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Data Appendix, pp. 121-138.

Thesis Appendix: Data Contributions

A.1 Consistent Panel of Occupations

A.1.1 Census Occupations

The United States Census records the detailed titles of workers' occupations. The publicly available Census data aggregates this occupation information and reports several hundred 3-digit occupation codes. Most of these occupation codes refer to narrow groups of occupations, such as “chemical engineers” or “petroleum engineers” while residual categories such as “engineers, n.e.c. (not elsewhere classified)” contain workers who could not be matched to a more detailed code. The occupational classification system gets redefined for every decennial Census. Changes to the occupation system often reflect the growth and decline of specific occupations. For instance, “loom fixers” formed a detailed occupation code until 1970 but they were later integrated into the broader group of “machinery maintenance occupations” as loom fixers' importance in the labor market declined. By contrast, a detailed occupation code for “speech therapists” was introduced only in 1980. Before, these workers were classified among “therapists and healers, n.e.c.”.

Appendix Table 1 lists the number of civilian occupations in each Census occupation system since 1950. The Census Bureau introduced ever more detailed occupation classifications between 1950 and 1980, thus almost doubling the number of reported occupation codes from 268 to 504. Each of the subsequent data sets provides at least 465 occupation codes. The two largest overhauls of the occupation system took place for the 1980 and 2000 Censuses. In these years, the Census Bureau not only added new occupations but also ceased using many detailed occupation categories that had been previously reported.

The occupational classification schemes also sort detailed occupations into broader occupation groups. One of these broader groups of occupations is called “service occupations”. These jobs typically involve caring for, serving, or protecting others. Appendix Table 1 shows the number of service occupations in each Census occupation system since 1950. The number of service occupation codes increased over time along with the overall growth in occupation codes. Furthermore, the 2000 Census slightly expanded the set of

Appendix Table 1. Number of Occupations in the 1950-2000 Censuses and 2005 ACS

	Census 1950	Census 1960	Census 1970	Census 1980	Census 1990	Census 2000 (5% Sample)	ACS 2005
No. of occupations	268	295	440	504	502	471	465
No. of service occs	28	32	44	44	46	59	57

Occupation counts include all civilian occupations. The 5% sample of the 2000 Census reports 34 fewer occupation codes than the 1% sample.

occupations that are considered to be “service occupations” by including additional jobs such as “gardeners and groundskeepers” or “movie picture projectionists”.

In order to track detailed occupations over time, empirical work has to rely on crosswalks that match occupation codes from different Census years. Meyer and Osborne (2005) provide a carefully constructed crosswalk that matches occupations from the 1960-2000 Censuses to a system of 386 ‘*occ1990*’ occupation codes which are roughly based on the 1990 Census occupation system. Due to the large similarity between occupations in the 1950 and 1960 Censuses, the *occ1990* system can readily be extended back to 1950. Furthermore, it can also be used for the 2005 American Community Survey which uses a slightly aggregated version of the 2000 Census occupation system.

One limitation of the *occ1990* system is that its occupation panel is unbalanced. For instance, there are no observations for the *occ1990* category “economics instructors” in the 2000 Census. The specific fields of college teachers are no longer reported in the 2000 Census and economics instructors therefore have to be included in the broader *occ1990* category “subject instructors, college”. This unbalanced panel structure would be problematic for the empirical work in this thesis that studies employment or wage changes within detailed occupations between 1980 and 2005.

A.1.2 *Occ1990dd* Occupation System

We therefore developed a new occupation system with 330 ‘*occ1990dd*’ codes that provides a balanced panel of occupations covering the 1980, 1990, and 2000 Censuses and the 2005 ACS. The balanced panel allows for the analysis of changes at the level of detailed occupations between 1980 and 2005.²⁹ Most *occ1990dd* codes result from a simple aggregation of *occ1990* occupations. Moreover, the *occ1990dd* system makes a particular effort to provide consistent definitions of the detailed service occupations which are studied in the first essay of this thesis. Appendix Table 2 lists all *occ1990dd* occupations and details the construction of occupation codes whose definitions differ from

²⁹We also experimented with an extension of the balanced panel back to the 1950 Census. Due to the smaller number of occupations reported in the earlier Censuses and considerable changes in the occupation system between 1970 and 1980, an extended balanced panel would be much less detailed.

the *occ1990* codes by Meyer and Osborne (2005).

The *occ1990dd* codes can be aggregated into broader occupation groups. Broader groups of occupations can be tracked quite well in every Census since 1950 even if some detailed occupation codes are not reported for every year. For simplicity, we distinguish the six major occupation groups that are reported in the 1990 Census on which the *occ1990* and *occ1990dd* occupation systems are based. The first of these groups is “managerial and professional specialty occupations” which covers most of the best paid occupations in the labor market. “Technical, sales, and administrative support occupations” cover a workforce that is on average better educated than any other occupation group apart from managers and professionals. The remaining four major occupation groups which all have relatively low education levels are “service occupations”, “farming, forestry, and fishing occupations”, “precision production, craft, and repair occupations”, and “operators, fabricators, and laborers”.

The designation of “service occupations” closely follows the updated and extended definition that is used in the 2000 Census. The effort to identify a consistent set of service occupations over time should mitigate the concern that the recent growth of employment and wages in service occupations may be influenced by a changing definition of these occupations. Moreover, any spurious changes that may nevertheless be caused by the 1980-2005 occupation crosswalk should be confined to the 1990-2000 period because the only noteworthy changes to the Census occupation system since 1980 took place between the 1990 and 2000 Censuses. The growth of service employment and wages does, however, also prevail in the 1980-1990 and 2000-2005 periods which are nearly unaffected by changes to occupational classification.

A.1.3 Matching Task Data to Occupations

We use job task data from the Dictionary of Occupational Titles (DOT; U. S. Department of Labor, Employment and Training Administration, 1977) to characterize the task content of occupations. The DOT assesses the occupational tasks of more than 12,000 highly detailed occupations. Our DOT data is based on an aggregation of these detailed occupations to the three-digit occupation codes of the 1970 Census.³⁰ The DOT task scores are available for all but a few occupation codes. Occupations with missing task data are mostly residual categories like “miscellaneous operatives” or “clerical workers, not specified” that may cover workers whose Census forms provided imprecise occupational information. We impute task scores for these occupations by computing, e.g., the task values for “professionals, not elsewhere classified” as the average task score of all professional occupations weighted by each occupation’s total work hours in 1970.

