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Practice Final Exam 2
PACKET 1

Instructions

1. **You may read this entire packet as soon as you get it. PLEASE DO NOT READ PACKET 2 UNTIL YOU ARE TOLD.**

2. You have three hours for the final exam.

3. The exam has **four parts**.

4. **Please write your answers directly in the space provided.** Short answers should be very succinct. Show your work and intuition clearly: credit is given for explanations and not just having the correct answer.

5. **Write your answers using a pen (not pencil).** This is because we will scan the exam, so it is necessary. If you do not have a pen, please ask us for one. **Put your Harvard ID number on the top of every sheet in Packet 2. This is also required for the scanning.**

6. You are permitted two double-sided 8½" x 11" sheet of notes, plus a calculator. No computers, wireless, or other electronic devices without prior permission. Cell phones must be turned off for the duration of the exam. You may not share resources with anyone else. No collaboration of any kind is allowed on this exam.

7. During the exam, you may take breaks to use the restroom. To ensure that all students are treated equally and your work is assessed accurately, we ask that you sign the bathroom log before leaving the room and leave your cell phone with the teaching staff while you are out of the room. Your phone will be returned when you come back to the room.

8. **Please return both parts of this exam.**

The Harvard University Honor Code
Members of the Harvard University community commit themselves to producing academic work of integrity – that is, work that adheres to the scholarly and intellectual standards of accurate attribution of sources, appropriate collection and use of data, and transparent acknowledgement of the contribution of others to their ideas, discoveries, interpretations, and conclusions. Cheating on exams or problem sets, plagiarizing or misrepresenting the ideas or language of someone else as one's own, falsifying data, or any other instance of academic dishonesty violates the standards of our community, as well as the standards of the wider world of learning and affairs.

I understand and agree to take the exam by myself under good test conditions. I will not provide help to anyone or seek help from anyone, including classmates, family members, tutors, teaching fellows, and course assistants.

____________________________________ ____________________________________
Printed Name of Student Date

____________________________________ ____________________________________
Signature of Student HUID

Introduction to Part A

In this part of the exam, we use data from Vince Monti's 2018 Harvard College senior thesis to measure the effect of the Affordable Care Act's (ACA) Medicaid Expansions on personal bankruptcy rates.

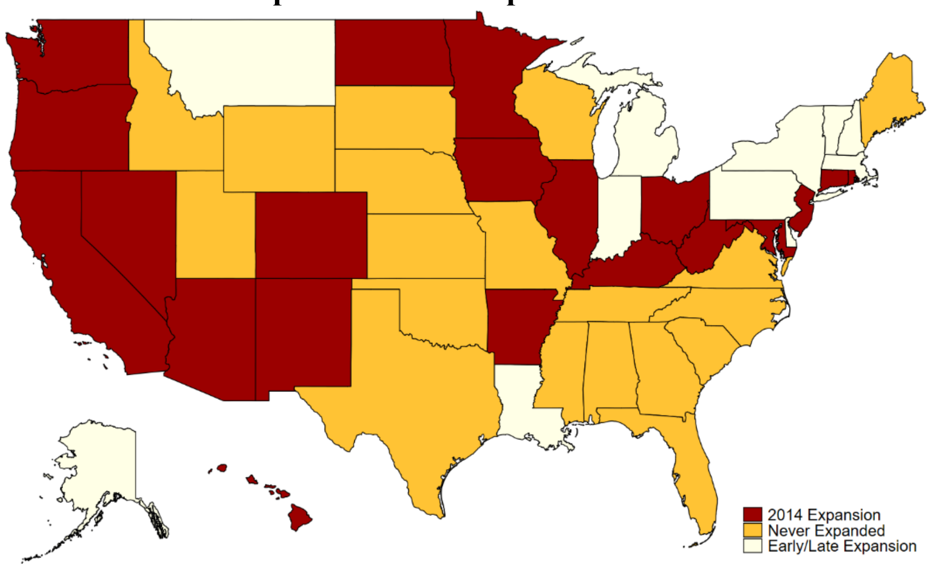
Under the Affordable Care Act, many states expanded their Medicaid programs to cover individuals with incomes up to 138% of the federal poverty line. The majority of these expansions took place in 2014.

As Vince notes in his thesis, "From a theoretical perspective, a large expansion of health insurance coverage to a disproportionally poor population should increase financial health and reduce bankruptcy. Insurance coverage protects the individual from accumulating large amounts of medical debt, particularly when the individual requires emergency, unexpected medical procedures. Without an ability to pay back debt, individuals, particularly those who face borrowing constraints, have little choice but to declare bankruptcy. Thus, the ACA's provision of low-cost or even free health insurance to poor populations (i.e., Medicaid expansion) should have prevented both the accumulation of debt and the declaration of personal bankruptcy."

The effectiveness of the ACA in reducing personal bankruptcies is ultimately an empirical question. Table A2 uses data on every bankruptcy filed in the United States since 2008 to shed light on this question.

We restrict attention to 39 states that either expanded Medicaid in 2014 or never expanded Medicaid. States that expanded Medicaid before 2014 or after 2014 are excluded.

