

The Dual U.S. Labor Market Uncovered

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Coarse classification of employed, unemployed, and non-participant



“A set of precise labor force concepts was developed in the late 1930s to classify people as working, looking for work, or not in the labor force. These concepts were adopted for a national survey of households, called the Monthly Report of Unemployment, which was initiated in 1940 by the Work Projects Administration. This survey was transferred to the Census Bureau in 1942 and later renamed the Current Population Survey. . . .” (BLS, History of the Current Population Survey)

Macro Heterogeneity within these categories topic of many studies

Finer classification needed to understand many aspects of labor market dynamics

- Short- vs long-term employed

Hall (1982); Hyatt and Spletzer (2016); Pries (2004); Morchio (2020); Pries and Rogerson (2021)

- Heterogeneity in types of unemployed

van den Berg and van Ours (1996); Hornstein (2012); Kroft *et al.* (2016); Jarosch and Pilossoph (2019); Ahn and Hamilton (2020)

- Differences in labor supply elasticities and labor force attachment

Elsby *et al.* (2015); Krusell *et al.* (2017); Kudlyak and Lange (2017); Heathcote *et al.* (2020)

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This paper: shows that the rich macro heterogeneity can be captured with a dual labor market structure (DLM) augmented with a *predominantly* home production sector

The gist of this paper in a (coco-) Nutshell

U.S. labor market well approximated as the combination of three segments

Primary (Stability)

Secondary (Turbulence)

Tertiary (Low Attachment)

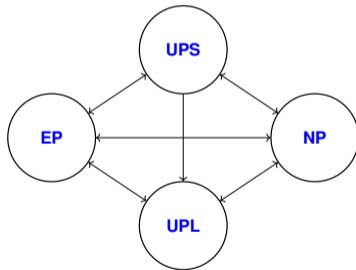


Three Segregated Segments

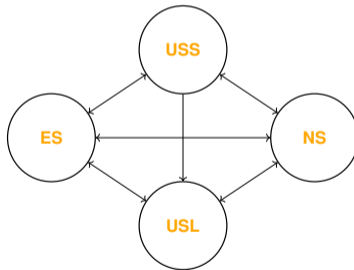
“The dual labor market is distinguished by the stability of jobs and very limited mobility between the two market segments.”

Doeringer and Piore (1970)

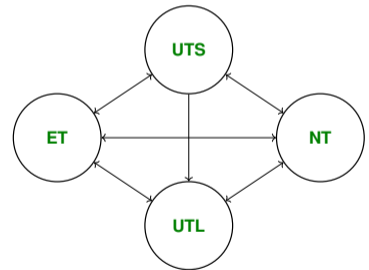
Primary



Secondary



Tertiary

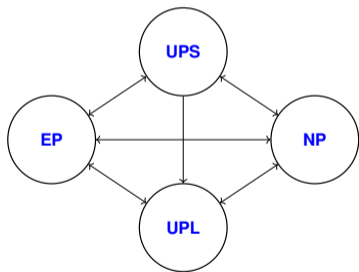


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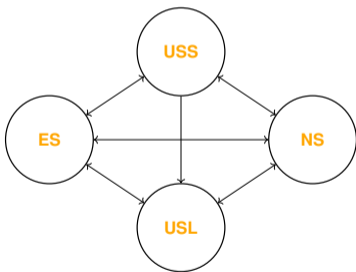
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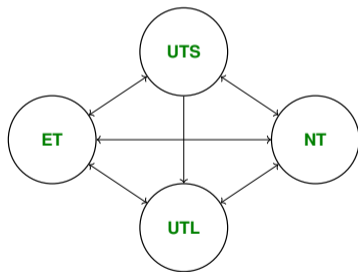
Primary



Secondary



Tertiary



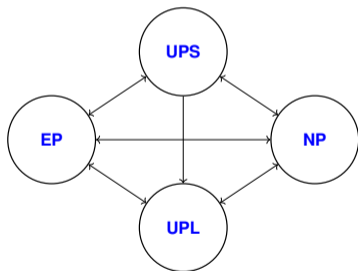
L=Employed (E), Short and Long-term Unemployed (US, UL) and Nonparticipant (N)

Three Segregated Segments

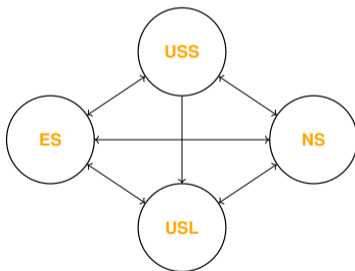
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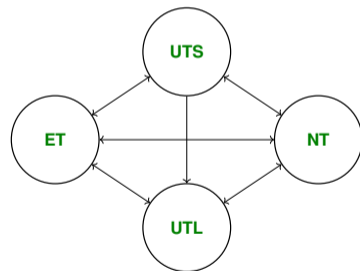
Primary



Secondary



Tertiary

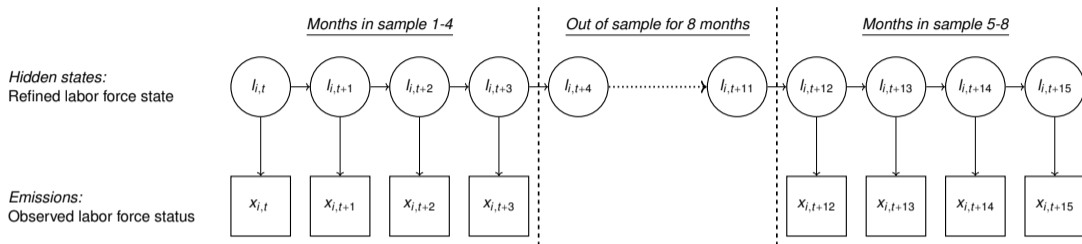


Use detailed labor force histories of 10,178,593 respondents in the CPS in 1980 to 2021

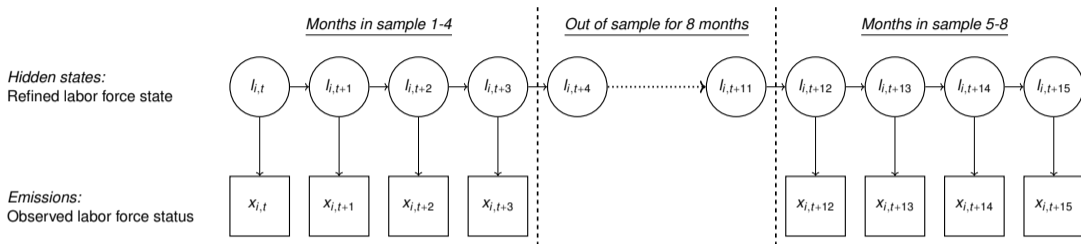
Methodology

Hidden Markov Model with Inequality Restrictions

Hidden Markov Model (HMM): CPS Structure



Hidden Markov Model (HMM): CPS Structure

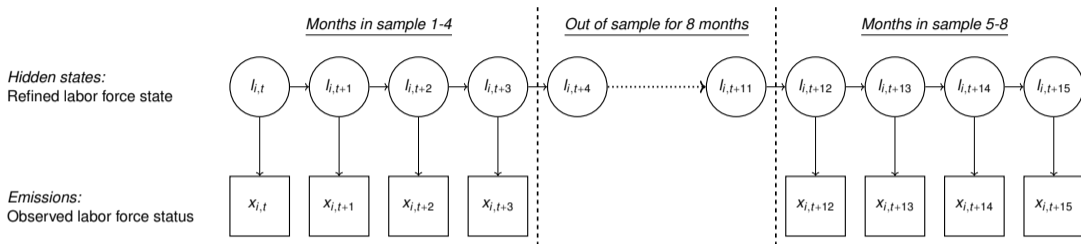


Identification of Macro Heterogeneity unsupervised machine learning problem

- Involves classifying individual, i at each point in time into untagged hidden labor market states $l \in L$