The DOT 1977 task values are matched to *occ1990dd* occupation codes in several steps.

³⁰See Autor et al. (2003) for a more detailed description of this data.

Appendix Table 2. "Occ1990dd" Occupation System, 1950-2005

Occ1990dd Code	Occupation Groups and Occupation Titles	Census 1950 Codes	Census 1960 Codes	Census 1970 Codes	Balanced Panel 1980-2005			ACS 2005 Codes
					Census 1980 Codes	Census 1990 Codes	Census 2000 (5% Sample) Codes	
A. Managerial and Professional Specialty Occupations								
A.1 Executive, Administrative, and Managerial Occupations								
4	Chief executives, public administrators, and legislators	250	270		3, 4	3, 4	1, 3	1
7	Financial managers			x	x	x	x	x
8	Human resources and labor relations managers				x	x	x	x
13	Managers and specialists in marketing, advert., PR		x	x	x	x	x	x
14	Managers in education and related fields	x	x	x	x	x	x	x
15	Managers of medicine and health occupations			x	x	x	x	x
18	Managers of properties and real estate	x	x	x	x	x	x	x
19	Funeral directors	x	x	x	x	x	x	x
22	Managers and administrators, n.e.c.	260, 290, 357	275, 280, 290	195, 201, 220, 222- 224, 245, 246	5, 17, 19	5, 16, 17, 21, 22	2, 10, 11, 14, 22, 30, 31, 33, 34, 36, 40, 42, 43, 60, 72	2, 10, 11, 14, 22, 30, 31, 33, 34, 36, 42, 43, 60, 72
A.2 Management Related Occupations								
23	Accountants and auditors	x	x	x	x	x	x	x
24	Insurance underwriters				x	x	x	x
25	Other financial specialists	x	x		x	x	x	x
26	Management analysts				x	x	x	x
27	Personnel, HR, training, and labor rel. specialists				x	x	x	x
28	Purchasing agents and buyers of farm products	x	x	x	x	x	x	x
29	Buyers, wholesale and retail trade	x	x	x	x	x	x	x
33	Purchasing managers, agents, and buyers, n.e.c.	x	x	x	x	x	x	x
34	Business and promotion agents				x	x	x	x
35	Construction inspectors			x	x	x	x	x
36	Inspectors and compliance officers, outside	x	x	x	x	x	x	x
37	Management support occupations				x	x	x	x
A.3 Professional Specialty Occupations								
43	Architects	x	x	x	x	x	x	x
44	Aerospace engineers	x	x	x	x	x	x	x
45	Metallurgical and materials engineers	x	x	x	x	x	x	x
47	Petroleum, mining, and geological engineers	48	91	20	46, 47	46, 47	150, 152	152
48	Chemical engineers	x	x	x	x	x	x	x
53	Civil engineers	x	x	x	x	x	x	x
55	Electrical engineers	x	x	x	x	x	x	x
56	Industrial engineers	x	x	x	x	x	x	x
57	Mechanical engineers	x	x	x	x	x	x	x
59	Engineers and other professionals, n.e.c.	49, 99	93, 195	23, 196	49, 54, 58, 59	49, 54, 58, 59	142, 144, 150, 153	134, 142, 144, 150, 153

Occ1990dd Code	Occupation Groups and Occupation Titles	Census 1950 Codes	Census 1960 Codes	Census 1970 Codes	Census 1980 Codes	Census 1990 Codes	Census 2000 (5% Sample) Codes	ACS 2005 Codes
64	Computer systems analysts and computer scientists			x	x	x	x	x
65	Operations and systems researchers and analysts			x	x	x	x	x
66	Actuaries			x	x	x	x	x
68	Mathematicians and statisticians	67, 83	135, 174	35, 36	67, 68	67, 68	124	124
69	Physicists and astronomers	x	x	x	x	x	x	x
73	Chemists	x	x	x	x	x	x	x
74	Atmospheric and space scientists			x	x	x	x	x
75	Geologists	x	x	x	x	x	x	x
76	Physical scientists, n.e.c.	x	x	x	x	x	x	x
77	Agricultural and food scientists	x	x	x	x	x	x	x
78	Biological scientists	x	x	x	x	x	x	x
79	Foresters and conservation scientists	x	x	x	x	x	x	x
83	Medical scientists				x	x	x	x
84	Physicians	x	x	x	x	x	x	x
85	Dentists	x	x	x	x	x	x	x
86	Veterinarians	x	x	x	x	x	x	x
87	Optometrists	x	x	x	x	x	x	x
88	Podiatrists			x	x	x	x	x
89	Other health and therapy occupations	x	x	x	x	x	x	x
95	Registered nurses	58, 59	150, 151	75, 923	95	95	313	313
96	Pharmacists	x	x	x	x	x	x	x
97	Dieticians and nutritionists	x	x	x	x	x	x	x
98	Respiratory therapists				x	x	x	x
99	Occupational therapists				99	99	315	315
103	Physical therapists				103	103	316	316
104	Speech therapists				x	x	x	x
105	Therapists, n.e.c.	x	x	x	x	x	x	x
106	Physicians' assistants				x	x	x	x
154	Subject instructors, college	12-29	31-60	102-140	113-153	113-153	220	220
155	Kindergarten and earlier school teachers			x	x	x	x	x
156	Primary school teachers	x	x	x	x	x	x	x
157	Secondary school teachers		x	x	x	x	x	x
158	Special education teachers				x	x	x	x
159	Teachers, n.e.c.		184	141, 145	159	159	234, 255	234, 255
163	Vocational and educational counselors			x	x	x	x	x
164	Librarians	x	x	x	x	x	x	x
165	Archivists and curators			x	x	x	x	x
166	Economists, market and survey researchers	x	x	x	x	x	x	x
167	Psychologists	x	x	x	x	x	x	x
169	Social scientists and sociologists, n.e.c.	52, 84	102, 175	24, 26, 92, 94	168, 169	168, 169	186	186
173	Urban and regional planners			x	x	x	x	x
174	Social workers	x	x	x	x	x	x	x
176	Clergy and religious workers	x	x	x	x	x	x	x
177	Welfare service workers			954	467	465	202	202
178	Lawyers and judges	55	105	30, 31	178, 179	178, 179	210, 211	210
183	Writers and authors	x	x	x	x	x	x	x
184	Technical writers				x	x	x	x