Figure A1
Map of Medicaid Expansion Status



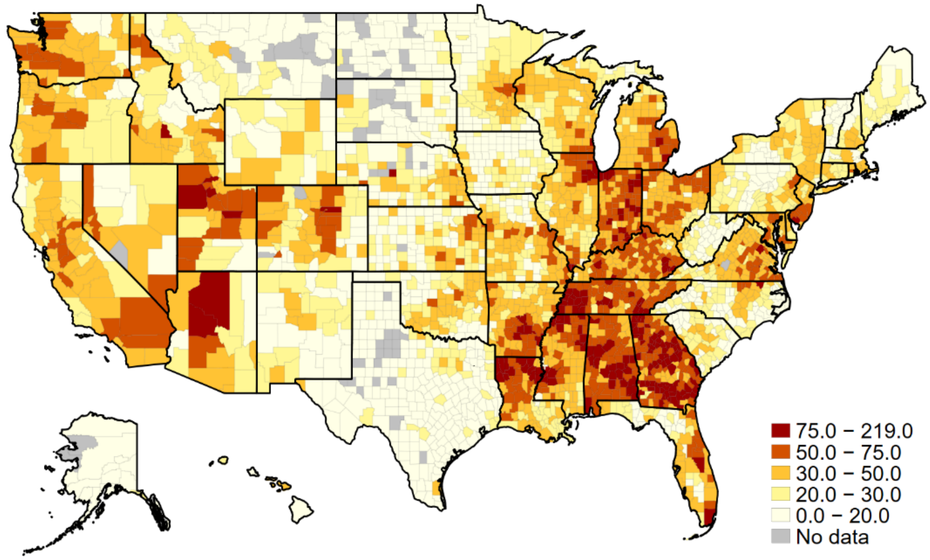
Note: Map shows states that expanded Medicaid in 2014, states that never expanded, and states that either expanded early or late. States that expanded early or late are excluded from the sample.

Table A1
Variable Definitions and Summary Statistics for Part A
Unit of observation: county (n = 2,640) by year (T = 9)

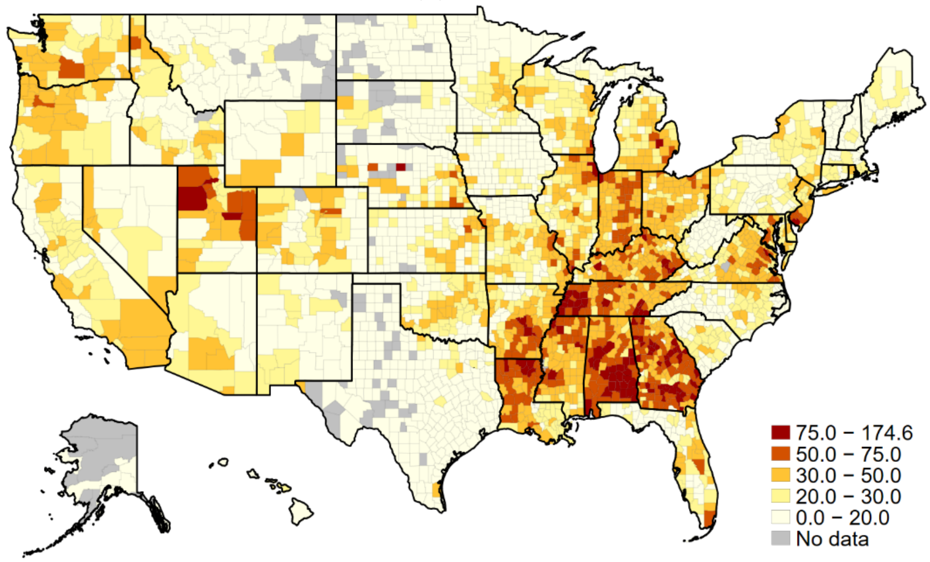
Variable	Definition	Mean	Std. Dev.
Bankruptcies per 1000 adults	Number of personal bankruptcies per 1,000 adults in county i in year t	39.99	26.60
Unemployment rate	The percent of the labor force in county i in year t that is not working but is searching for employment	7.23	3.02
After Medicaid expansion	= 1 if county i is in a state that expanded Medicaid in 2014 and the year is 2014 or later = 0 if county i is in a state that never expanded Medicaid *or* if county i is in a state that expanded Medicaid in 2014, but the year is before 2014	0.144	0.351
$Expansion_t$	= 1 for county i if it is in a state that expanded Medicaid in 2014 and the year equals the first year that the state expanded Medicaid (which is 2014 in our sample) = 0 if county i is in a state that never expanded Medicaid *or* if county i is in a state that expanded Medicaid in 2014, but the year is not 2014	0.0479	0.213
$\Delta Expansion_t$	= $Expansion_t$ - $Expansion_{t-1}$	0.00	0.283
$\Delta Expansion_{t-1}$	= $Expansion_{t-1}$ - $Expansion_{t-2}$	0.00	0.283

Notes: This table defines the variables used in Part A of the exam. The sample is restricted to counties in states that expanded Medicaid in 2014 or never expanded Medicaid. States that expanded Medicaid before 2014 or after 2014 are excluded.