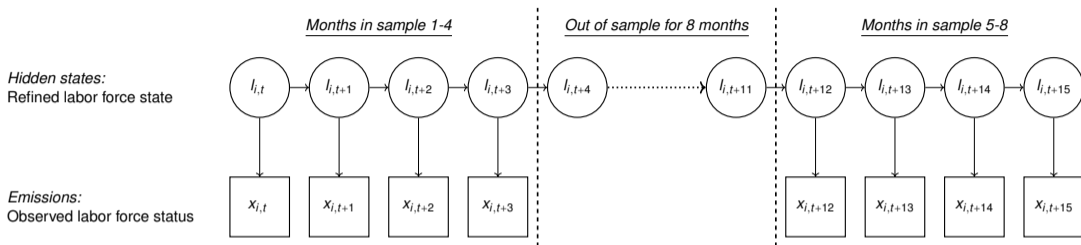
Hall and Kudlyak (2019), Shibata (2019), Gregory *et al.* (2021), Braxton *et al.* (2021), Lentz *et al.* (2022)

Hidden Markov Model (HMM): CPS Structure



- **Transition model:** Dynamics of hidden states
- **Emissions model:** Likelihood of observations — the hidden states

Hidden Markov Model: Three objects



Unconditional probabilities:

Stocks of individuals in each hidden state

$$\delta_{l,t} = P(l_{i,t} = l; t)$$

Transition probabilities (horizontal arrows):

Hidden states first-order Markov process

$$q_{l,l',t} = P(l_{i,t} = l' \mid l_{i,t-1} = l; t)$$

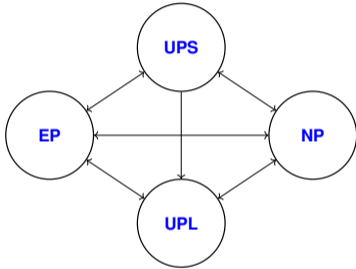
Emission probabilities (vertical arrows):

Observations only conditionally dependent on current hidden state

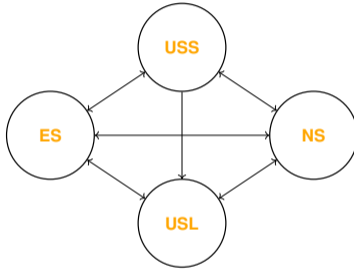
$$\omega_{x,l,t} = P(x_{i,t} = x \mid l_{i,t} = l; t)$$

Restrictions and Assumptions for Identification and Interpretability

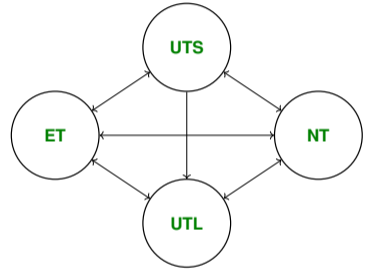
Primary



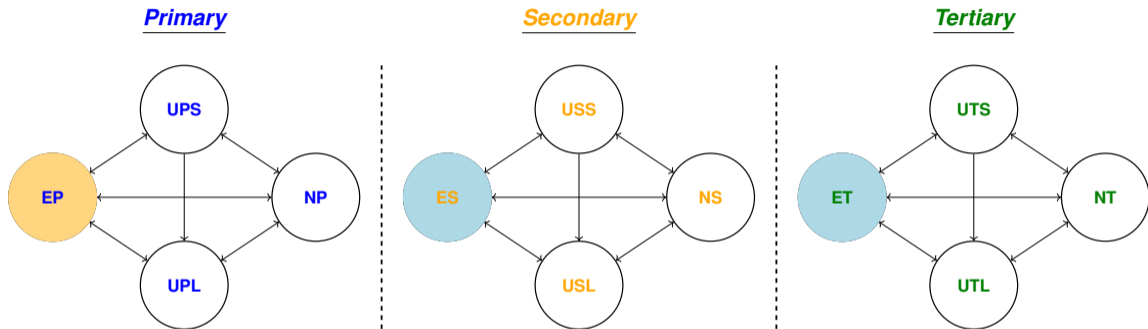
Secondary



Tertiary



Restrictions and Assumptions for Identification and Interpretability

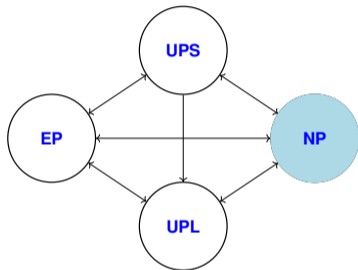


Employment in primary sector more persistent

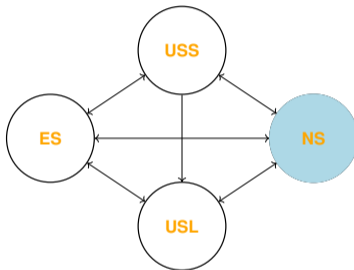
Distinguishes primary sector from secondary (and tertiary)

Restrictions and Assumptions for Identification and Interpretability

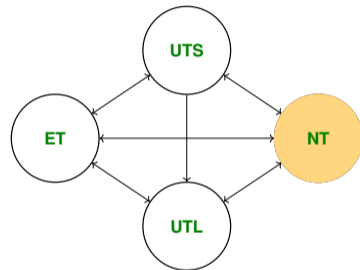
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Secondary



Tertiary

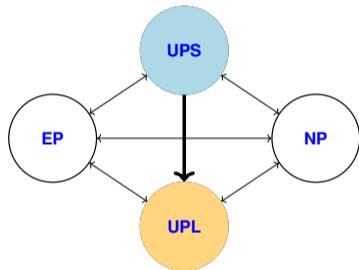


Persistence of non-participation higher in the tertiary sector

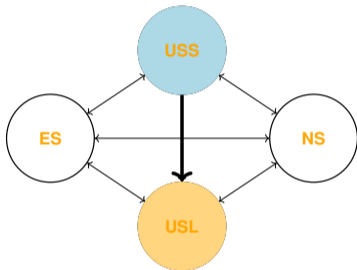
Pins down tertiary segment as “home production” sector

Restrictions and Assumptions for Identification and Interpretability

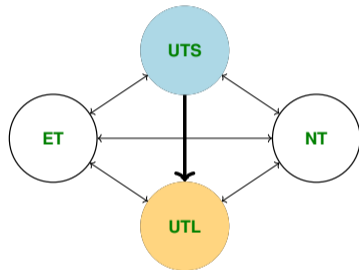
Primary



Secondary



Tertiary

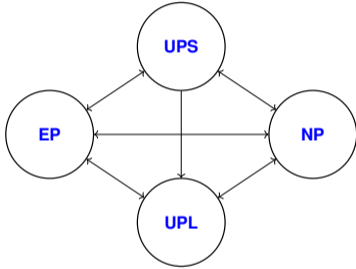


Long-term unemployment (UL) more persistent than short-term U (US)
Can only go from short- to long-term unemployment

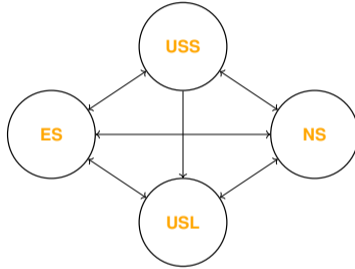
Separates short- and long-term employed types

Restrictions and Assumptions for Identification and Interpretability

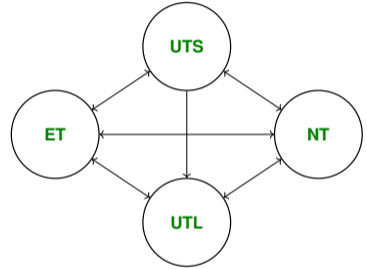
Primary



Secondary



Tertiary



No mobility between sectors, no misclassification error and random missing observations

4-8-4 structure of CPS limits estimation of cross-segment mobility.
Make sure that estimated stocks and flows match those published by BLS.