Occ1990dd Code	Occupation Groups and Occupation Titles	Census 1950 Codes	Census 1960 Codes	Census 1970 Codes	Census 1980 Codes	Census 1990 Codes	Census 2000 (5% Sample) Codes	ACS 2005 Codes
185	Designers	x	x	x	x	x	x	x
186	Musicians and composers	x	x	x	x	x	x	x
187	Actors, directors, and producers	x	x	x	x	x	x	x
188	Painters, sculptors, craft-artists, and print-makers	x	x	x	x	x	x	x
189	Photographers	x	x	x	x	x	x	x
193	Dancers	x	x	x	x	x	x	x
194	Art/entertainment performers and related occs	x	x	x	x	x	x	x
195	Editors and reporters	x	x	x	x	x	x	x
198	Announcers			x	x	x	x	x
199	Athletes, sports instructors, and officials	x	x	x	x	x	x	x
B. Technical, Sales, and Administrative Support Occupations								
B.1 Technicians and Related Support Occupations								
203	Clinical laboratory technologies and technicians	x	x	x	x	x	x	x
204	Dental hygienists			x	x	x	x	x
205	Health record technologists and technicians			x	x	x	x	x
206	Radiologic technologists and technicians			x	x	x	x	x
207	Licensed practical nurses	x	x	x	x	x	x	x
208	Health technologists and technicians, n.e.c.			x	x	x	x	x
214	Engineering technicians		190	154, 155, 162	213-216	213-216	155	155
217	Drafters	x	x	x	x	x	x	x
218	Surveyors, cartographers, mapping scientists/techs	x	x	x	x	x	x	x
223	Biological technicians			x	x	x	x	x
224	Chemical technicians			x	x	x	x	x
225	Other science technicians	x	x	x	x	x	x	x
226	Airplane pilots and navigators	x	x	x	x	x	x	x
227	Air traffic controllers			x	x	x	x	x
228	Broadcast equipment operators	76	164	171	228	228	290	290
229	Computer software developers			x	x	x	x	x
233	Programmers of numerically controlled machine tools			x	x	x	x	x
234	Legal assistants and paralegals				x	x	x	x
235	Technicians, n.e.c.	96	192	165, 173	235	235	196	196
B.2 Sales Occupations								
243	Sales supervisors and proprietors	x	x		x	x	x	x
253	Insurance sales occupations		x	x	x	x	x	x
254	Real estate sales occupations	x	x	x	x	x	x	x
255	Financial service sales occupations	x	x	x	x	x	x	x
256	Advertising and related sales jobs	x	x	x	x	x	x	x
258	Sales engineers		x	x	x	x	x	x
274	Salespersons, n.e.c.	300, 410, 430, 490	301, 381, 383, 394	261, 280- 282, 285, 296	257, 259, 284, 285	257, 259, 284, 285	485, 494, 496	485, 494, 496
275	Retail salespersons and sales clerks			283, 284, 314	263-269, 274, 275	263-269, 274, 275	474-476, 484	474-476, 484
276	Cashiers	x	x	x	x	x	x	x
277	Door-to-door sales, street sales, and news vendors	x	x	x	x	x	x	x
283	Sales demonstrators, promoters, and models	223, 514	382	262	283	283	490	490

Occ1990dd Code	Occupation Groups and Occupation Titles	Census 1950 Codes	Census 1960 Codes	Census 1970 Codes	Census 1980 Codes	Census 1990 Codes	Census 2000 (5% Sample) Codes	ACS 2005 Codes
B.3 Administrative Support Occupations								
303	Office supervisors			x	x	x	x	x
308	Computer and peripheral equipment operators			x	x	x	x	x
313	Secretaries and stenographers	350	342, 345	370-372, 376	313, 314	313, 314	570	570
315	Typists		360	391	315	315	582	582
316	Interviewers, enumerators, and surveyors			x	x	x	x	x
317	Hotel clerks				x	x	x	x
318	Transportation ticket and reservation agents	x	x	x	x	x	x	x
319	Receptionists and other information clerks		341	364	319, 323	319, 323	540	540
326	Correspondence and order clerks				x	x	x	x
328	Human resources clerks, excl payroll and timekeeping	x	x	x	x	x	x	x
329	Library assistants	x	x	x	x	x	x	x
335	File clerks		x	x	x	x	x	x
336	Records clerks				325, 336	325, 336	520, 542	520, 542
337	Bookkeepers and accounting and auditing clerks	x	x	x	x	x	x	x
338	Payroll and timekeeping clerks		x	x	x	x	x	x
344	Billing clerks and related financial records processing			303, 341, 342	339, 343, 344	339, 343, 344	511	511
346	Mail and paper handlers			x	x	x	x	x
347	Office machine operators, n.e.c.	341	325	344, 355	345, 347	345, 347	590	590
348	Telephone operators	x	x	x	x	x	x	x
349	Other telecom operators	x	x	x	x	x	x	x
354	Postal clerks, excluding mail carriers		x	x	x	x	x	x
355	Mail carriers for postal service	x	x	x	x	x	x	x
356	Mail clerks, outside of post office	x	x		x	x	x	x
357	Messengers	x	x	x	x	x	x	x
359	Dispatchers	x	x	x	x	x	x	x
361	Inspectors, n.e.c.	x	x					
364	Shipping and receiving clerks	x	x	x	x	x	x	x
365	Stock and inventory clerks		x	x	x	x	x	x
366	Meter readers			x	x	x	x	x
368	Weighers, measurers, and checkers			x	x	x	x	x
373	Material recording, sched., prod., plan., expediting cl.			x	x	x	x	x
375	Insurance adjusters, examiners, and investigators	x	x	x	x	x	x	x
376	Customer service reps, invest., adjusters, excl. insur.			x	x	x	x	x
377	Eligibility clerks for government prog., social welfare				x	x	x	x
378	Bill and account collectors	x	x	x	x	x	x	x
379	General office clerks				379	379	586	586
383	Bank tellers	x	x	x	x	x	x	x
384	Proofreaders			x	x	x	x	x
385	Data entry keyers			x	x	x	x	x
386	Statistical clerks			x	x	x	x	x
387	Teacher's aides			382	387	387, 467	254	254
389	Administrative support jobs, n.e.c.	390, 533	370, 450	311, 394, 395, 396	369, 374, 389	369, 374, 389	522, 583, 593	522, 593