Figure A2
Map of Personal Bankruptcies per 1000 Adults
(a) 2013



(b) 2015



Notes: Maps show the number of bankruptcies per 1,000 adults by county in 2013 (panel a) and 2015 (panel b).

Table A2
The Effect of the ACA's Medicaid Expansions on Personal Bankruptcies

Dependent variable:	Bankruptcies per 1000 adults					
Method:	OLS	OLS	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects
	(1)	(2)	(3)	(4)	(5)	(6)
After Medicaid expansion	-13.74** (4.796)	-7.699 (3.942)	-4.547 (5.427)	-5.246** (1.880)	-1.970 (1.668)	
Unemployment rate		3.685** (0.557)	3.510** (0.729)	1.963** (0.394)	1.265** (0.372)	1.960** (0.395)
$\Delta Expansion_t$						-4.796** (1.605)
$\Delta Expansion_{t-1}$						-10.09** (3.525)
$Expansion_{t-2}$						-15.74** (5.644)
Year fixed effects			x	x	x	x
County fixed effects				x	x	x
County-specific linear time trends					x	
Standard errors	Clustered	Clustered	Clustered	Clustered	Clustered	Clustered
Observations	23,404	23,404	23,404	23,404	23,404	23,404
Years	2008-16	2008-16	2008-16	2008-16	2008-16	2008-16
R^2	0.033	0.201	0.224	0.888	0.978	0.888

Notes: The dependent variable in all columns is the number of people declaring bankruptcy per 1,000 residents of county *i* in year *t*. *After Medicaid expansion* is a dummy variable that equals 1 in all years after a state expanded Medicaid and 0 otherwise. $Expansion_t$ is an indicator that equals 1 in the first year that a state expanded Medicaid (which is 2014 in our sample) and 0 otherwise; $\Delta Expansion_t$ equals $Expansion_t$ - $Expansion_{t-1}$ and $\Delta Expansion_{t-1}$ equals $Expansion_{t-1}$ -$Expansion_{t-2}$. Standard errors are given in parentheses under estimated coefficients. Standard errors are clustered in all regressions, where the cluster is at the state level. Coefficients are individually statistically significant at the *5%, **1% significance level.

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Introduction to Part B

Each year, more than two million Muslim men and women from over one hundred different countries gather in Mecca in Saudi Arabia for the Hajj (Arabic for "pilgrimage"). The Hajj consists of five days of religious activities, but pilgrims often stay for over a month.

In this part of the exam, we study the impact of taking part in the Hajj pilgrimage on beliefs about female educational attainment using survey data from Pakistan on 1,604 successful and unsuccessful applicants for a travel visa for the Hajj. The survey was conducted eight months after the completion of the Hajj.

The Hajj involves more gender mixing than is typical among the pilgrims we study. According to surveys and interviews, integration between men and women who are strangers is less common in Pakistan than in other countries. With equal numbers of male and female pilgrims, such gender interactions are a natural part of the Hajj.

Background:

- Historically, overcrowding on the Hajj has created logistical and safety problems.
- Saudi Arabia has established quotas for the number of Hajj visas available for each major Islamic country.
- Pakistan's total quota was 150,000 visas for the time period studied here.
- 90,000 visas were allocated by the government by randomized lottery. The lottery (described further below) is the primary source of visas for most Pakistanis.
- 138,000 people applied for 90,000 Hajj visas through the lottery
- The remaining 60,000 visas were allocated by private tour operators, which is expensive.

The Hajj visa lottery in Pakistan:

- Individuals apply to the Hajj lottery as parties of up to 20 individuals, who will travel and stay together during the pilgrimage.
- There are eight regional cities that pilgrims use as points of departure for the Hajj
- Pakistan divides the 90,000 visas between the eight regional cities of departure
- In each regional city of departure, a computer algorithm selects parties randomly to be given a visa until the quota of individuals for that region is full
- This process leads to a slightly lower chance of success for larger parties; if the selected party is larger than the remaining quota, it is set aside and another is randomly chosen from the remaining pool.

