Online Appendix

Hassle Costs versus Information: How Do Prescription Drug Monitoring Programs Reduce Opioid Prescribing?

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Table A1: Appropriate and Inappropriate Condition Definitions

Category	Condition	Diagnosis Codes
Appropriate	Kidney Stones	ICD-9 Codes: 592X ICD-10 Codes: N20X
	Fractures	ICD-9 Codes: 800X-830X ICD-10 Codes: M84X, M80X, SX2X
Inappropriate	Headache	ICD-9 Codes: 784X ICD-10 Codes: G44X, R51X
	Sprains/Strains	ICD-9 Codes: 840X-848X, S93X ICD-10 Codes: SX3X, SX6X, SX9X
	Lower Back Pain	ICD-9 Codes: 7242X ICD-10 Codes: M545X, S399X

Note: Opioid-appropriate and -inappropriate conditions were identified using prescribing recommendations in *UpToDate*, which identifies headache, sprains, strains and lower back pain as generally not requiring opioids for treatment. Kidney stones and fractures are identified as causing more severe pain and requiring a prescription of opioids. The remainder of conditions are unclassified. Source: Pino, C. A., & Covington, M. (2019) Prescription of opioids for acute pain in opioid naïve patients. *UpToDate*. Available online. Accessed February, 11.

Table A2: PDMP Mandate Effects on the Intensive Margin

	Daily MME>50	Log MME | 1-2 Days	Log MME | 3-7 Days	Log MME | >7 Days
Panel A: All				
Post x Kentucky	0.00037	-0.0059	-0.017	0.047
	(0.0067)	(0.011)	(0.0089)	(0.037)
Dep. Var. Mean	0.29	4.41	4.91	6.25
Panel B: Naive				
Post x Kentucky	-0.000098	0.0026	-0.015	0.10**
	(0.0075)	(0.012)	(0.0100)	(0.034)
Dep. Var. Mean	0.25	4.39	4.87	5.49
Panel C: Non-Naive				
Post x Kentucky	0.0058	-0.016	-0.0087	0.0020
	(0.0064)	(0.012)	(0.0086)	(0.028)
Dep. Var. Mean	0.33	4.44	4.98	6.54
N	1540	1539	1540	1519

Note: *** p<0.001, ** p<0.01, * p<0.05. Standard errors are clustered at the state level. Each estimate shows the coefficient on the difference-in-differences term (post x KY) from a separate regression. All specifications include state and year fixed effects, KY specific linear trend, and full set of controls. Each column represents a different outcome variable. For Cols 2-4, the outcome is Log MME conditional on the number of days supply (e.g., Col (2) is Log MME conditional on receiving a prescription for 1-2 days supply). Panel A shows estimates from the full sample, Panel B from the opioid naive sample, and Panel C from the opioid non-naive sample.

Table A3: P-values from Different Inference Methods

	All	Appropriate	Inappropriate
Panel A: All			
Coefficient	-0.023	-0.0035	-0.061
Cluster Robust	<0.001	0.54	<0.001
One-Tailed			
Ferman Pinto	0.032	0.41	<0.001
Permutation Test	0.057	0.46	0.029
Two-Tailed			
Ferman Pinto	0.059	0.79	<0.001
Permutation Test	0.14	0.86	0.057
Panel B: Naive			
Coefficient	-0.015	0.0088	-0.045
Cluster Robust	<0.001	0.26	<0.001
One-Tailed			
Ferman Pinto	0.071	0.71	0.004
Permutation Test	0.14	0.57	0.057
Two-Tailed			
Ferman Pinto	0.13	0.60	0.0044
Permutation Test	0.23	0.71	0.086
Panel C: Non-Naive			
Coefficient	-0.035	-0.033	-0.083
Cluster Robust	<0.001	<0.001	<0.001
One-Tailed			
Ferman Pinto	0.024	0.053	<0.001
Permutation Test	0.029	0.31	0.029
Two-Tailed			
Ferman Pinto	0.027	0.17	<0.001
Permutation Test	0.029	0.46	0.057
Panel D: Triple Difference			
Coefficient	-0.019	-0.042	-0.039
Cluster Robust	<0.001	0.001	<0.001
One-Tailed			
Ferman Pinto	0.087	0.061	0.028
Permutation Test	0.17	0.31	0.17
Two-Tailed			
Ferman Pinto	0.16	0.19	0.072
Permutation Test	0.26	0.54	0.26