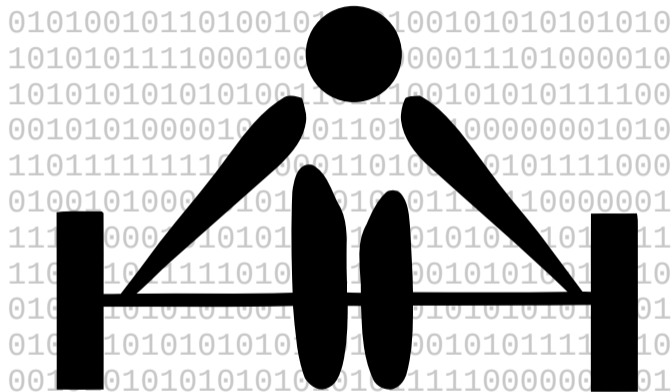
Use extensive answers about labor force status as emissions

1. **Employed** (3): Part-time for economic reasons, absent from work for other reasons, and the rest
2. **Unemployed** (16): 4 reasons for unemployment \otimes 4 categories of unemployment duration
 - Reason: Temporary layoffs, temporary job ended, job losers, and the rest
 - Duration: less than 5 weeks, 5-14 weeks, 15-26 weeks, longer than 26 weeks
3. **Nonparticipation** (10)
 - Discouraged, Marginally attached, Temporary job ended, Previous job search, Available for work or not, Want a job

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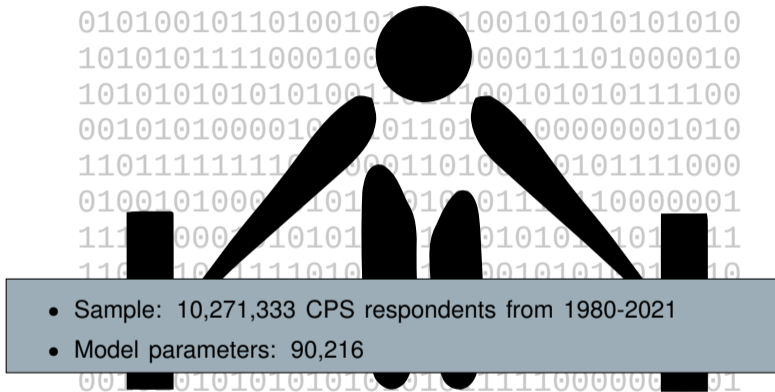
Numerical weightlifting: New implementation of EM algorithm



Likelihood maximization using EM-algorithm

Dempster *et al.* (1977), Baum *et al.* (1970), Andersen *et al.* (2011)

Numerical weightlifting: New implementation of EM algorithm



Likelihood maximization using EM-algorithm

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EM algorithm iterates over two steps

E-step: Calculate expectation of full-information likelihood

- For a given set of parameter values, calculate the expected path across hidden states for individuals and substitute this into the likelihood function.

M-step: Maximize the expected likelihood with respect to the parameters

- Maximize the expected likelihood with respect to the parameters with inequality constraints

Algorithm from Andersen *et al.* (2011)

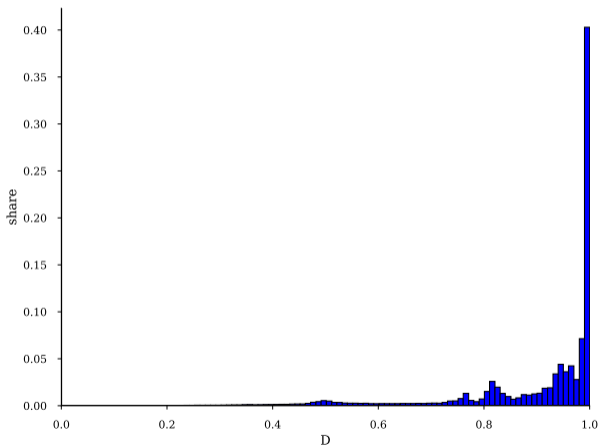
Iterate over two steps until convergence...

Model reliably classifies CPS respondents in markets

Compute for each individual i

$$D_i = \frac{\sqrt{9}}{\sqrt{6}} \sqrt{\sum_{M \in \{P, S, T\}} \left(P_i(M) - \frac{1}{3} \right)^2}$$

- rescaled distance of the posterior distributions
- from non-informative, uniform case
- measures the degree of information the model provides



E-step example: Respondent who is employed

Date	Emission	P(P)	P(S)	P(T)
2005-01	Employed-not PTER+no other absence	89.2	7.3	3.5
2005-02	Employed-not PTER+no other absence	92.5	4.9	2.6
2005-03	Employed-not PTER+no other absence	94.8	3.2	2
2005-04	Employed-not PTER+no other absence	96.4	2.2	1.5
2006-01	Employed-not PTER+no other absence	98.9	0.9	0.2
2006-02	Employed-not PTER+no other absence	99.3	0.6	0.1
2006-03	Employed-not PTER+no other absence	99.5	0.4	0.1
2006-04	Employed-not PTER+no other absence	99.7	0.3	0.1

Someone who reports to be employed, is not absent from work, and does not work part-time for economic reasons

E-step example: Part-time employed for economic reasons

Date	Emission	P(P)	P(S)	P(T)
2005-01	Employed-not PTER+no other absence	89.2	7.3	3.5
2005-02	Employed-PTER	31.5	66.2	2.2
2005-03	Employed-PTER	1.7	98.2	0.1
2005-04	Employed-PTER	0.1	99.9	0
2006-01	Employed-PTER	0	100	0
2006-02	Employed-PTER	0	100	0
2006-03	Employed-PTER	0	100	0
2006-04	Employed-not PTER+no other absence	0	100	0

Because people who are PTER tend to have less persistent employment spells, worker classified in secondary market

E-step example: Information in type of non-participation

Date	Emission	P(P)	P(S)	P(T)
2005-01	Employed-not PTER+no other absence	89.2	7.3	3.5
2005-02	U-Temporary job ended-less than 5 weeks	63.3	36.7	0
2005-03	Nonparticipants who do not want a job	46.6	53.3	0.1
2005-04	Nonparticipants who do not want a job	46.6	53.1	0.3
2006-01	Nonparticipants who do not want a job	10.2	87.7	2.1
2006-02	Nonparticipants who do not want a job	10.5	84.7	4.8
2006-03	Nonparticipants who do not want a job	10.6	78.8	10.5
2006-04	Nonparticipants who do not want a job	9.1	70.5	20.4

Whether you are marginally attached or don't want a job affects imputed probabilities

Estimates capture important dimensions of heterogeneity

segment	to from	E	US	UL	N
Primary	E	97.91	0.73	0.04	1.32
	US	51.12	7.35	34.34	7.19
	UL	23.34	0.00	69.23	7.43
	N	46.26	2.15	1.96	49.62
Secondary	E	85.00	6.79	0.81	7.40
	US	31.88	31.17	7.75	29.19
	UL	13.36	0.00	63.62	23.03
	N	14.12	13.46	6.98	65.44
Tertiary	E	72.14	1.88	0.15	25.84
	US	18.72	9.50	26.96	44.82
	UL	15.04	0.00	64.24	20.71
	N	1.82	0.66	0.14	97.38

- **Short- vs long-term employed**
Explained by difference in persistence of employment

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- **Short- vs long-term employed**
Explained by difference in persistence of employment
- **Heterogeneity in types of unemployed**
Explained by different job finding rates across sectors and different types of unemployment within sectors

Estimates capture important dimensions of heterogeneity

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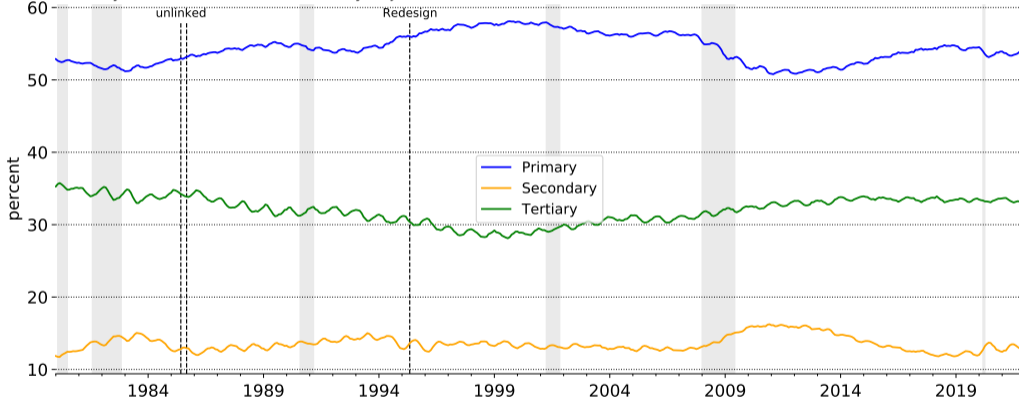
- **Short- vs long-term employed**
Explained by difference in persistence of employment
- **Heterogeneity in types of unemployed** Explained by different job finding rates across sectors and different types of unemployment within sectors
- **Differences in labor force attachment** Those in the primary sectors are the most attached to labor force, those tertiary the least attached