Table B1
Outline of the Hajj Pilgrimage

<table>
<tr><th colspan="8">OVERALL TIME IN SAUDI ARABIA: 40 DAYS</th></tr>
<tr><th>AFTER ARRIVAL</th><th colspan="6">FORMAL RITUALS OF THE HAJJ--ALL PILGRIMS FROM ALL NATIONS PARTICIPATE SIMULTANEOUSLY, 5 DAYS</th><th>BEFORE DEPARTURE</th></tr>
<tr><td rowspan="4">Pakistani pilgrims have a staggered arrival up to 35 days before the formal rituals of the Hajj. During this time, they typically perform umrah and pray in the Masjid al-Haram in Mecca. If they will not be in the country for long after the formal rituals, they may visit Medina, though this is typically done after.</td><td></td><td>Day 1</td><td>Day 2</td><td>Day 3</td><td>Day 4</td><td>Day 5</td><td rowspan="4">Pakistani pilgrims have a staggered departure up to 35 days following the formal rituals of the Hajj. During this time, they typically make a trip to Medina for several days, where they pray at the prophet's mosque, the Masjid al-Nabawi. The trip to Medina is common for all nations. Outside this time, they perform umrah and pray in the Masjid al-Haram in Mecca.</td></tr>
<tr><td>Morning</td><td>Ihram garments are donned.
Tawaf and sa'y are performed in the Masjid al-Haram in Mecca.</td><td>Travel to Mount Arafat at dawn, 25-30 kilometers away.</td><td>Travel to Mina from Muzdalifah.
Participate in jamarat ritual. Pilgrims symbolically “stone the devil” by throwing the pebbles they have collected at three pillars..</td><td>Return to Mina if night spent in Mecca.</td><td></td></tr>
<tr><td>Afternoon</td><td>Travel to the town of Mina, 5-6 kilometers away.
Rest, prayer, and reading of the Qu'ran.</td><td>Stay on plain of Arafat until sunset in prayer and contemplation.</td><td>Sacrifice an animal. The meat is given to the poor. A voucher may be purchased for this.
Pilgrims released from most ihram restrictions. They have their heads shaved.</td><td>Complete jamarat ritual, stoning all three pillars in Mina.</td><td>Complete jamarat ritual, again stoning all three pillars in Mina.
Pilgrims must leave Mina for Mecca by sunset. Otherwise they must repeat the jamarat the following day before returning.</td></tr>
<tr><td>Night</td><td>Spend night in tents at Mina.</td><td>After sunset, begin journey to Muzdalifah, about 15 kilometers away.
Spend night in the open at Muzadalifah.
Pray and collect pebbles for jamarat the next day.</td><td>Return to Masjid al-Haram to perform tawaf. Pilgrims may also do this the morning of the fourth day.
Spend night in either Mecca or Mina.</td><td>Spend night in Mina.</td><td>Spend night in Mecca. Pilgrims perform a farewell tawaf before leaving Mecca.</td></tr>
</table>

Notes:
Tawaf: Four quick circumambulations of the ka'ba followed by three leisurely circumambulations. Pilgrims say a set of prayers as they walk.
Sa'y: Walking seven times back and forth between the hills of Safa and Marwah, now enclosed in the Masjid al-Haram.
Umrah: A minor pilgrimage that can be done at any time, consisting of a *tawaf* and *sa'y* while wearing the ihram.

Table B2
Summary statistics

Observations: n = 1,604 survey respondents, who are a random sample drawn from the universe of successful and unsuccessful applicants for the Hajj visa lottery in Pakistan

Regressors	**Variable definition**	Mean	Std. Dev.
girlsed	= 1 if respondent answered "yes" to the following question: "In your opinion, should girls attend school?" = 0 if respondent answered "no"	0.945	0.228
Hajj	= 1 if respondent attended the Hajj = 0 if respondent did not go	0.592	0.492
success	= 1 if respondent was successful in Hajj lottery, meaning that the individual was selected in the lottery to be given a visa = 0 if respondent was not successful in Hajj lottery	0.532	0.499
age	Age of respondent	54.55	13.22
age^2	Age of respondent squared	3,151	1,414
urban	= 1 if respondent lives in urban area = 0 if respondent lives in rural area	0.674	0.469
literate	= 1 if respondent is literate = 0 if respondent is not literate	0.599	0.490
female	= 1 if respondent is female = 0 if respondent is male	0.490	0.500
Small party	= 1 if respondent's visa party was below median size = 0 if respondent's visa party was above median size	0.475	0.500
Party size	Party size category	n/a	n/a
Place of departure	City of departure code, corresponding to 8 cities in Pakistan	n/a	n/a

Notes: Table describes and summarizes variables in Table B3.

Table B3.
The Effect of the Hajj pilgrimage on beliefs about female educational attainment

Dependent variable:	*success*	*girlsed*	*Hajj*	*girlsed*	*girlsed*	*girlsed*
Method:	OLS	OLS	OLS	OLS	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)
Hajj	___	0.0142 (0.0116)	___	___	0.0268* (0.0132)	0.0104 (0.0177)
success	___	___	0.855** (0.0123)	0.0229* (0.0113)	___	___
Hajj × *small party*	___	___	___	___	___	0.0356 (0.0267)
Instruments	n/a	n/a	n/a	n/a	success	success, success × small party
Controls:						
Demographic variables[a]	x	x	x	x	x	x
Place of departure × Party size fixed effects	x	x	x	x	x	x
Standard errors	Cluster	Cluster	Cluster	Cluster	Cluster	Cluster
F-statistics testing the hypothesis that the population coefficients on the indicated regressors are all zero (p-values in parentheses):						
Demographic variables[a]	0.769 (0.573)	3.206 (0.00707)	2.219 (0.0504)	3.255 (0.00639)	3.206 (0.00676)	3.182 (0.00711)
Observations	1,604	1,604	1,604	1,604	1,604	1,604
R^2	0.013	0.028	0.759	0.030	0.027	0.027

Notes: The two stage least squares regression in (5) uses *success* as an instrument for *Hajj*. The two stage least squares regression in (6) instruments for both *Hajj* and *Hajj* × *small party* using *success* and *success* × *small party* as instruments. Standard errors appear in parentheses below coefficients. Standard errors are clustered by household in all columns except column 3, which uses homoskedastic standard errors. * significant at 5%; ** significant at 1%.