Occ1990dd Code	Occupation Groups and Occupation Titles	Census 1950 Codes	Census 1960 Codes	Census 1970 Codes	Census 1980 Codes	Census 1990 Codes	Census 2000 (5% Sample) Codes	ACS 2005 Codes
C. Service Occupations								
C.1 Housekeeping and Cleaning Occupations								
405	Housekeepers, maids, butlers, and cleaners	700, 751- 753, 764	802, 820, 821, 823, 824, 832	901, 902, 940, 941, 950, 982, 984	405, 407, 449	405, 407, 449	423	423
408	Laundry and dry cleaning workers	643, 710	674, 803	611, 630, 983	403, 747, 748	403, 747, 748	830	830
C.2 Protective Service Occupations								
415	Supervisors of guards				x	x	x	x
417	Fire fighting, fire prevention, and fire inspection occs	x	x	x	x	x	x	x
418	Police and detectives, public service	773	853	964	6, 414, 418	6, 414, 418	371, 382, 384, 385	371, 382, 384, 385
423	Sheriffs, bailiffs, correctional institution officers	771, 782	852, 854	963, 965	423, 424	423, 424	370, 380	370, 380
425	Crossing guards	785	860	960	425	425	394	394
426	Guards and police, except public service	763	851	962	426	426	391, 392	391, 392
427	Protective service, n.e.c.				x	x	x	x
C.3 Other Service Occupations								
Food Preparation and Service Occupations								
433	Supervisors of food preparation and service				433	433	401	401
434	Bartenders	x	x	x	x	x	x	x
435	Waiters and waitresses	x	x	x	x	x	x	x
436	Cooks	754	825	912, 981	404, 436, 437	404, 436, 437	400, 402	400, 402
439	Food preparation workers				439	439	403	403
444	Miscellaneous food preparation and service workers	760	830, 835	911, 913, 914, 916	438, 443	438, 443	405, 406, 412-415	405, 406, 412-415
Healthcare Support Occupations								
445	Dental Assistants	302	303	921	445	445	364	364
447	Health and nursing aides	730	810	922, 925	446, 447	446, 447	360-363, 365, 461	360-363, 365, 461
Building/Grounds Cleaning/Maintenance Occs								
448	Supervisors of cleaning and building service				x	x	x	x
450	Superv. of landscaping, lawn service, groundskeeping				485	485	421	421
451	Gardeners and groundskeepers	930	964	755	486	486	425	425
453	Janitors	x	x	x	x	x	x	x
455	Pest control occupations				x	x	x	x
Personal Appearance Occupations								
457	Barbers		814	935	457	457	450	450
458	Hairdressers and cosmetologists	x	x	x	x	x	x	x
Recreation and Hospitality Occupations								
459	Recreation facility attendants	732	813	932	459	459	430, 440, 443	430, 440, 443
461	Guides				x	x	x	x
462	Ushers	x	x	x	x	x	x	x
464	Baggage porters, bellhops and concierges	x	x	x	x	x	x	x
466	Recreation and fitness workers	77	165	101	175	175	462	462
467	Motion picture projectionists	562	493	505	773	773	441	441

Occ1990dd Code	Occupation Groups and Occupation Titles	Census 1950 Codes	Census 1960 Codes	Census 1970 Codes	Census 1980 Codes	Census 1990 Codes	Census 2000 (5% Sample) Codes	ACS 2005 Codes
Child Care Workers								
468	Child care workers		x	x	x	x	x	x
Misc. Personal Care and Service Occupations								
469	Personal service occupations, n.e.c	720, 731, 761, 790	804, 812, 831, 890	933, 943, 945, 976, 986	454, 469	454, 469	446, 465	446, 465
470	Supervisors of personal service jobs, n.e.c				456	456	432	432
471	Public transportation attendants and inspectors			931	465	463	455, 941	455, 941
472	Animal caretakers, except farm			740	487	487	434, 435	434, 435
D. Farming, Forestry, and Fishing Occupations								
D.1 Farm Operators and Managers								
473	Farmers (owners and tenants)	100	200	801	473, 474	473, 474	21	21
475	Farm managers	123	222	802, 806, 821	475, 476	475, 476	20	20
D.2 Other Agricultural and Related Occupations								
479	Farm workers, incl. nursery farming	810-840	901-903, 905	822-824, 846	477, 479, 484	477, 479, 484	434, 605	434, 605
488	Graders and sorters of agricultural products	x	x		x	x	x	x
489	Inspectors of agricultural products				x	x	x	x
496	Timber, logging, and forestry workers	x	x	x	x	x	x	x
498	Fishers, marine life cultivators, hunters, and kindred	910	962	752	483, 498, 499	483, 498, 499	610	610
E. Precision Production, Craft, and Repair Occupations								
E.1 Mechanics and Repairers								
503	Supervisors of mechanics and repairers				x	x	x	x
505	Automobile mechanics and repairers	x	x	x	x	x	x	x
507	Bus, truck, and stationary engine mechanics				x	x	x	x
508	Aircraft mechanics	x	x	x	x	x	x	x
509	Small engine repairers				x	x	x	x
514	Auto body repairers			x	x	x	x	x
516	Heavy equipment and farm equipment mechanics			x	x	x	x	x
518	Industrial machinery repairers				x	x	x	x
519	Machinery maintenance occupations	x	x	x	x	x	x	x
523	Repairers of industrial electrical equipment	x	x	x	x	x	x	x
525	Repairers of data processing equipment			x	x	x	x	x
526	Repairers of household appliances and power tools			x	x	x	x	x
527	Telecom and line installers and repairers	x	x	x	x	x	x	x
533	Repairers of electrical equipment, n.e.c.	551	473	484	533, 538	533, 538	703, 711	703, 711
534	Heating, air conditioning, and refrigeration mechanics		x	x	x	x	x	x
535	Precision makers, repairers, and smiths	x	x	x	x	x	x	x
536	Locksmiths and safe repairers				x	x	x	x
539	Repairers of mechanical controls and valves				x	x	x	x
543	Elevator installers and repairers				x	x	x	x
544	Millwrights	x	x	x	x	x	x	x
549	Mechanics and repairers, n.e.c.	553, 554, 605, 614, 615	475, 480, 610, 620, 621	403, 486, 492, 495, 571, 572, 575, 586	547, 549, 864	547, 549	734, 751, 755, 756, 762	734, 751, 755, 756, 762