Three Labor Market Segments

Secondary market is small

Shares of population in labor market segments

Monthly observations, not seasonally adjusted



Source: CPS and authors' calculations

Total is very different from each of its three parts

	Primary	Secondary	Tertiary	Total
Share of population	54.46	13.75	31.79	100.00
Unemployment rate	2.07	26.45	19.92	6.62
Labor-force participation rate	97.16	72.92	8.84	65.77
Employment-to-population ratio	95.15	53.55	7.05	61.42

- High employment rates in primary and secondary
- Stark differences in unemployment rates

LFPR

EPOP

Different markets contribute to different labor market aggregates

	Primary	Secondary	Tertiary	Total
Share of population	54.46	13.75	31.79	100.00
Share of unemployment	25.0	61.8	13.2	6.62
Share of labor force	80.4	15.3	4.3	65.77
Share of employment	84.4	12.0	3.6	61.42

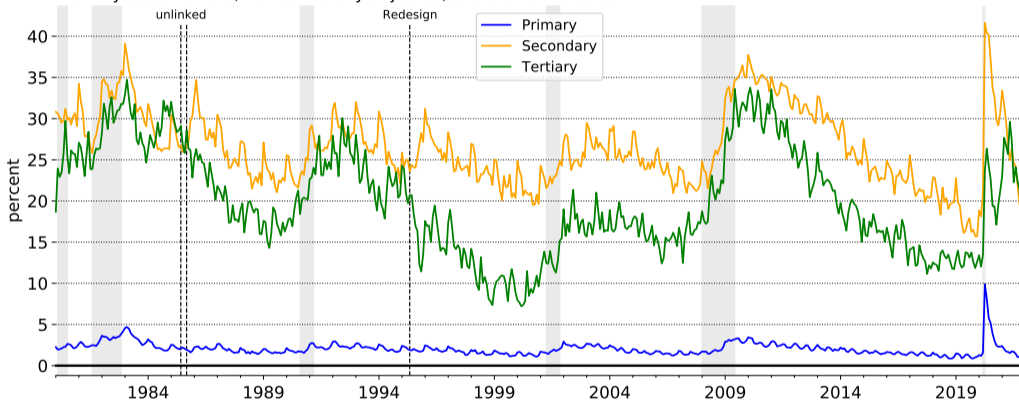
- Primary sector account for 84% of employment but accounts for only 25% of unemployment
- Secondary sector constitutes less than 14% of the population but accounts for
 - almost two thirds of unemployment

Morchio (2020)

Unemployment fluctuations in each segment

Unemployment rates in labor market segments

Monthly observations, not seasonally adjusted, share of labor force

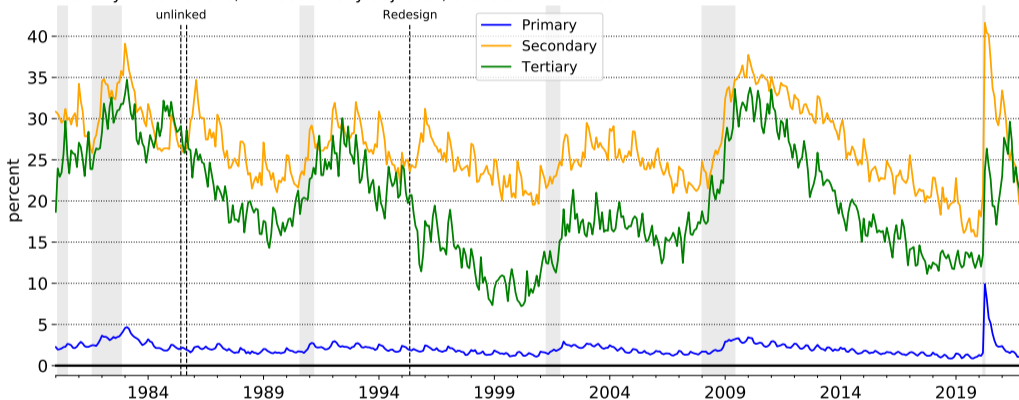


Source: CPS and authors' calculations

Unemployment fluctuations in each segment

Unemployment rates in labor market segments

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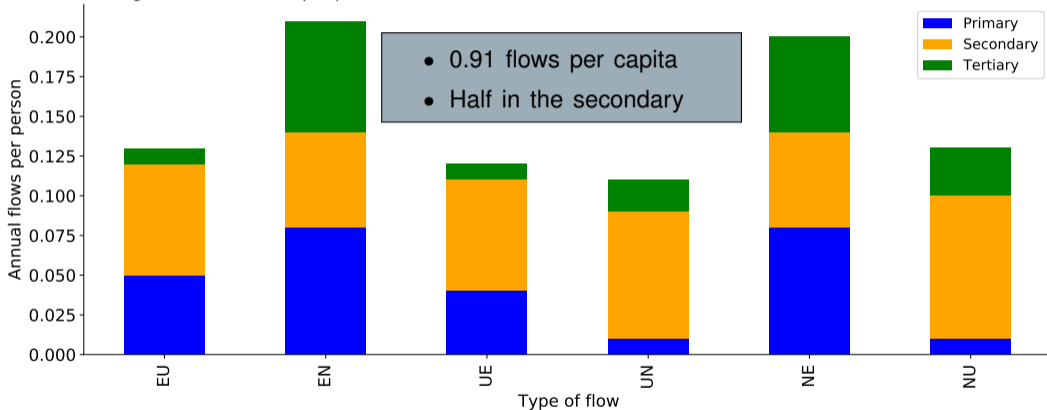
Source: CPS and authors' calculations

- Secondary and tertiary: Strongly countercyclical.
- Secondary: more than 40 percent of the fluctuations in unemployment

U.S. labor market owes its dynamism to 14 percent of population

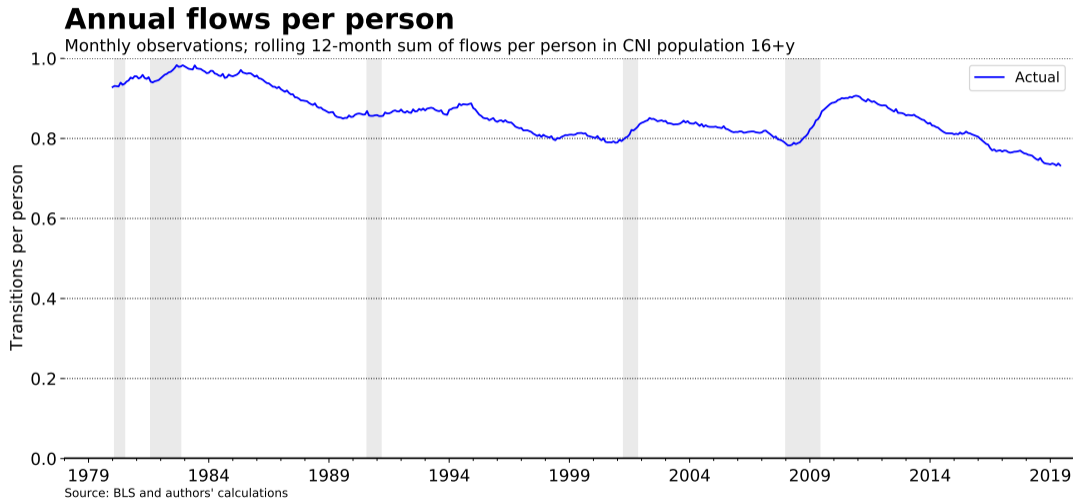
Composition of flows per person in the population