[a]*Demographic variables*: Indicator for sex of respondent (female), quadratic polynomial in age of respondent, an indicator for whether the respondent is in an urban area, and an indicator for whether respondent is literate.

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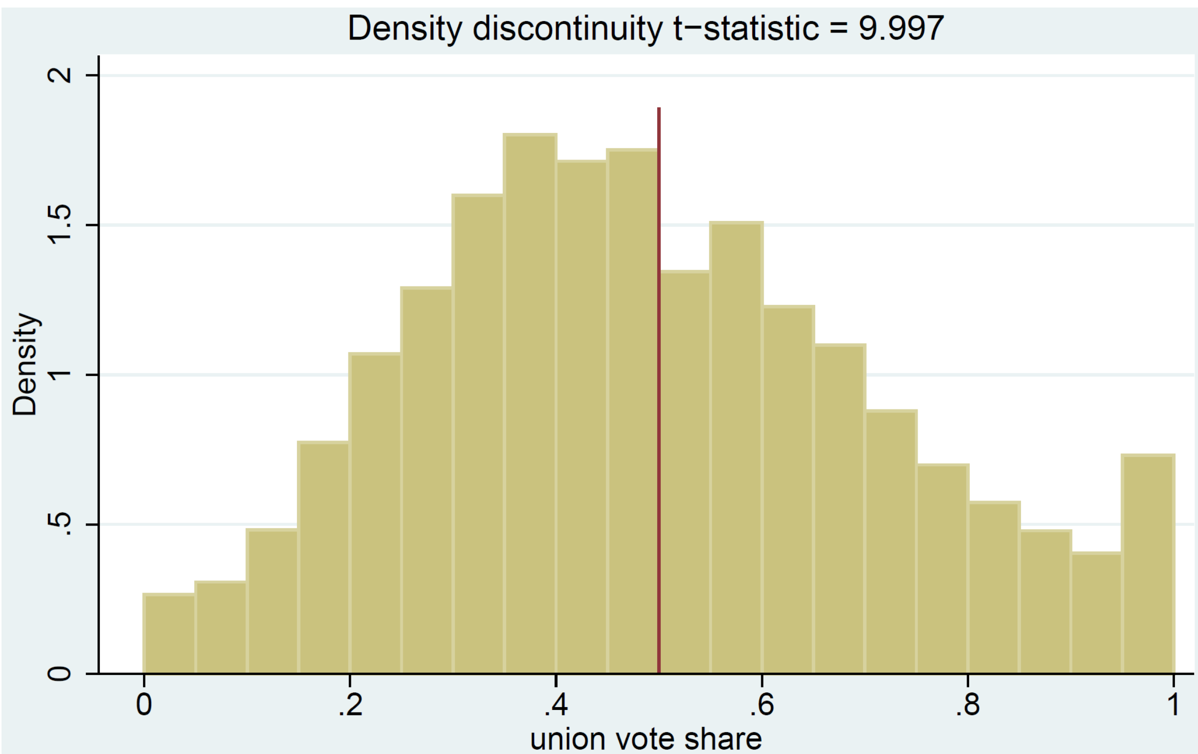
Introduction to Part C

In mid-April, graduate student teaching fellows and research assistants at Harvard University voted to unionize. Of the 5,048 eligible voters, 1,931 students (56% of voters) cast ballots to be represented by the United Auto Workers, 1,523 (44% of voters) voted against, and the remaining 1,594 did not cast ballots. On April 30, the National Labor Relations Board (NLRB) certified the election results. On May 1, Harvard announced that it would negotiate "in good faith" with the new union. Previous research has documented that demographically similar union workers earn 15% higher wages than their non-union counterparts.

In this part of the exam, we study the effect of unionization on wages by exploiting the outcomes of close NLRB union certification elections. Most new unionization occurs as a result of such elections. By law, if a majority of workers vote in favor of the union, the management is required to bargain "in good faith" with the recognized union. We use data on 28,796 establishments that had a NLRB union certification election that have been linked with establishment level data on workers' annual earnings.

Figure C1
Union Vote Share Density for NLRB Certification Elections



Notes: Density of binned union vote share for NLRB elections. The density discontinuity t-statistic is from a McCrary (2008) test. Data are from NLRB election records.