Note: Each panel and column presents the coefficient from our preferred specification followed by p-values from 5 separate methods of correcting for clustered errors. The first is the standard Huber-White cluster robust adjustment. The following four p-values are obtained using one- and two-sided tests from the Ferman & Pinto (2019) inference method and a permutation test procedure.

Table A4: State Rankings by Coefficient Magnitude from Permutation Tests

Full			Naïve			Non-Naïve		
	b	p-value		b	p-value		b	p-value
SOUTH DAKOTA	-0.04	0.00	SOUTH DAKOTA	-0.03	0.00	WASHINGTON	-0.04	0.00
WASHINGTON	-0.02	0.00	WYOMING	-0.03	0.00	**KENTUCKY**	-0.03	0.00
KENTUCKY	-0.02	0.00	ALASKA	-0.03	0.02	DELAWARE	-0.03	0.00
DELAWARE	-0.02	0.02	GEORGIA	-0.02	0.00	HAWAII	-0.03	0.00
GEORGIA	-0.02	0.00	DELAWARE	-0.02	0.07	OREGON	-0.03	0.00
WYOMING	-0.02	0.02	**KENTUCKY**	-0.02	0.00	GEORGIA	-0.02	0.00
IDAHO	-0.01	0.00	WASHINGTON	-0.01	0.00	DC	-0.01	0.01
HAWAII	-0.01	0.14	NEBRASKA	-0.01	0.01	IDAHO	-0.01	0.00
NEBRASKA	-0.01	0.01	TEXAS	-0.01	0.08	ARKANSAS	-0.01	0.00
ARKANSAS	-0.01	0.00	NORTH CAROLINA	-0.01	0.20	MONTANA	-0.01	0.16
ALASKA	-0.01	0.45	ARKANSAS	0.00	0.18	NEBRASKA	-0.01	0.05
OREGON	-0.01	0.05	IOWA	0.00	0.41	MINNESOTA	-0.01	0.09
NORTH CAROLINA	0.00	0.38	INDIANA	0.00	0.51	SOUTH DAKOTA	-0.01	0.41
MINNESOTA	0.00	0.38	MISSOURI	0.00	0.49	KANSAS	0.00	0.21
MISSOURI	0.00	0.21	CALIFORNIA	0.00	0.60	MISSISSIPPI	0.00	0.25
TEXAS	0.00	0.59	MINNESOTA	0.00	0.84	ARIZONA	0.00	0.34
MONTANA	0.00	0.86	COLORADO	0.00	0.65	NORTH CAROLINA	0.00	0.53
IOWA	0.00	0.86	SOUTH CAROLINA	0.00	0.10	MICHIGAN	0.00	0.73
CALIFORNIA	0.00	0.95	MONTANA	0.00	0.50	WISCONSIN	0.00	0.64
COLORADO	0.00	0.85	MARYLAND	0.00	0.13	IOWA	0.00	0.81
ARIZONA	0.00	0.80	ARIZONA	0.01	0.21	COLORADO	0.00	0.99
SOUTH CAROLINA	0.00	0.23	KANSAS	0.01	0.16	MISSOURI	0.00	1.00
KANSAS	0.00	0.38	WISCONSIN	0.01	0.02	SOUTH CAROLINA	0.00	0.92
WISCONSIN	0.00	0.24	FLORIDA	0.01	0.00	TEXAS	0.00	0.62
INDIANA	0.00	0.31	IDAHO	0.01	0.00	CALIFORNIA	0.00	0.52
MARYLAND	0.01	0.08	UTAH	0.01	0.00	WYOMING	0.01	0.37
DC	0.01	0.19	ILLINOIS	0.01	0.00	MARYLAND	0.01	0.14
MISSISSIPPI	0.01	0.00	HAWAII	0.01	0.04	UTAH	0.01	0.01
MICHIGAN	0.01	0.10	OREGON	0.01	0.00	INDIANA	0.01	0.01
UTAH	0.01	0.00	MAINE	0.01	0.00	ALABAMA	0.01	0.01
FLORIDA	0.01	0.00	MICHIGAN	0.01	0.01	ALASKA	0.02	0.05
ILLINOIS	0.01	0.00	MISSISSIPPI	0.01	0.00	ILLINOIS	0.02	0.00
MAINE	0.02	0.00	NORTH DAKOTA	0.02	0.00	FLORIDA	0.02	0.00
ALABAMA	0.02	0.00	DC	0.02	0.00	NORTH DAKOTA	0.02	0.00
NORTH DAKOTA	0.02	0.00	ALABAMA	0.03	0.00	MAINE	0.03	0.00