Occ1990dd Code	Occupation Groups and Occupation Titles	Census 1950 Codes	Census 1960 Codes	Census 1970 Codes	Census 1980 Codes	Census 1990 Codes	Census 2000 (5% Sample) Codes	ACS 2005 Codes
E.2 Construction Trades								
558	Supervisors of construction work				x	x	x	x
563	Masons, tilers, and carpet installers	x	x	x	x	x	x	x
567	Carpenters	x	x	x	x	x	x	x
573	Drywall installers			x	x	x	x	x
575	Electricians	x	x	x	x	x	x	x
577	Electric power installers and repairers			433	577	577	704, 741	704, 741
579	Painters, construction and maintenance	x	x	x	x	x	x	x
583	Paperhangers	x	x	x	x	x	x	x
584	Plasterers	x	x	x	x	x	x	x
585	Plumbers, pipe fitters, and steamfitters	x	x	x	x	x	x	x
588	Concrete and cement workers	x	x	x	x	x	x	x
589	Glaziers	x	x	x	x	x	x	x
593	Insulation workers	x	x	x	x	x	x	x
594	Paving, surfacing, and tamping equipment operators			x	x	x	x	x
595	Roofers and slaters	x	x	x	x	x	x	x
597	Structural metal workers	x	x	x	x	x	x	x
598	Drillers of earth			x	x	x	x	x
599	Misc. construction and related occupations	611	613	440	596, 599	596, 599	671, 675, 676	671, 675, 676
E.3 Extractive Occupations								
614	Drillers of oil wells				614	614	680	680
615	Explosives workers	x	x	x	x	x	x	x
616	Miners	x	x	x	x	x	x	x
617	Other mining occupations				617	617	694	694
E.4 Precision Production Occupations								
628	Production supervisors or foremen	x	x	x	x	x	x	x
634	Tool and die makers and die setters	x	x	x	x	x	x	x
637	Machinists	x	x	x	x	x	x	x
643	Boilermakers	x	x	x	x	x	x	x
644	Precision grinders and fitters				x	x	x	x
645	Patternmakers and model makers	570	502	514	645, 656, 676	645, 656, 676	806	806
649	Engravers	x	x	x	x	x	x	x
653	Other metal and plastic workers	591, 612	525, 614	535, 536, 540	646, 653, 654	646, 653, 654	652, 816	652
657	Cabinetmakers and bench carpeters	x	x	x	x	x	x	x
658	Furniture/wood finishers, other prec. wood workers			443	658, 659	658, 659	851	851
666	Dressmakers, seamstresses, and tailors	590, 633	524, 651	551, 613	666, 667	666, 667	835	835
668	Upholsterers	x	x	x	x	x	x	x
669	Shoemakers, other prec. apparel and fabric workers	525, 645	432, 680, 705	444, 542, 636	669, 674	669, 674	833	833
675	Hand molders and shapers, except jewelers			x	x	x	x	x
677	Optical goods workers	x	x	x	x	x	x	x
678	Dental laboratory and medical appliance technicians			x	x	x	x	x
679	Bookbinders	x	x	x	x	x	x	x
684	Other precision and craft workers	594	545		684	684	822	822

Occ1990dd Code	Occupation Groups and Occupation Titles	Census 1950 Codes	Census 1960 Codes	Census 1970 Codes	Census 1980 Codes	Census 1990 Codes	Census 2000 (5% Sample) Codes	ACS 2005 Codes
686	Butchers and meat cutters	x	x	x	x	x	x	x
687	Bakers	x	x	x	x	x	x	x
688	Batch food makers				x	x	x	x
694	Water and sewage treatment plant operators				x	x	x	x
695	Power plant operators	x	x	x	x	x	x	x
696	Plant and system operators, stationary engineers	x	x	x	x	x	x	x
699	Other plant and system operators				x	x	x	x
F. Operators, Fabricators, and Laborers								
F.1 Machine Operators, Assemblers, and Inspectors								
703	Lathe, milling, and turning machine operatives	535	452	454, 652, 653	703-705	703-705	801	801
706	Punching and stamping press operatives			x	x	x	x	x
707	Rollers, roll hands, and finishers of metal	x	x	x	x	x	x	x
708	Drilling and boring machine operators			x	x	x	x	x
709	Grinding, abrading, buffing, and polishing workers	x	x	x	x	x	x	x
713	Forge and hammer operators	x	x	x	x	x	x	x
719	Molders and casting machine operators	x	x	x	x	x	x	x
723	Metal platers			x	x	x	x	x
724	Heat treating equipment operators	x	x	x	x	x	x	x
727	Sawing machine operators and sawyers	x	x	x	x	x	x	x
729	Nail, tacking, shaping and joining mach ops (wood)				728, 729	728, 729	854	854
733	Other woodworking machine operators				726, 733	726, 733	855	855
734	Printing machine operators, n.e.c.	520, 571, 575, 613	423, 503, 512, 615	423, 434, 515, 530, 531	734, 735, 737	734, 735, 737	824	824
736	Typesetters and compositors	x	x	x	x	x	x	x
738	Winding and twisting textile and apparel operatives			x	x	x	x	x
739	Knitters, loopers, and toppers textile operatives	x	x	x	x	x	x	x
743	Textile cutting and dyeing machine operators				743	743	836, 840	840
744	Textile sewing machine operators			x	x	x	x	x
745	Shoemaking machine operators	x	x	x	x	x	x	x
747	Clothing pressing machine operators				x	x	x	x
749	Miscellaneous textile machine operators	x	x	x	x	x	x	x
753	Cementing and gluing machine operators				x	x	x	x
754	Packers, fillers, and wrappers		x	x	x	x	x	x
755	Extruding and forming machine operators				755, 758	755, 758	792, 872	792, 872
756	Mixing and blending machine operators	x	x	x	x	x	x	x
757	Separating, filtering, and clarifying machine operators				x	x	x	x
763	Food roasting and baking machine operators				x	x	x	x
764	Washing, cleaning, and pickling machine operators				x	x	x	x
765	Paper folding machine operators				x	x	x	x
766	Furnance, kiln, and oven operators, apart from food	x	x	x	x	x	x	x
769	Slicing, cutting, crushing and grinding machine	555	490	501, 612	768, 769	768, 769	785, 871	785, 871
774	Photographic process workers	x	x	x	x	x	x	x