Average annualized flows per person



Source: BLS and authors' calculations

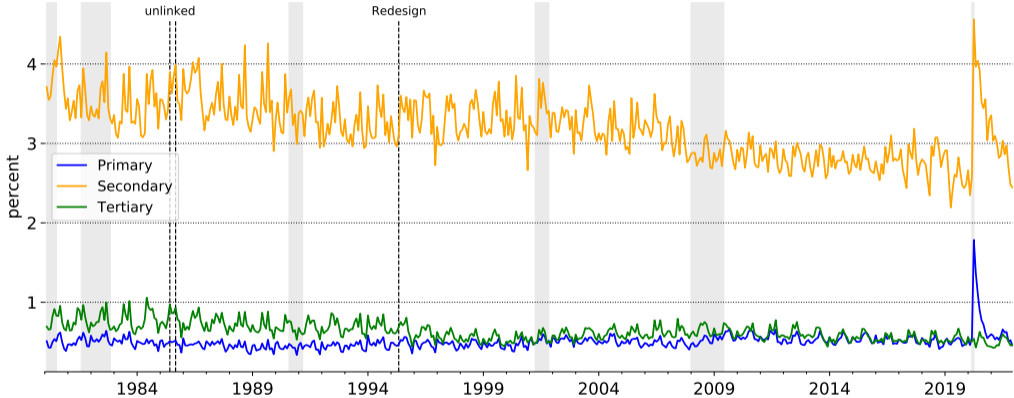
Declining dynamism: Annual flows per capita have declined



Secondary market main source of the decline

Flows per capita in labor market segments

Monthly observations, not seasonally adjusted, annualized monthly flows per person in segment



Source: CPS and authors' calculations

Potential Reasons for Segmentation

Many causes emphasized by studies on the Dual Labor Markets

Some, but limited, evidence for ...

- **Discrimination**

Doeringer and Piore (1970), Dickens and Lang (1985)

- Women, Black and Hispanic workers, foreign-born underrepresented in primary
- Explanatory power small and declining over time

- **Unionization**

Berger *et al.* (1980), Reich *et al.* (1973)

- Small effects and not consistent with stable secondary share
-

Most support in data for ...

- **Life-cycle career choices**

Pries (2004), Morchio (2020)

- **Efficiency wage theory**

Bulow and Summers (1986), Albrecht and Vroman (1992), Saint-Paul (1997)

- **Differential labor demand fluctuations**

Berger *et al.* (1980), Saint-Paul (1997)

Regression of segment probabilities on worker characteristics

	Primary	Secondary	Tertiary
Female	-0.1189 (-466.82)	-0.0053 (-31.095)	0.1241 (524.19)
Less than high school	-0.2279 (-533.61)	0.0545 (192.34)	0.1734 (436.53)
High school diploma	-0.1235 (-302.55)	0.0378 (139.50)	0.0857 (225.77)
Some college	-0.0704 (-172.78)	0.0275 (101.53)	0.0429 (113.33)
Black	-0.0700 (-182.25)	0.0616 (241.52)	0.0084 (23.591)
Other	-0.0579 (-109.71)	0.0175 (49.964)	0.0404 (82.314)
Hispanic	-0.0291 (-72.960)	0.0391 (147.74)	-0.0100 (-26.990)
R-squared	0.1891	0.0490	0.2305

- **Men vs. Women** Differences along primary vs. tertiary

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R-squared	0.1891	0.0490	0.2305

- **Men vs. Women** Differences along primary vs. tertiary
- **Education correlated** But cannot explain the differences

Regression of segment probabilities on worker characteristics

	Primary	Secondary	Tertiary
Female	-0.1189 (-466.82)	-0.0053 (-31.095)	0.1241 (524.19)
Less than high school	-0.2279 (-533.61)	0.0545 (192.34)	0.1734 (436.53)
High school diploma	-0.1235 (-302.55)	0.0378 (139.50)	0.0857 (225.77)
Some college	-0.0704 (-172.78)	0.0275 (101.53)	0.0429 (113.33)
Black	-0.0700 (-182.25)	0.0616 (241.52)	0.0084 (23.591)
Other	-0.0579 (-109.71)	0.0175 (49.964)	0.0404 (82.314)
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- **Men vs. Women** Differences along primary vs. tertiary
- **Education correlated** But cannot explain the differences
- **Race and ethnicity** White workers more likely to be in primary
- Effects of demographic characteristics declining over time while secondary share has been stable
- Life-cycle effects most important