Table A5: Synthetic Control State Weights

State	Weight
WASHINGTON	.497
MARYLAND	.178
INDIANA	.174
FLORIDA	.093
ALABAMA	.035
MONTANA	.023

Note: Table displays weights for states with non-zero weights from the synthetic control model used to construct the synthetic control unit for the estimates in Appendix Table A5. Weights were calculated using the opioid prescription rate in control states during pre-mandate quarters. States allocated a zero weight include: AK, AZ, AR, CA, CO, DE, DC, GA, HI, ID, IL, IN, IA, KS, ME, MI, MN, MO, MS, NE, NC, ND, OR, SC, SD, TX, UT, WI, WY.

Table A6: PDMP Mandate Effects on Opioid Prescriptions: Synthetic Control Method

	All	Appropriate	Inappropriate
Panel A: All			
Post x Kentucky	-0.038	-0.018	-0.075
RMSPE ratio rank	[2]	[6]	[1]
Dep. Var. Mean	0.26	0.64	0.38
Panel B: Naive			
Post x Kentucky	-0.033	-0.031	-0.070
RMSPE ratio rank	[2]	[5]	[2]
Dep. Var. Mean	0.22	0.65	0.34
Panel C: Non-Naive			
Post x Kentucky	-0.045	-0.039	-0.078
RMSPE ratio rank	[2]	[3]	[1]
Dep. Var. Mean	0.33	0.63	0.45
N	1540	1532	1540

Note: Each estimate shows the coefficient from a synthetic control model. Each panel and column represents a different sample.Root mean squared prediction error (RMSPE) ratio rank is calculated using the method proposed by Abadie, Diamond, and Hainmueller (2010). All ranks are out of 35, with the exception of the non-naive, appropriate sample which is out of 31. For this sample, states without observations across all quarter-years were dropped (AK, DE, SD, WY).

Table A7: Alternate Trend Specification: PDMP Mandate Effects on Opioid Prescriptions

	All	Appropriate	Inappropriate	Unclassified
Panel A: All				
Post x Kentucky	-0.030***	-0.017**	-0.069***	-0.027***
	(0.0020)	(0.0047)	(0.0037)	(0.0018)
Dep. Var. Mean	0.26	0.64	0.38	0.21
Panel B: Naive				
Post x Kentucky	-0.022***	-0.0043	-0.052***	-0.021***
	(0.0018)	(0.0068)	(0.0032)	(0.0015)
Dep. Var. Mean	0.22	0.65	0.34	0.17
Panel C: Non-Naive				
Post x Kentucky	-0.040***	-0.044***	-0.090***	-0.032***
	(0.0027)	(0.0075)	(0.0052)	(0.0023)
Dep. Var. Mean	0.33	0.63	0.45	0.29
N	1540	1532	1540	1540
Panel D: Triple Difference				
Post x KY x Non-Naive	-0.018***	-0.040**	-0.039***	-0.011***
	(0.0020)	(0.011)	(0.0039)	(0.0018)
Dep. Var. Mean	0.26	0.64	0.38	0.21
N	3080	3072	3080	3080

Note: *** p<0.001, ** p<0.01, * p<0.05. Standard errors are clustered at the state level. Each column shows coefficient on the difference-in-differences term (post x KY) and the interaction with a linear trend (post x KY x trend). All specifications include state and year fixed effects, KY specific linear trend (KY x trend) and the full set of demographic and policy controls. Outcome is the share of patients receiving an opioid following an ED visit.