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Table C1
Summary Statistics for Variables used in Figure C1 and Table C2

Unit of Observation: n = 28,796 establishments that had
a NLRB union certification election in 1984-1999

Regressors	**Variable definition**	**Mean**	**Std. Dev.**
Union win	= 1 if Union won election = 0 otherwise	0.45	0.497
Vote share	Vote share for union in NLRB union certification election	0.49	0.50
Union margin of victory	Vote share for union minus 50% threshold for union win. Positive values correspond to a union win. Negative values correspond to a union loss.	-0.01	0.50
Earnings	Employee annual earnings in $1000s measured after the election, calculated as average earnings paid to workers at the establishment in years 1-3 after the election	$27.4	$11.1
Log(Earnings)	Natural logarithm of employee annual earnings	3.383	0.374

Notes to Table C1: Table describes and summarizes variables used in Table C2.

Table C2
Close NLRB Union Certification Elections and Employee Compensation

Dependent variable:	log(annual earnings)			
	(1)	(2)	(3)	(4)
Regressors:				
Union Win	-0.026 (0.017)	-0.018 (0.016)	-0.018 (0.016)	-0.016 (0.015)
Control function	Linear	Quadratic	Cubic	Quartic
Bandwidth	0.05	Global	Global	Global
Standard errors	HR	HR	HR	HR
Observations	4,733	28,796	28,796	28,796

Notes to Table C2: Regressions are estimated by OLS with heteroskedasticity-robust standard errors in parentheses below coefficients. All regressions contain an intercept and either a linear (column 1), quadratic (column 2), cubic (column 3), or quartic (column 4) function of the union win margin, the values of which are not reported in the table. The control function is allowed to differ on either side of *Union margin of victory* = 0. *significant at 5%; **significant at 1%.

Introduction to Part D

Influenza (flu) is a respiratory virus that can result in illness ranging from mild to severe. Each year, millions of people get sick with influenza, hundreds of thousands are hospitalized, and thousands of people die from flu.

Tracking flu activity to inform prevention measures is an important public health function that is currently performed by Centers for Disease Control and Prevention's (CDC) flu surveillance system. The CDC's flu surveillance system measures the number of outpatient visits for influenza-like illnesses (ILI) using reports from clinics across the United States. The most recently available data are for the week ending on April 28, 2018. Data for the week ending on May 5 will be released tomorrow at <https://gis.cdc.gov/grasp/fluview/fluportaldashboard.html>.

In this part of the exam, we will try to forecast ILI visits before it is released. The goal of flu forecasting is to provide a forward-looking tool that health officials can use to target medical interventions, inform earlier public health actions, and allocate resources for communications, disease prevention and control. The potential benefits of flu forecasting are significant.

Some of our forecasts will use an equivalent series on ILI visits produced by Taiwan's CDC. This series, based on data from the Taiwan National Infectious Disease Statistics System, may be a potentially useful predictor for ILI visits in the United States, since viruses spread across the globe as people move across continents.

Figure D1

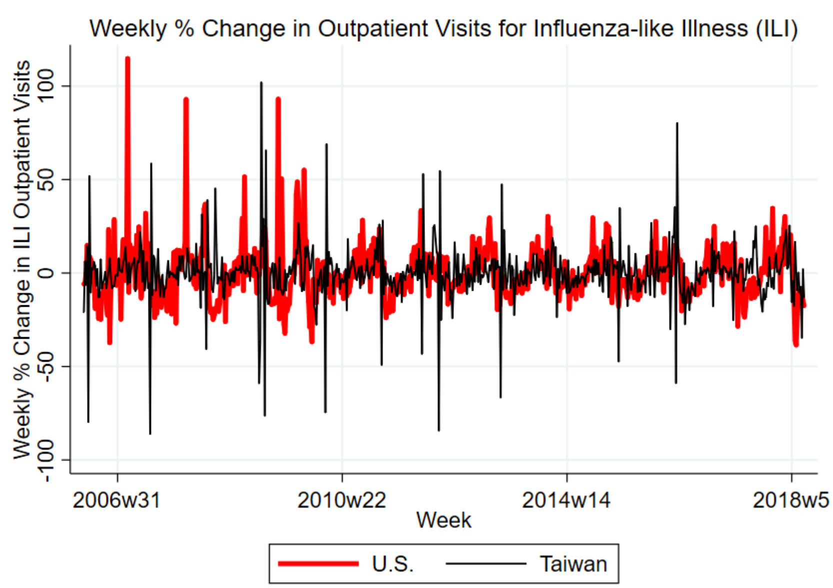


Table D1. Variable Definitions and Recent Values
Weekly data, 2003w1-2018w17 for U.S. and 2005w1-2018w18 for Taiwan

Variable	Short definition	Full definition
$100\Delta lnCDC_t$	Weekly growth in outpatient visits for influenza-like illness (ILI) in the United States (% per week), available starting in 2003w1	100ln(*US ILI visits*$_t$/*US ILI visits*$_{t-1}$), where *US ILI visits*$_t$ = total ILI outpatient visits in the United States' CDC flu surveillance system in week *t*.
$100\Delta lnTaiwan_t$	Weekly growth in outpatient visits for influenza-like illness (ILI) in Taiwan (% per week), available starting in 2005w1	100ln(*Taiwan ILI visits*$_t$/*Taiwan ILI visits*$_{t-1}$), where *Taiwan ILI visits*$_t$ = total outpatient ILI visits in the Taiwan National Infectious Disease Statistics System in week *t*.