Occ1990dd Code	Occupation Groups and Occupation Titles	Census 1950 Codes	Census 1960 Codes	Census 1970 Codes	Census 1980 Codes	Census 1990 Codes	Census 2000 (5% Sample) Codes	ACS 2005 Codes
779	Machine operators, n.e.c.	690	775	660, 690- 696	673, 693, 714, 715, 717, 725, 759, 777, 779, 798	673, 693, 714, 715, 717, 725, 759, 777, 779, 798	894, 896	894, 896
783	Welders, solderers, and metal cutters	685	721	665, 680	783, 784	783, 784	771-773, 775	771-773, 775
785	Assemblers of electrical equipment		x	x	x	x	x	x
789	Painting and decoration occupations			543	789	789	881	881
799	Production checkers, graders, and sorters in manufacturing		643, 671	452, 610, 624, 625	689, 796, 797, 799	689, 796, 797, 799	874	874
F.2 Transportation and Material Moving Occupations								
803	Supervisors of motor vehicle transportation				x	x	x	x
804	Truck, delivery, and tractor drivers	632, 683, 960	650, 715, 971, 972	705, 706, 715, 763	804-806, 856	804-806, 856	913, 960	913, 960
808	Bus drivers	x	x	x	x	x	x	x
809	Taxi cab drivers and chauffeurs	682	714	714	809, 814	809, 814	914, 915	911, 914, 915
813	Parking lot attendants			x	x	x	x	x
823	Railroad conductors and yardmasters	203, 631	252, 645	226, 704	823	823	924	924
824	Locomotive operators: engineers and firemen	x	x	x	x	x	x	x
825	Railroad brake, coupler, and switch operators	x	x	x	x	x	x	x
829	Ship crews and marine engineers	240, 673	265, 703	221, 661, 701	497, 828, 829, 833	497, 828, 829, 833	930, 931, 933	930, 931
834	Miscellaneous transportation occupations	623	635		834	834	942	942
844	Operating engineers of construction equipment			x	x	x	x	x
848	Crane, derrick, winch, hoist, longshore operators	513	415	424	845, 848, 849	845, 848, 849	951, 956	951, 956
853	Excavating and loading machine operators	x	x		x	x	x	x
859	Stevedores and misc. material moving occupations	660, 940	690, 965	726, 760	843, 859, 876	843, 859, 876	965, 973, 975	965, 973, 975
865	Helpers, constructions				x	x	x	x
866	Helpers, surveyors			x	x	x	x	x
869	Construction laborers			750, 751	869	869	626, 673	626, 673
873	Production helpers				873, 874	873, 874	895	895
875	Garbage and recyclable material collectors			x	x	x	x	x
878	Machine feeders and offbearers				x	x	x	x
885	Garage and service station related occupations	x	x	x	x	x	x	x
887	Vehicle washers and equipment cleaners	x	x	x	x	x	x	x
888	Packers and packagers by hand			x	x	x	x	x
889	Laborers, freight, stock, and material handlers, n.e.c.	970	973, 985	753, 762, 770, 780, 785, 796	877, 883, 889	868, 877, 883, 889	674, 675, 962	674, 675, 962

Occupation codes from the 1950-1990 Censuses, the 2000 Census 5% sample, and the 2005 American Community Survey are indicated whenever the composition of an "occ1990dd" deviates from the "occ1990" code with the same number. The definition of all other occupations is taken from the "occ1990" crosswalk by Meyer and Osborne (2005) and "x" indicates the availability of an occupation code in a given dataset.

We first map the DOT data to the occupation codes of the 1980 Census using a Census file that relates 1970 codes to 1980 codes based on a subsample of occupation responses from the 1980 Census that were coded according to both occupation schemes. The task scores for the 1980 occupation codes can readily be mapped to the nearly identical 1990 codes. For a small number of occupations with missing data, task values are again imputed based on the task scores for similar jobs. Finally, we derive task scores for *occ1990dd* occupations by averaging the task data of all 1990 Census occupations that form a given *occ1990dd* code, weighting each 1990 Census occupation by its contribution to the total work hours of the respective *occ1990dd* code.

Following Autor et al. (2003), we use a simple average of the DOT task variables *DCP* (direction, control, and planning of activities) and *GED-MATH* (quantitative reasoning requirements) to measure “abstract tasks”. The average of *STS* (adaptability to work requiring set limits, tolerances, or standards) and *FINGDEX* (finger dexterity) captures “routine tasks” and *EYEHAND* (eye, hand, foot coordination) operationalizes “manual tasks”. While abstract tasks are typically concentrated in the most skilled occupations, medium- and lower-skilled jobs tend to combine routine and manual tasks. We use the routine and manual task scores of each *occ1990dd* occupation to compute an index of routine task-intensity, *RTI*, according to

$$RTI_k = \ln \left(\hat{R}_{k,1980} / \hat{M}_{k,1980} \right) \quad (\text{A.9})$$

where \hat{R} and \hat{M} are, respectively, the intensity of routine and manual task input in for each occupation k , measured on a 0 to 10 scale. Equation (A.9) is undefined for occupations with a zero manual task score and we therefore use the manual score of the 5th percentile of the occupation distribution to derive an *RTI* score for these jobs.

The *RTI* value of an occupation provides a rough measurement of the relative importance of routine tasks in that occupation. Furthermore, since computer technology also supplies routine task inputs, *RTI* can be interpreted as an occupation’s potential susceptibility to displacement by automation.

A.2 Commuting Zone Microdata

A.2.1 Local Labor Market Concepts

The analysis of local labor markets is motivated by the notion that employers and workers interact within a space bounded by places of work and places of residence. This local determination of market outcomes can lead to persistent geographic differences in wage and employment levels and trends (Topel, 1986).

Empirical studies of local labor market dynamics require both a geographic delineation

of such markets as well as the ability to observe the necessary geographic information in the data source. In practice, the latter constraint often dictates the definition of local markets.

Due to a lack of precise geographical information, empirical studies often consider the fifty states of the United States as local labor markets (e.g., Topel, 1986). This definition has evident limitations. There is no apparent economic motivation why the boundaries of local labor markets should coincide with state boundaries. On the one hand, many states are arguably too large for being considered a single local market. On the other hand, local labor markets should reasonably be allowed to cross state boundaries. In particular, there are many urban areas overlapping with state lines (e.g., New York City/Jersey City, Washington D.C./Arlington, Kansas City MO/Kansas City KS), notably because cities developed on both sides of rivers that serve as state boundaries.