Over time

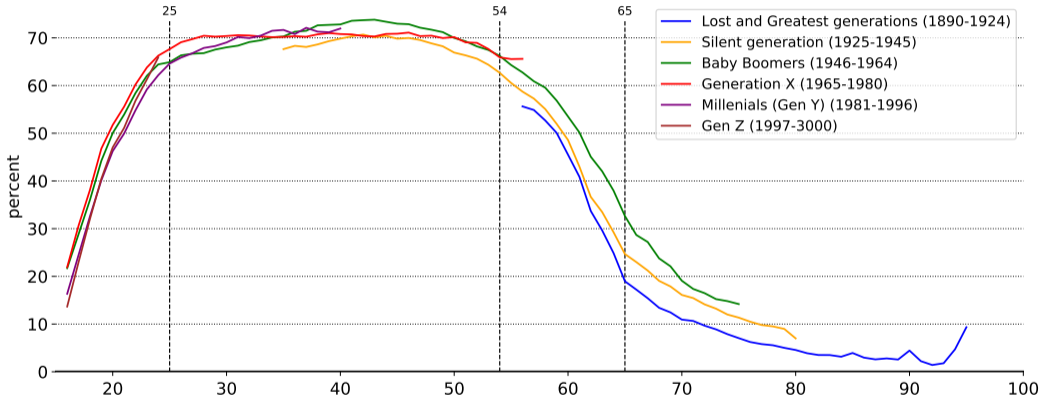
Geography

Life Cycle

Primary market share peaks for prime-age workers

Segment share by cohort: Primary

Fraction of persons in primary segment, by age and cohort

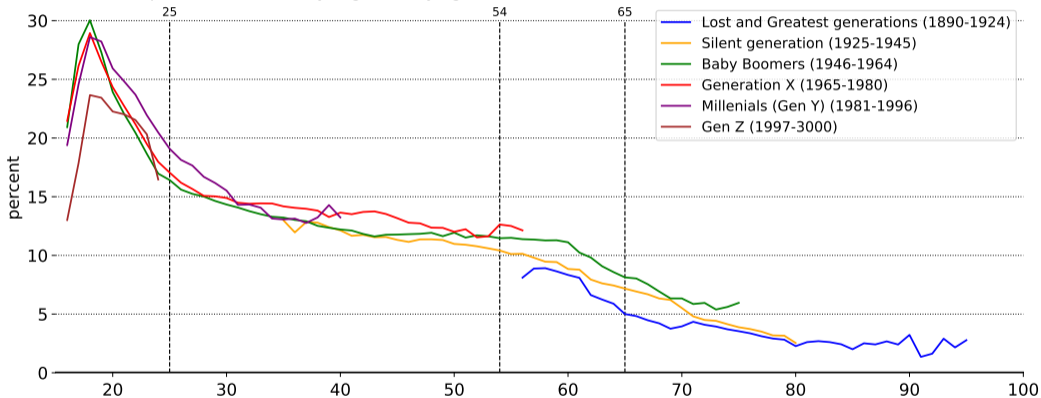


Source: BLS and authors' calculations

Secondary share high for teenagers. Levels off during prime-age

Segment share by cohort: Secondary

Fraction of persons in secondary segment, by age and cohort

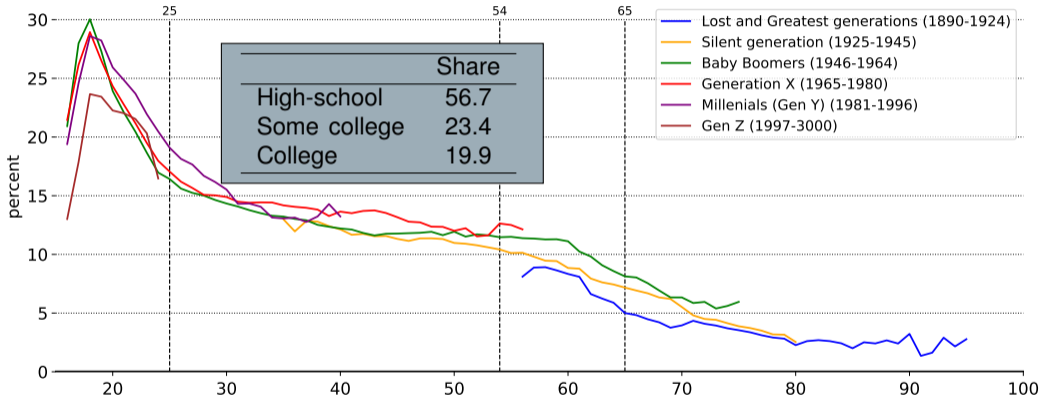


Source: BLS and authors' calculations

Secondary share high for teenagers. Levels off during prime-age

Segment share by cohort: Secondary

Fraction of persons in secondary segment, by age and cohort

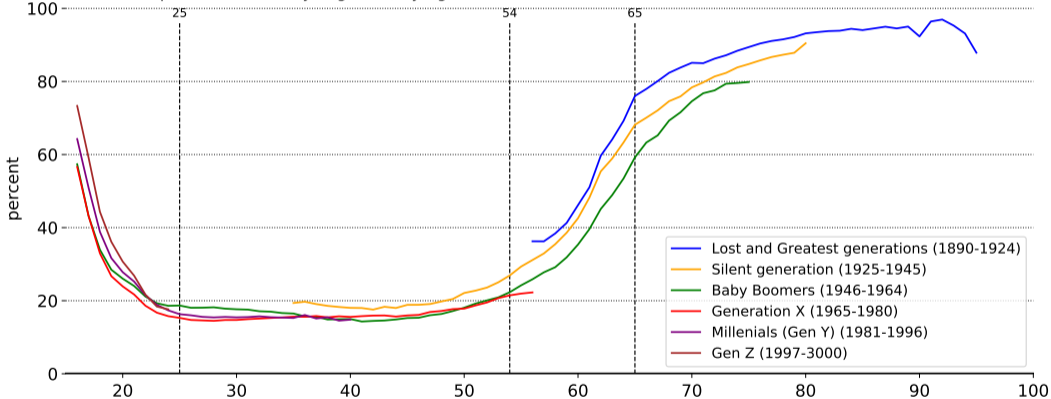


Source: BLS and authors' calculations

Tertiary share high for the young and old

Segment share by cohort: Tertiary

Fraction of persons in tertiary segment, by age and cohort



Source: BLS and authors' calculations

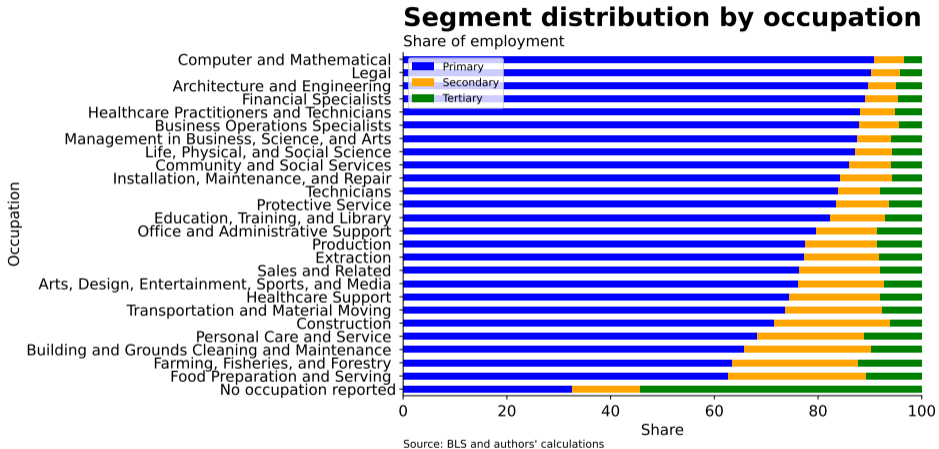
Efficiency Wages and Demand Fluctuations

Primary sector jobs more stable and better paid

	Primary	Secondary	Tertiary	Total
J2J rate	2.1	4.5	3.3	2.4
Tenure	5.0	1.8	2.0	4.0
Weekly hours	40	32	30	40
Hourly earnings	6.2	-23.1	-23.1	0.0
Weekly earnings	8.3	-45.5	-44.0	0.0
Return to education	7.1%	5.7%	6.0%	—
Return to experience	3.4%	2.1%	2.0%	—

- Return to education and experience both higher in primary

Distribution of segments within occupation

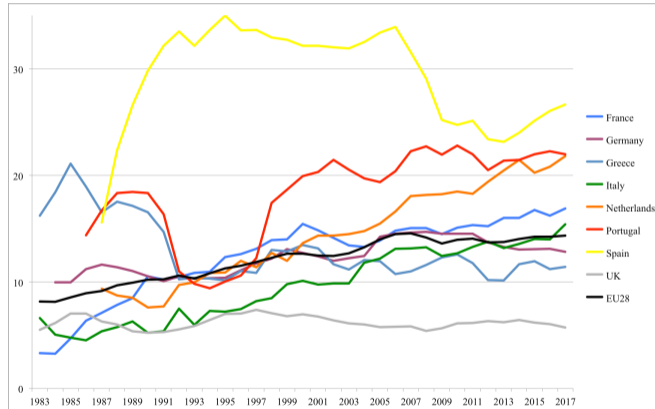


Also consistent with differential frequency and magnitude of demand fluctuations
“Response to flux and uncertainty,”

Piore (1970) Industries

Dual Labor Markets in Europe

Figure 1. Share of employees with fixed-term contracts (%)



Source: Organisation for Economic Co-operation and Development, OECD Statistics (stats.oecd.org).

Implications and Conclusion

DLM evidence raises challenges for theory and policy

Study the reasons for market segmentation

- Initially indifferent workers endogenously sort into segments due market imperfections

Bulow and Summers (1986), Albrecht and Vroman (1992), Saint-Paul (1997)

- Barriers to education and information as well as discrimination

Doeringer and Piore (1970), Piore (1970), Berger *et al.* (1980)

Reassess cost of unemployment and role of unemployment insurance

- Costs of business cycles based on average does not apply to anyone
- UI is transfer to those in secondary for absorbing most of economic fluctuations

Krusell *et al.* (2010)

Focus on secondary sector for stabilization policies

- Because of the different degrees of business-cycle sensitivity across market segments, it is important for the implementation of such policies to identify who is in the secondary tier

The labor market is the sum of three very different parts

Primary (Stability)



Secondary (Turbulence)



Tertiary (Low Attachment)



Provides a new perspective on many empirical puzzles in macro-labor and food for thought for future theories and policy design

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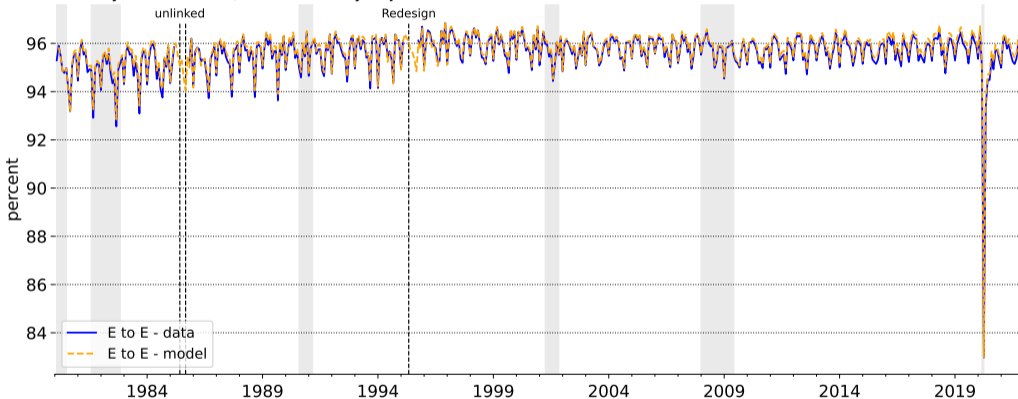
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FOM matches the one-month persistence of employment...