Recent values of outpatient visits for influenza-like illness (ILI) and weekly growth (%)

		United States		Taiwan	
Week	**Week ending on**	**Visits**	***Growth* (%)**	**Visits**	***Growth (%)***
2018w11	March 17	25,763	-11.5974	87,046	0.286484
2018w12	March 24	23,560	-8.93889	78,400	-10.4613
2018w13	March 31	20,472	-14.0492	72,866	-7.32012
2018w14	April 7	18,648	-9.33189	51,560	-34.5877
2018w15	April 14	16,189	-14.1407	52,571	1.941872
2018w16	April 21	14,190	-13.1794	46,197	-12.925
2018w17	April 28	13,443	-5.40791	43,702	-5.5521

Table D2
AR and ADL Regressions for Outpatient Visits for Influenza-like Illness (ILI)

Dependent variable:	**100 × Δln CDC_t**	**100 × Δln CDC_t**	**100 × Δln CDC_t**	**100 × Δln CDC_t**	**100 × Δln CDC_t**	**100 × Δln CDC_t**	**100 × Δln $Taiwan_t$**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Regressors:							
$100\Delta lnTaiwan_{t-1}$	___	___	___	___	___	0.0117 (0.0289) [0.0261]	-0.283** (0.0786) [0.0588]
$100\Delta lnCDC_{t-1}$	0.334** (0.0530) [0.0588]	0.250** (0.0499) [0.0465]	0.224** (0.0512) [0.0503]	0.217** (0.0504) [0.0532]	0.216** (0.0507) [0.0539]	0.382** (0.0711) [0.0799]	0.130** (0.0399) [0.0375]
$100\Delta lnCDC_{t-2}$	___	0.255** (0.0496) [0.0511]	0.230** (0.0491) [0.0576]	0.213** (0.0481) [0.0560]	0.212** (0.0479) [0.0559]	___	___
$100\Delta lnCDC_{t-3}$	___	___	0.100** (0.0456) [0.0473]	0.0835 (0.0459) [0.0480]	0.0832 (0.0471) [0.0490]	___	___
$100\Delta lnCDC_{t-4}$	___	___	___	0.0762* (0.0348) [0.0454]	0.0759* (0.0353) [0.0446]	___	___
$100\Delta lnCDC_{t-5}$	___	___	___	___	0.00139 (0.0370) [0.0400]	___	___
Constant	0.129 (0.559) [0.691]	0.0867 (0.540) [0.568]	0.0734 (0.538) [0.549]	0.0623 (0.536) [0.544]	0.0622 (0.536) [0.542]	0.0272 (0.534) [0.644]	-0.00186 (0.574) [0.574]
Sample	2003w1-2018w17	2003w1-2018w17	2003w1-2018w17	2003w1-2018w17	2003w1-2018w17	2005w1-2018w17	2005w1-2018w17
Observations	800	800	800	800	800	643	643
Summary statistics:							
R^2	0.112	0.170	0.178	0.183	0.183	0.146	0.091
BIC	5.533	5.474	5.472	5.475	5.483	5.231	5.373
AIC	5.527	5.462	5.455	5.451	5.454	5.217	5.359
Adjusted R^2	0.111	0.167	0.175	0.179	0.178	0.143	0.0877
RMSE	15.86	15.34	15.27	15.24	15.25	13.57	14.57
GARCH(1,1) s.d. for 2018w18	12.13	12.67	10.78	10.75	11.13	12.03	10.99
QLR-statistic	9.530103 2009w22	5.417624 2009w21	4.267189 2009w21	3.711143 2009w23	3.170977 2009w23	4.460958 2009w23	9.363596 2016w8

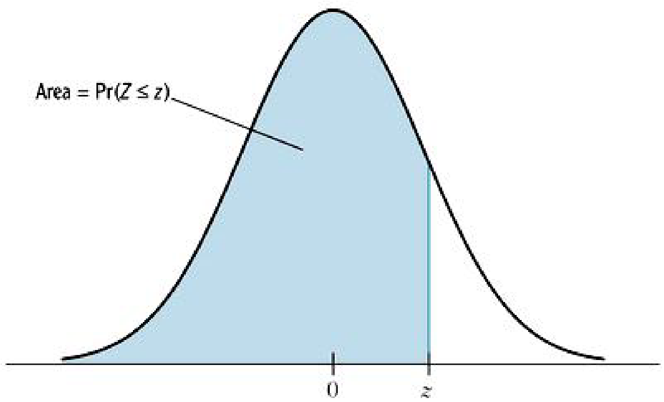
Notes: Table reports two different types of standard errors underneath estimated OLS regression coefficients. Heteroskedasticity robust standard errors are reported in parentheses. Newey-West HAC standard errors with 7 lags are reported in square brackets. *significant at 5%; **significant at 1% (using HR standard errors).

Figure D2
Regression 6: Chow F-statistics for Different Break Dates with 0.15 Trimming

Notes: F-statistic testing for a break in the coefficients and intercept in Table D2/regression (6), plotted as a function of the break date, for all possible break dates in the middle 70% of the sample.