The use of counties as local labor markets (e.g., Gould, Weinberg and Mustard, 2002) provides a considerably more detailed geographic structure than states but raises similar methodological concerns. Again, local markets are restricted to be located within a single state, and while many states are too large to form a local market, counties may often be too small. Furthermore, county-level information is usually not available in publicly accessible microdata.

The most popular concept for local labor markets in recent research are Metropolitan Statistical Areas (MSAs) which are used, e.g., by Card (2001), Beaudry, Doms and Lewis (2006), and Mazzolari and Ragusa (2008). MSAs are defined for statistical purposes by the Office of Management and Budget (Office of Management and Budget, 2000) and consist of clusters of counties that cover a city and its surrounding suburbs. Various sources of microdata such as the Integrated Public Use Microdata Series of the Census (IPUMS) or the Current Population Survey (CPS) report MSA codes and data for these geographic units is thus readily available to researchers. The use of MSAs as a concept for local labor markets has certainly more economic appeal than the use of states. MSAs typically cover areas with reasonably commutable distances, and they can be located both within states or overlapping state boundaries.

The main disadvantage of MSAs is, however, that they only cover areas of the United States with major urban population centers. Moreover, the geographic definition of MSAs changes over time. MSA delineations are newly determined for every decennial Census and they are based on slightly different definition criteria over the years. In practice, the geographic area of MSAs tends to grow along with the sprawl of urban settlements.³¹ An additional complication for empirical work is that many MSAs are only partially identified

³¹Jaeger, Loeb, Turner and Bound (1998) propose the use of more detailed geographic units reported in 1970-1990 IPUMS data to identify areas that roughly correspond to MSAs according to their 1970 definitions. This approach reduces, but does not eliminate, the inconsistency in the geographic measurement of MSAs.

in IPUMS data since 1980. As a consequence of these issues, an MSA code for a given city may refer to a different geographic area in every decennial Census data. The changing geography of MSAs is troublesome for research that wants to track shifts in labor force composition of local labor markets over time. The gradual addition of outlying suburbs to MSAs biases observed changes in composition towards the characteristics of suburban residents who differ substantially from urban residents.

A.2.2 Commuting Zones

The first two essays of this thesis pursue an alternative approach for the definition of local labor markets based on the concept of Commuting Zones (CZs). Commuting zones are clusters of counties that are characterized by strong commuting ties within CZs, and weak commuting ties across CZs. They have been defined by Tolbert and Killian (1987) and Tolbert and Sizer (1996) with the explicit goal of creating geographic units that capture the economic notion of local labor markets.

CZs have been computed using county-level residence-to-work commuting data from the 1980 Census and later based on such data from the 1990 Census. The strength of commuting ties between two counties i and j is measured according to

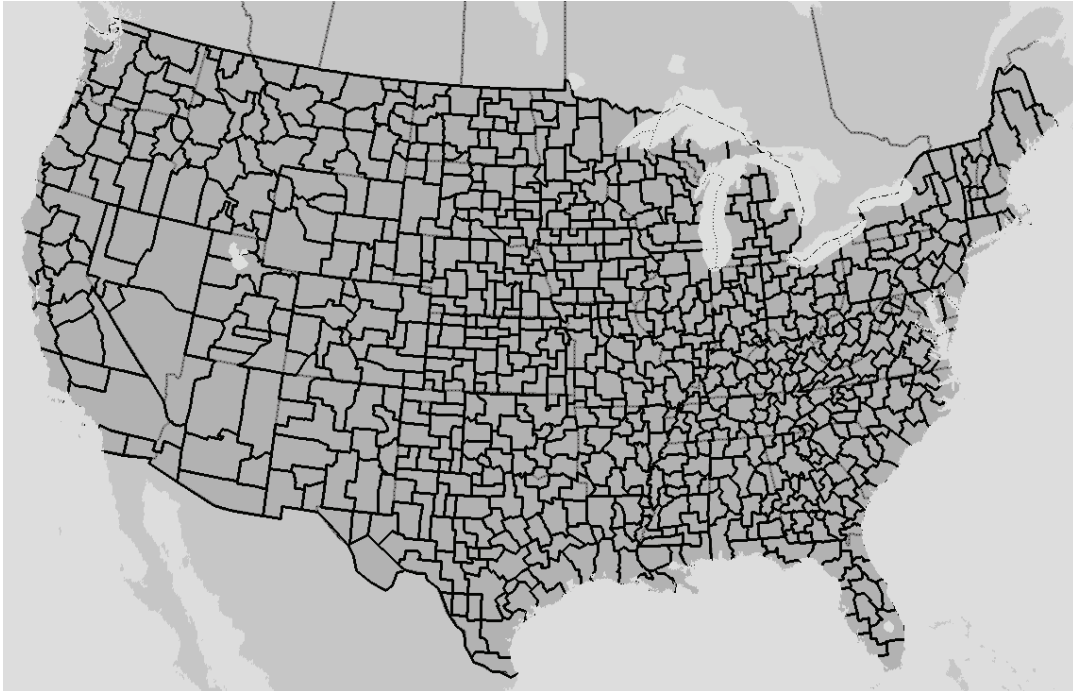
$$T_{ij} = \frac{c_{ij} + c_{ji}}{\text{argmin}(r_i, r_j)} \quad (\text{A.10})$$

where r_i is the number of all workers residing in county i and c_{ij} is the number of workers who reside in county i but work in county j . The commuting tie statistic T_{ij} hence divides the flow of workers who commute in either direction between the two counties i and j by the number of workers who live in the smaller of the two counties. By using just the labor force of the smaller county in the denominator, the statistic is better able to identify commuting ties between counties with large size differentials where the total commuter flow might seem negligible relative to the larger county's population even if all residents of the smaller county commuted to the larger one.

CZs are derived using a clustering algorithm for average linkage that starts by grouping the county pair with largest value of T_{ij} and subsequently forms clusters of interrelated counties. CZs are defined such that the average value of T_{ij} for the county pairs in a CZ is above 0.02. By consequence, commuting ties between CZs are so weak that further aggregation would decrease the within-cluster average of T_{ij} below 0.02. Based on commuting patterns from 1980, the clustering procedure yields 764 CZs while 1990 data produces 741 CZs. In each year, the average CZ consists of about four counties. Appendix Figure 1 shows a map of the 722 CZs that result from commuting patterns in the 48 mainland states in 1990.

