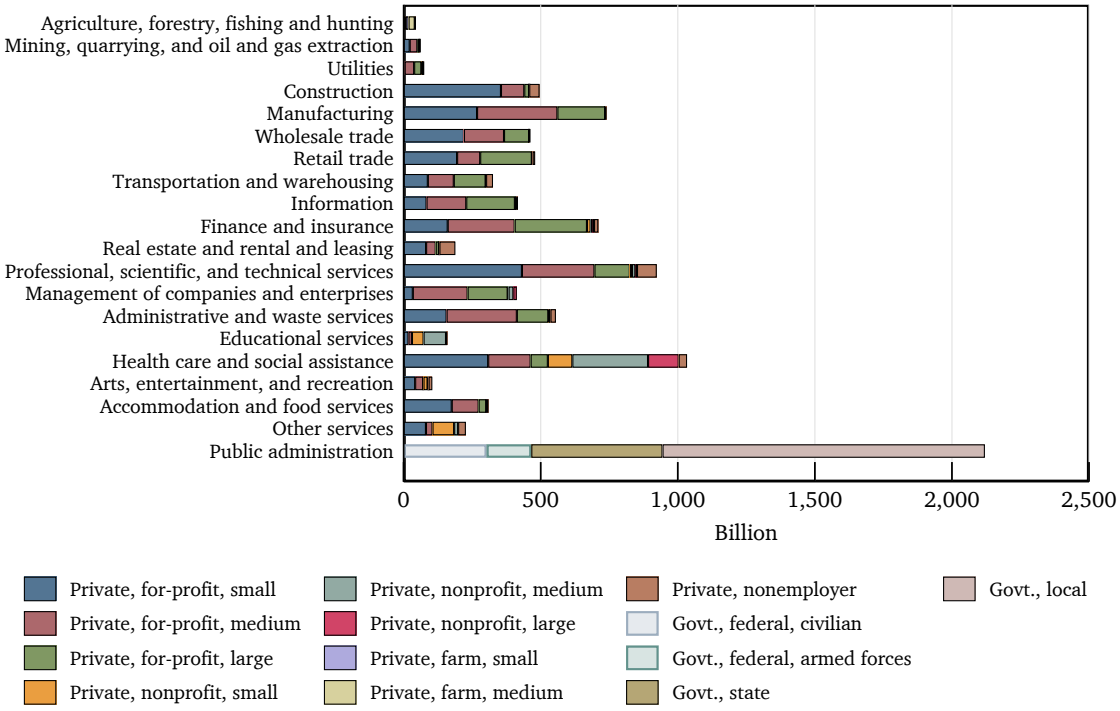
Figure C1. Number of U.S. Businesses and Governments, 2019, by Sector and Class



Sources: See table 1.

Notes: Transparent bars indicate classes that are not covered by one of the four direct lending programs we consider.

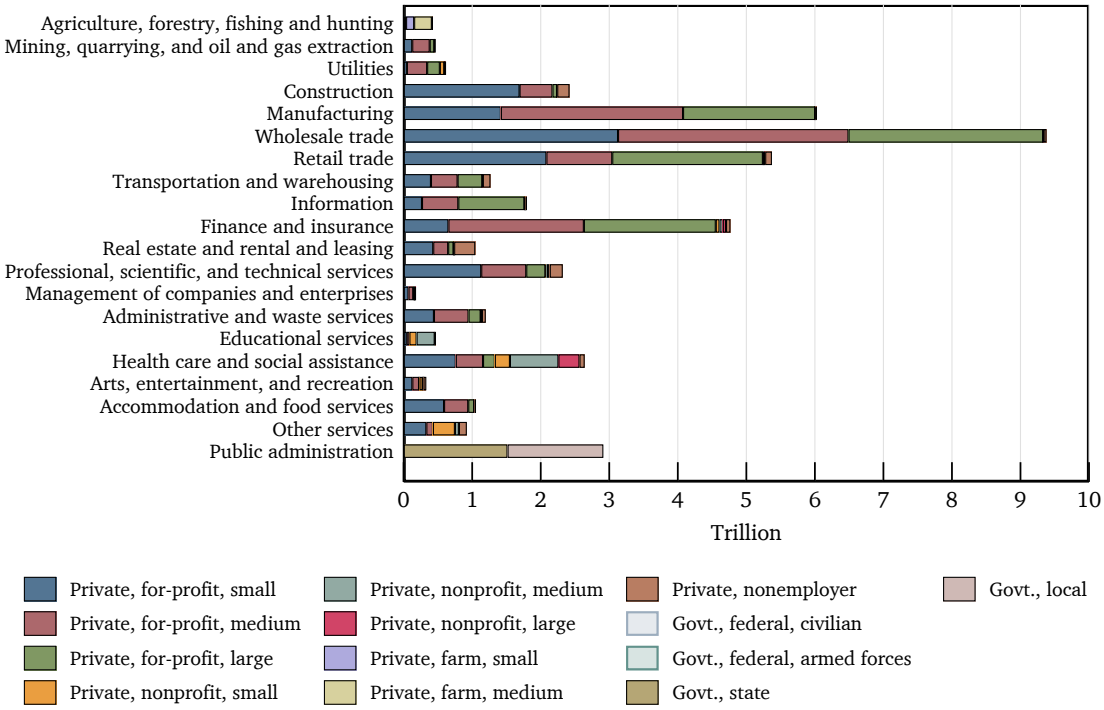
Figure C2. Annual Payroll of U.S. Businesses and Governments, 2019, by Sector and Class



Sources: See table 1.

Notes: Transparent bars indicate classes that are not covered by one of the four direct lending programs we consider.

Figure C3. Annual receipts of U.S. Businesses and Governments, 2019, by Sector and Class



Sources: See table 1.
Notes: Transparent bars indicate classes that are not covered by one of the four direct lending programs we consider.

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