Table A8: PDMP Mandate Effects on Opioid Prescriptions using All States as Controls

	All	Appropriate	Inappropriate	Unclassified
Panel A: All				
Post x Kentucky	-0.030***	-0.044***	-0.069***	-0.024***
	(0.0016)	(0.0049)	(0.0027)	(0.0015)
Dep. Var. Mean	0.25	0.64	0.38	0.21
Panel B: Naive				
Post x Kentucky	-0.027***	-0.032***	-0.050***	-0.024***
	(0.0014)	(0.0059)	(0.0025)	(0.0013)
Dep. Var. Mean	0.22	0.64	0.34	0.17
Panel C: Non-Naive				
Post x Kentucky	-0.035***	-0.061***	-0.092***	-0.025***
	(0.0024)	(0.0061)	(0.0047)	(0.0024)
Dep. Var. Mean	0.33	0.63	0.45	0.28
N	1540	1532	1540	1540
Panel D: Triple Difference				
Post x KY x Non-Naive	-0.0080**	-0.028***	-0.042***	-0.00072
	(0.0024)	(0.0077)	(0.0053)	(0.0023)
Dep. Var. Mean	0.25	0.64	0.38	0.21
N	3080	3072	3080	3080

Note: *** p<0.001, ** p<0.01, * p<0.05. Standard errors are clustered at the state level. Each estimate shows the coefficient on the difference-in-differences term (post x KY) from a separate regression. All specifications include state and year fixed effects, KY specific linear trend, and full set of controls. Outcome is the share of patients receiving an opioid following an ED visit. Each panel and column represent a different sample. Col (1) shows estimates from the full sample of diagnosed conditions. Col (2) contains ED visits with diagnosis codes for opioid appropriate conditions, Col (3) contains visits for opioid inappropriate conditions, Col (4) contains visits that are unclassified (neither appropriate nor inappropriate).

Table A9: PDMP Mandate Effects on Opioid Prescriptions: Nine-Month Lookback

	All	Appropriate	Inappropriate	Unclassified
Panel A: All				
Post x Kentucky	-0.024***	-0.0074	-0.064***	-0.021***
	(0.0026)	(0.0057)	(0.0044)	(0.0023)
Dep. Var. Mean	0.26	0.64	0.38	0.21
Panel B: Naive				
Post x Kentucky	-0.018***	-0.0050	-0.054***	-0.016***
	(0.0022)	(0.0087)	(0.0038)	(0.0018)
Dep. Var. Mean	0.22	0.65	0.34	0.17
Panel C: Non-Naive				
Post x Kentucky	-0.032***	-0.015*	-0.076***	-0.027***
	(0.0033)	(0.0073)	(0.0058)	(0.0029)
Dep. Var. Mean	0.32	0.64	0.44	0.27
N	1540	1533	1540	1540
Panel D: Triple Difference				
Post x KY x Non-Naive	-0.013***	-0.011	-0.023***	-0.010***
	(0.0023)	(0.012)	(0.0046)	(0.0019)
Dep. Var. Mean	0.26	0.64	0.38	0.21
N	3080	3073	3080	3080

Note: *** p<0.001, ** p<0.01, * p<0.05. Standard errors are clustered at the state level. Each estimate shows the coefficient on the difference-in-differences term (post x KY) from a separate regression. All specifications include state and year fixed effects, KY specific linear trend, and full set of controls. Outcome is the share of patients receiving an opioid following an ED visit. Each panel and column represent a different sample. Col (1) shows estimates from the full sample of diagnosed conditions. Col (2) contains ED visits with diagnosis codes for opioid appropriate conditions, Col (3) contains visits for opioid inappropriate conditions, Col (4) contains visits that are unclassified (neither appropriate nor inappropriate).