CZs provide an economically appealing concept of local markets because they reflect

Appendix Figure 1. Geography of Commuting Zones in 1990



the notion that employers and workers in a local market should be located within commutable distances. In contrast to MSAs, the definition of CZs does not rely on the presence of a major city and CZs hence cover the entire area and entire workforce of the United States. Despite these advantages, CZs have hardly been used in empirical economic research, likely because this geographic unit is not reported in publicly accessible microdata. The following section however develops a procedure to match IPUMS data to CZs.

A.2.3 Matching Census Microdata to Commuting Zones

The United States Census records the precise location of every respondent's residence. The publicly available IPUMS Census microdata does, however, suppress this exact geographical information. Data confidentiality laws require that public release microdata must not report geographic units that contain fewer than 100,000 residents.³² The most detailed geographic units in IPUMS data are thus defined to comprise between 100,000 and 200,000 residents each. These units which were newly delineated for each decennial Census are alternatively called State Economic Areas (SEAs, in 1940 and 1950), County Groups (CGs, in 1970 and 1980), or Public Use Microdata Areas (PUMAs, in 1990 and

³²The Census Bureau can, however, report average population characteristics for smaller geographic units. The third essay of this thesis uses such averaged data for Census tracts, a geographic unit of about 4000 residents.

2000). The Census Bureau did not report comparably detailed geographic information in 1960. All other geographic units reported in IPUMS data, including states and MSAs, are multiples of SEAs/CGs/PUMAs and do not provide additional geographic precision.³³ A direct identification of CZs in IPUMS data would violate confidentiality laws as some CZs do not reach the required population threshold of 100,000 persons.³⁴

We developed a procedure to match Census microdata to 1990 CZs. The key step of this procedure relates every PUMA (or SEA/CG) $j = 1, \dots, J$ to every CZ $k = 1, \dots, 741$ by computing the probability that a resident of j lives in k in Census year t , i.e.,

$$\alpha_{jkt} = \sum_{c=1}^C \frac{r_{jct} r_{ckt}}{r_{jt} r_{ct}} \quad \text{where } c = 1, \dots, 3141 \text{ and } t = 1950, 1970, 1980, 1990, 2000 \quad (\text{A.11})$$

In equation (A.13), r_{jt} is the number of residents in PUMA j in year t , r_{ct} is the number of residents in county c in year t , r_{jct} is the number of residents in the overlap between PUMA j and county c , and r_{ckt} is the number of residents in the overlap between county c and CZ k .

The share $\frac{r_{ckt}}{r_{ct}}$ of county c 's population that falls into CZ k is either zero or one and can easily be determined since every county matches to exactly one CZ by definition. The fraction $\frac{r_{jct}}{r_{jt}}$ denotes the share of PUMA j 's population that overlaps with a county c . While r_{jt} is observed in the microdata, r_{jct} is not. The Census Bureau provides files with population counts for each PUMA-county overlap r_{jct} for 1990 and 2000 but not for other years. In 1950 and 1970, the SEAs and CGs either map into a single county which implies $r_{jct} = r_{jt}$ when j is in c , or they are composed by multiple entire counties and hence $r_{jct} = r_{ct}$ when j contains c . In either case, r_{jct} can be determined based only on the available population counts for SEAs, CZs, and counties. The same procedure can be used for most of the 1980 CGs. A few of the 1980 CGs, particularly in the state of Connecticut, however combine parts of different counties. Since data for r_{jct} is not directly available for 1980, we aggregate these split-county CGs to aggregated CGs and then use county population counts to compute $r_{jct} = r_{ct}$ when an aggregated CG j contains a county c . Finally, the 2005 American Community Survey (ACS) uses the same PUMA definitions as the 2000 Census. We apply the α_{jkt} values of the year 2000 to the PUMAs of the 2005 ACS.

The computation of (A.13) makes use of the fact that the county structure of the United States is very stable over time. The counties that form a 1950 SEA or 1970 CG

³³PUMAs and 1980 CGs do not always perfectly sum up to MSAs and MSA codes reported in IPUMS data hence sometimes only identify the more central parts of an MSA.

³⁴With view to this constraint, Tolbert and Killian (1987) and Tolbert and Sizer (1996) aggregated smaller CZs to create Labor Market Areas (LMAs) whose population exceeds 100,000 residents. Two special IPUMS data releases for 1980 and 1990 report these LMA codes instead of MSA codes. Unfortunately, however, the LMA samples only include microdata for one percent of the population which creates a considerably larger sampling error as opposed to the standard five percent samples with MSA codes.

are typically the same geographic units as the counties that make up the target geography, 1990 CZs. We adjust for the few counties that split or merged between 1950 and 2000 by mapping each year’s county structure to the 3141 counties of the year 1990. Most of these changes occurred in Alaska which is divided into political units called boroughs and a set of Census Areas that serve statistical only purposes. We do not map data from Alaska and Hawaii to CZs in 1950 because the Census did not designate SEAs for these territories prior to statehood. The empirical analysis of CZs between 1950 and 2005 therefore focuses on the 722 CZs that cover the 48 mainland states.

In order to map Census microdata to CZs, we replace every individual microdata observation $n = 1, \dots, N$ of Census year t with 722 observations that are identical to the initial observation except for the person weight which is adjusted from the initial Census person weight w_{nt} to

$$\omega_{nkt} = w_{nt}\alpha_{jkt} \quad \text{where } k = 1, \dots, 722 \text{ and } t = 1950, 1970, 1980, 1990, 2000, 2005 \quad (\text{A.12})$$

Observations are dropped whenever $\alpha_{jkt} = 0$ and the number of observations per person is thus equal to the number of CZs that overlap with the PUMA in which the person resides. The adjusted person weights ω_{nkt} in the resulting dataset sum to the original weights w_{nt} for each person n , i.e.,

$$\sum_{k=1}^{722} \omega_{nkt} = w_{nt} \quad \forall n = 1, \dots, N \quad (\text{A.13})$$

This procedure essentially ‘splits’ a person into multiple parts whenever an individual’s PUMA cannot be uniquely assigned to a CZ. In practice, however, many PUMAs match fully into a single CZ. Of the 2071 PUMAs in the 2000 Census, only 19 percent overlap with several CZs.

The individual-level CZ data is observed with noise due to the need to match PUMAs to CZs. However, it allows studying wage and employment dynamics in local labor markets that are defined according to a tractable economic definition and with fixed boundaries. While an analysis of MSAs over time is usually biased by the inclusion of an ever larger geographic area, the CZ geography consistently covers the entire area of the United States.