Selected Tables from Stock and Watson, *Introduction to Econometrics*

TABLE 1 The Cumulative Standard Normal Distribution Function



z	Second Decimal Value of z									
	0	1	2	3	4	5	6	7	8	9
−2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
−2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
−2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
−2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
−2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
−2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
−2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
−2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
−2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
−2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
−1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
−1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
−1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
−1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
−1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
−1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
−1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
−1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
−1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
−1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
−0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611

TABLE 1 *(continued)*

z	Second Decimal Value of z									
	0	1	2	3	4	5	6	7	8	9
−0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
−0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
−0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
−0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
−0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
−0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
−0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
−0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
−0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986

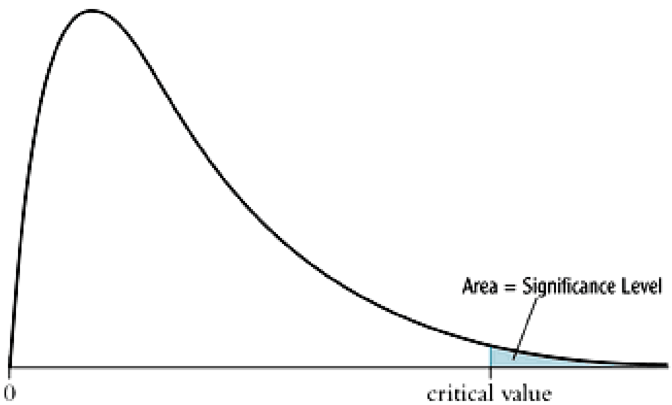
This table can be used to calculate Pr(Z " z) where Z is a standard normal variable. For example, when $z = 1.17$, this probability is 0.8790, which is the table entry for the row labeled 1.1 and the column labeled 7.

TABLE 3 Critical Values for the χ^2 Distribution

	Significance Level		
Degrees of Freedom	**10%**	**5%**	**1%**
1	2.71	3.84	6.63
2	4.61	5.99	9.21
3	6.25	7.81	11.34
4	7.78	9.49	13.28
5	9.24	11.07	15.09
6	10.64	12.59	16.81
7	12.02	14.07	18.48
8	13.36	15.51	20.09
9	14.68	16.92	21.67
10	15.99	18.31	23.21
11	17.28	19.68	24.72
12	18.55	21.03	26.22
13	19.81	22.36	27.69
14	21.06	23.68	29.14
15	22.31	25.00	30.58
16	23.54	26.30	32.00
17	24.77	27.59	33.41
18	25.99	28.87	34.81
19	27.20	30.14	36.19
20	28.41	31.41	37.57
21	29.62	32.67	38.93
22	30.81	33.92	40.29
23	32.01	35.17	41.64
24	33.20	36.41	42.98
25	34.38	37.65	44.31
26	35.56	38.89	45.64
27	36.74	40.11	46.96
28	37.92	41.34	48.28
29	39.09	42.56	49.59
30	40.26	43.77	50.89

This table contains the 90th, 95th, and 99th percentiles of the χ^2 distribution. These serve as critical values for tests with significance levels of 10%, 5%, and 1%.

TABLE 4 Critical Values for the $F_{m,\infty}$ Distribution



	Significance Level		
Degrees of Freedom	10%	5%	1%
1	2.71	3.84	6.63
2	2.30	3.00	4.61
3	2.08	2.60	3.78
4	1.94	2.37	3.32
5	1.85	2.21	3.02
6	1.77	2.10	2.80
7	1.72	2.01	2.64
8	1.67	1.94	2.51
9	1.63	1.88	2.41
10	1.60	1.83	2.32
11	1.57	1.79	2.25
12	1.55	1.75	2.18
13	1.52	1.72	2.13
14	1.50	1.69	2.08
15	1.49	1.67	2.04
16	1.47	1.64	2.00
17	1.46	1.62	1.97
18	1.44	1.60	1.93
19	1.43	1.59	1.90
20	1.42	1.57	1.88
21	1.41	1.56	1.85
22	1.40	1.54	1.83
23	1.39	1.53	1.81
24	1.38	1.52	1.79
25	1.38	1.51	1.77
26	1.37	1.50	1.76
27	1.36	1.49	1.74
28	1.35	1.48	1.72
29	1.35	1.47	1.71
30	1.34	1.46	1.70

This table contains the 90th, 95th, and 99th percentiles of the $F_{m,\infty}$ distribution. These serve as critical values for tests with significance levels of 10%, 5%, and 1%.

TABLE 14.6 Critical Values of the QLR Statistic with 15% Trimming

Number of Restrictions (q)	10%	5%	1%
1	7.12	8.68	12.16
2	5.00	5.86	7.78
3	4.09	4.71	6.02
4	3.59	4.09	5.12
5	3.26	3.66	4.53
6	3.02	3.37	4.12
7	2.84	3.15	3.82
8	2.69	2.98	3.57
9	2.58	2.84	3.38
10	2.48	2.71	3.23