Table A10: PDMP Mandate Effects on Opioid Prescriptions: Excluding Patients with a Benzodiazepine Prescription

	All	Appropriate	Inappropriate	Unclassified
Panel A: All				
Post x Kentucky	-0.023***	0.00017	-0.058***	-0.021***
	(0.0025)	(0.0056)	(0.0043)	(0.0021)
Dep. Var. Mean	0.25	0.64	0.38	0.21
Panel B: Naive				
Post x Kentucky	-0.015***	0.012	-0.040***	-0.016***
	(0.0022)	(0.0078)	(0.0037)	(0.0018)
Dep. Var. Mean	0.22	0.65	0.34	0.17
Panel C: Non-Naive				
Post x Kentucky	-0.035***	-0.027**	-0.085***	-0.029***
	(0.0032)	(0.0084)	(0.0061)	(0.0030)
Dep. Var. Mean	0.32	0.63	0.45	0.28
N	1540	1532	1540	1540
Panel D: Triple Difference				
Post x KY x Non-Naive	-0.020***	-0.040**	-0.045***	-0.013***
	(0.0026)	(0.013)	(0.0048)	(0.0025)
Dep. Var. Mean	0.25	0.64	0.38	0.21
N	3080	3072	3080	3080

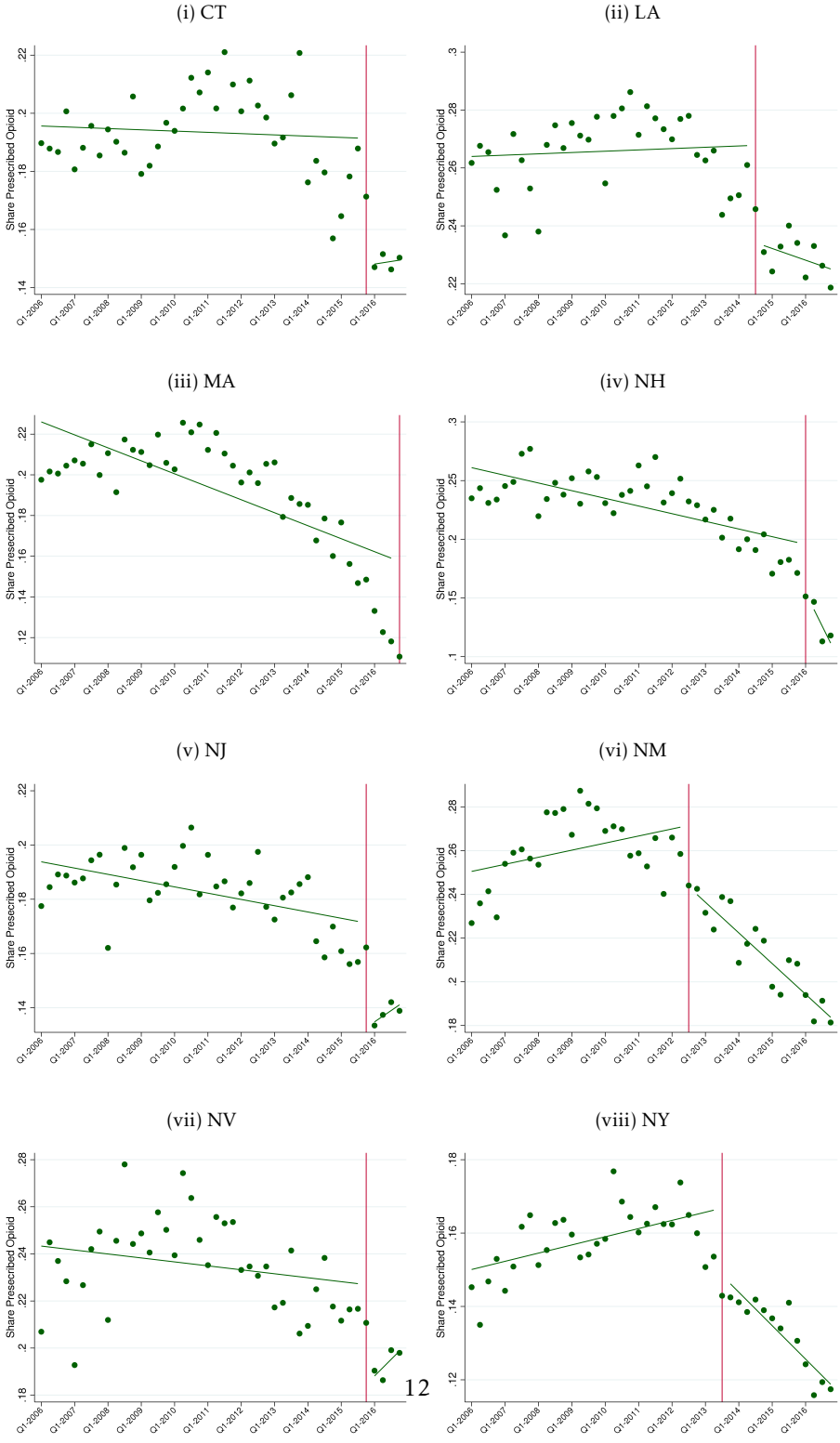
Note: *** p<0.001, ** p<0.01, * p<0.05. Standard errors are clustered at the state level. Each estimate shows the coefficient on the difference-in-differences term (post x KY) from a separate regression. All specifications include state and year fixed effects, KY specific linear trend, and full set of controls. Outcome is the share of patients receiving an opioid following an ED visit. Each panel and column represent a different sample. Col (1) shows estimates from the full sample of diagnosed conditions. Col (2) contains ED visits with diagnosis codes for opioid appropriate conditions, Col (3) contains visits for opioid inappropriate conditions, Col (4) contains visits that are unclassified (neither appropriate nor inappropriate).