1-month transition probabilities between labor market states

Monthly observations; not seasonally adjusted

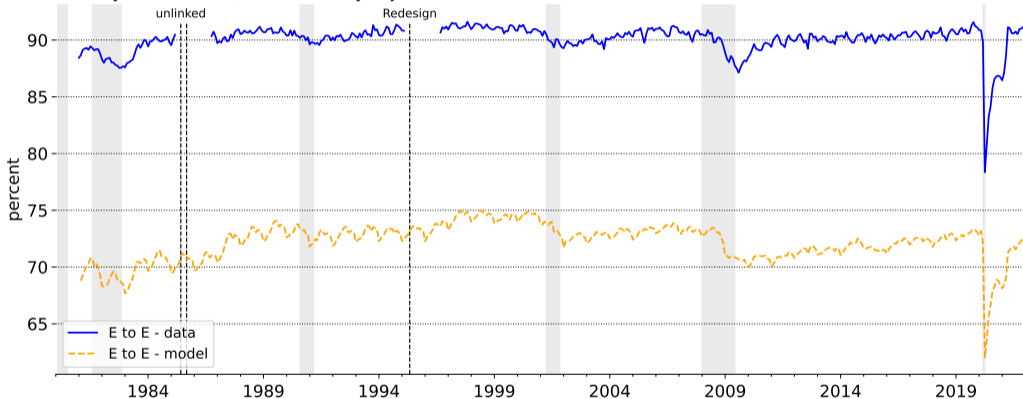


Source: BLS and authors' calculations

... But fails to fit 12-month persistence

12-month transition probabilities between labor market states

Monthly observations; not seasonally adjusted



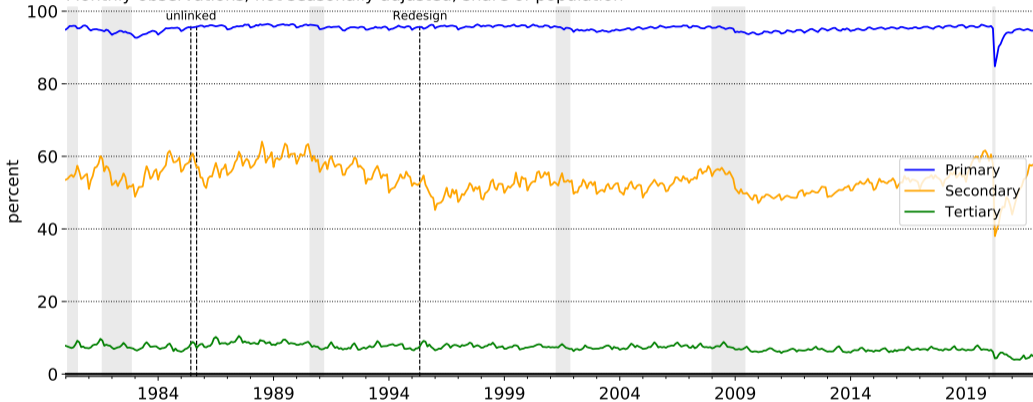
Source: BLS and authors' calculations

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Employment-to-population ratio in each segment

Employment-population ratio in labor market segments

Monthly observations, not seasonally adjusted, share of population



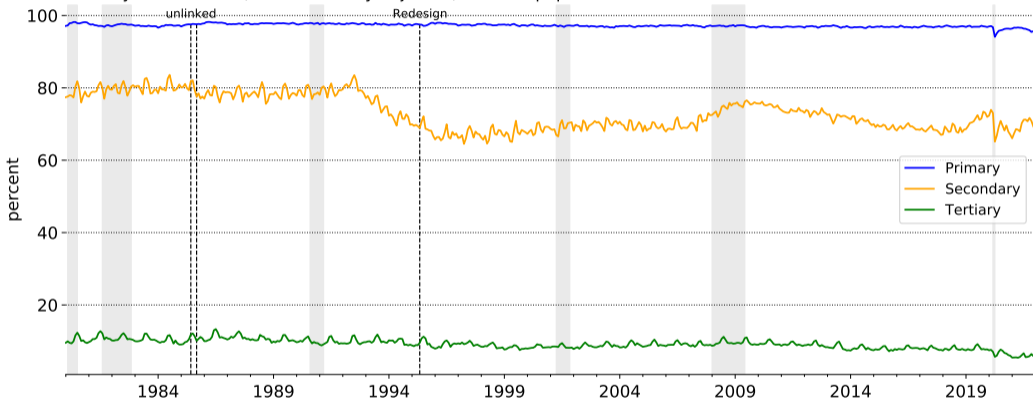
Source: CPS and authors' calculations

- Primary and tertiary: flat EPOP ratios; stark difference in levels
- Secondary: cyclically sensitive

Labor force participation rates in each segment

Labor force participation rate in labor market segments

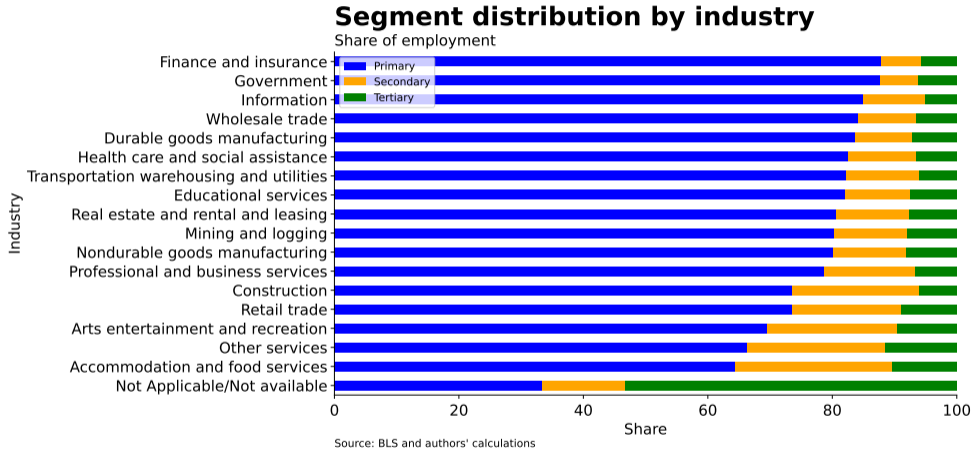
Monthly observations, not seasonally adjusted, share of population



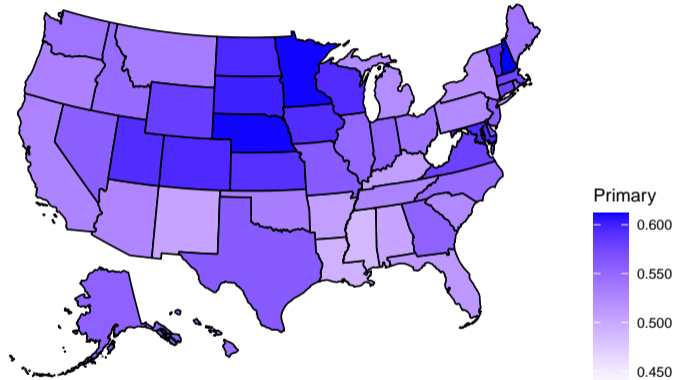
Source: CPS and authors' calculations

- Secondary market: LFPR rose during the Great Recession.
- Tertiary market: slow downtrend + seasonality