Table A11: PDMP Mandate Effects on Opioid Prescriptions: Integration of All Robustness Tests

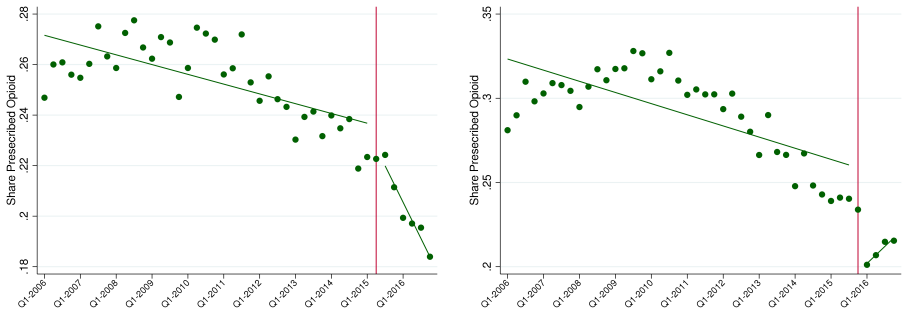
	All	Appropriate	Inappropriate	Unclassified
Panel A: All				
Post x Kentucky	-0.031***	-0.023***	-0.071***	-0.027***
	(0.0014)	(0.0042)	(0.0032)	(0.0012)
Dep. Var. Mean	0.25	0.64	0.38	0.21
Panel B: Naive				
Post x Kentucky	-0.024***	-0.020**	-0.059***	-0.021***
	(0.0014)	(0.0060)	(0.0029)	(0.0012)
Dep. Var. Mean	0.21	0.64	0.33	0.16
Panel C: Non-Naive				
Post x Kentucky	-0.037***	-0.028***	-0.082***	-0.031***
	(0.0022)	(0.0059)	(0.0042)	(0.0020)
Dep. Var. Mean	0.31	0.64	0.44	0.27
N	2244	2235	2244	2244
Panel D: Triple Difference				
Post x KY x Non-Naive	-0.012***	-0.012	-0.023***	-0.0097***
	(0.0025)	(0.0092)	(0.0035)	(0.0025)
Dep. Var. Mean	0.25	0.64	0.38	0.21
N	4488	4479	4488	4488