Distribution of segments within industries

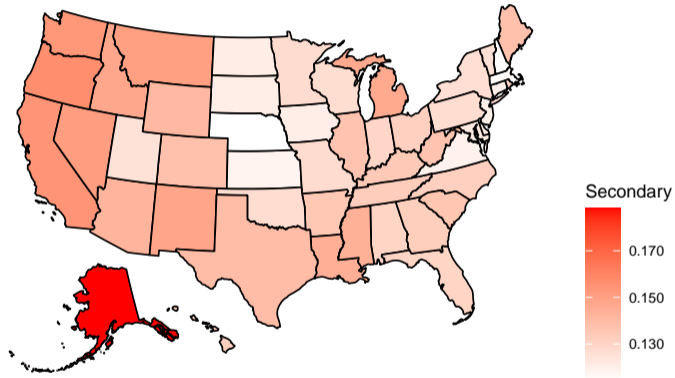


Geography of Dual Labor Market



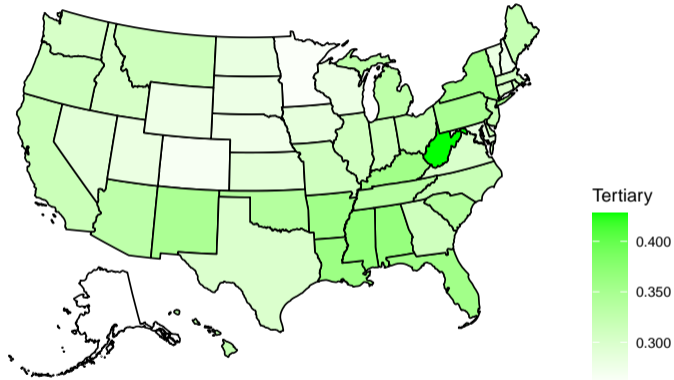
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Geography of Dual Labor Market



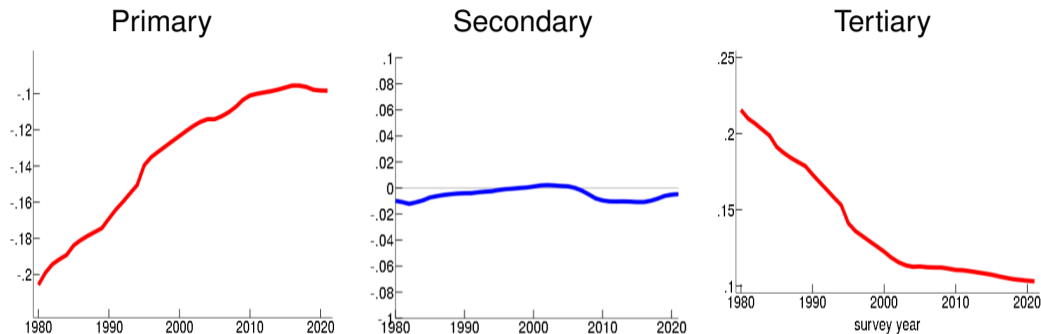
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Geography of Dual Labor Market



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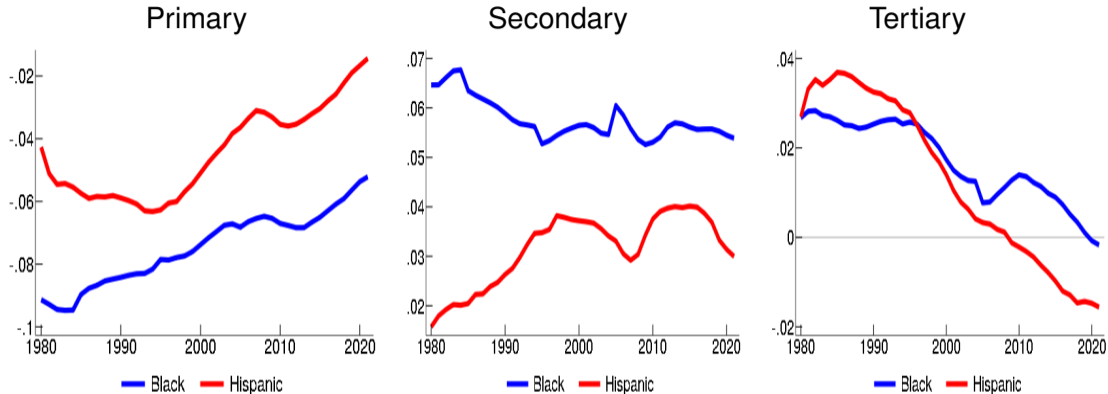
Posterior probability of women over time



- Women more likely in the primary sector over time
- The decline in tertiary sector involvement slows down after 2000

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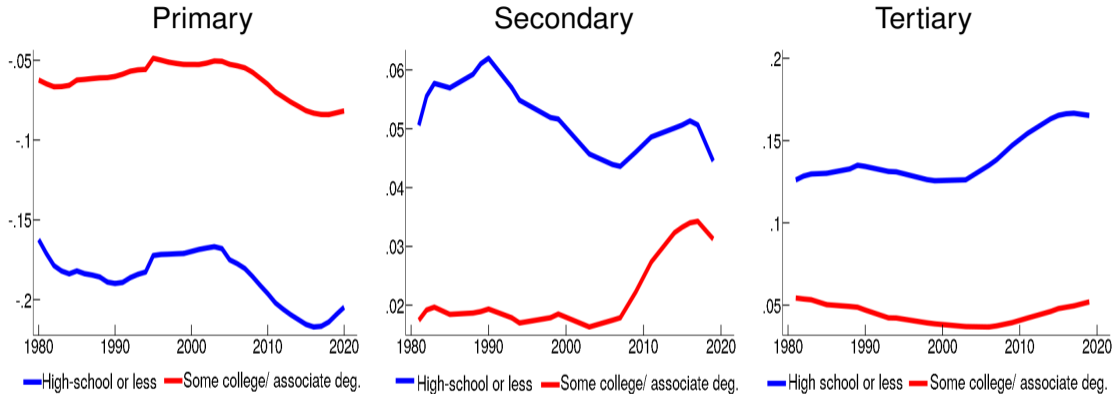
Posterior probability by race and ethnicity over time



- Disparities both in primary/secondary market and persistence in nonemployment
- Some improvement over time in disparities

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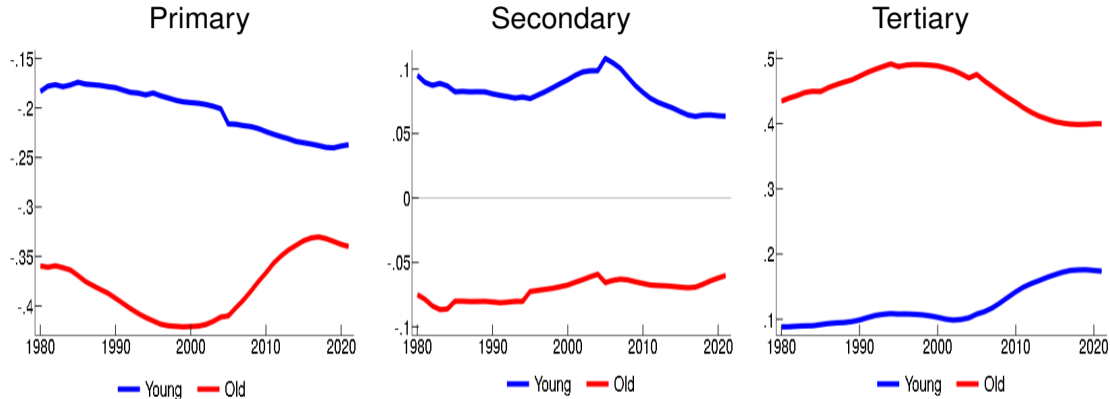
Posterior probability by education over time



- Rise in tertiary market for high-school educated workers
- Education only partially captures type of market

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Posterior probability by age over time



- Workers 16-24 year old more likely to be in the secondary sector
- Workers 55+ most likely in the tertiary sector

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Contributions relative to labor-market machine-learning literature

Growing literature on using machine learning to learn about rich heterogeneity in labor market outcomes

	Data Set	Time Period	Ex ante Economic Interpretability	Degree of Heterogeneity	Dynamic Model	Individual Segments
Ahn, Hobijn, and Şahin (2022)	CPS	1980-2021	✓	✓	✓	✓
Shibata (2019)	CPS	1976-2014	X	✓	X	✓
Hall and Kudlyak (2019)	CPS	2014-2017	X	✓	X	X
Ahn and Hamilton (2020)	CPS	1976-2017	X	✓	✓	X
Gregory, Menzio, and Wiczer (2021)	LEHD	1997-2014	X	✓	X	✓

We use a **time-varying** parameter model to uncover differences in the **dynamic** features of each segment (e.g., seasonality, trend, cyclical) that provides **economic interpretability** and **direct aggregation** of **individual-level results**.

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