Note: *** p<0.001, ** p<0.01, * p<0.05. Standard errors are clustered at the state level. Each estimate shows the coefficient on the difference-in-differences term (post x KY) from a separate regression. The sample excludes patients with a benzodiazepine prescription and includes all states as controls. All specifications include state and year fixed effects, KY specific linear trend, the interaction with a linear trend (post x KY x trend), and the full set of controls. Outcome is the share of patients receiving an opioid following an ED visit, defining naive status using a 9-month lookback period. Each panel and column represent a different sample. Col (1) shows estimates from the full sample of diagnosed conditions. Col (2) contains ED visits with diagnosis codes for opioid appropriate conditions, Col (3) contains visits for opioid inappropriate conditions, Col (4) contains visits that are unclassified (neither appropriate nor inappropriate).

Figure A1: Rate of Opioid Prescriptions in All Other Mandate States

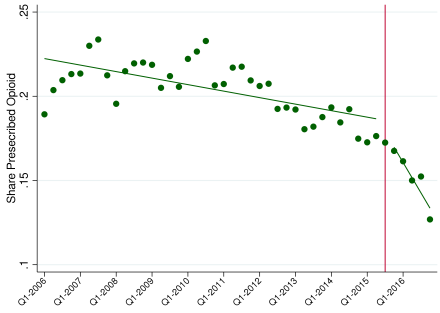


Note: Share of patients receiving an opioid following an ED visit using Optum data from 2006-2016 for all other mandate states. Vertical line represents introduction of mandate in each state.

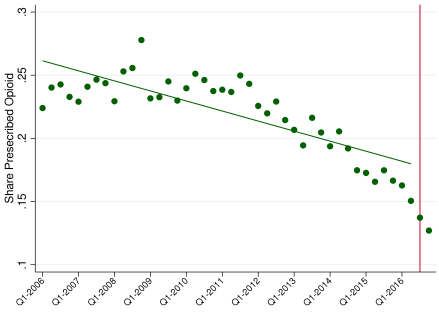


(i) OH

(ii) OK

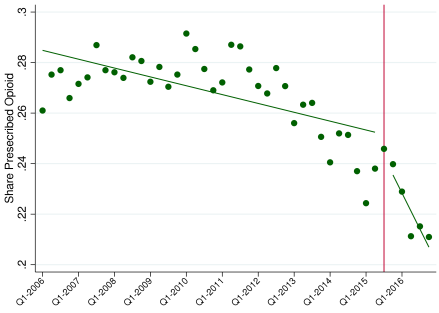


(iii) PA

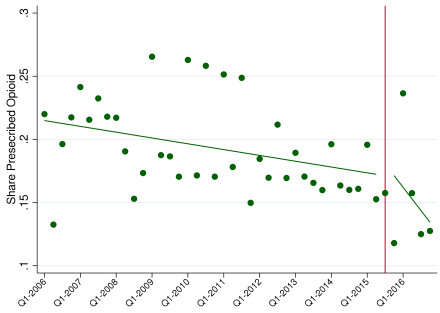


(iv) RI

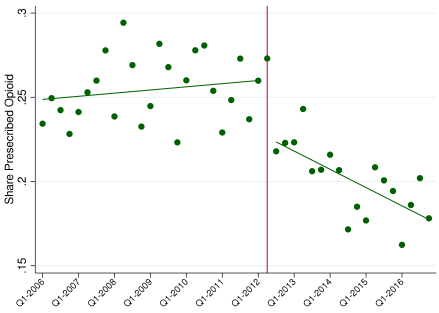
(v) TN



(vi) VA



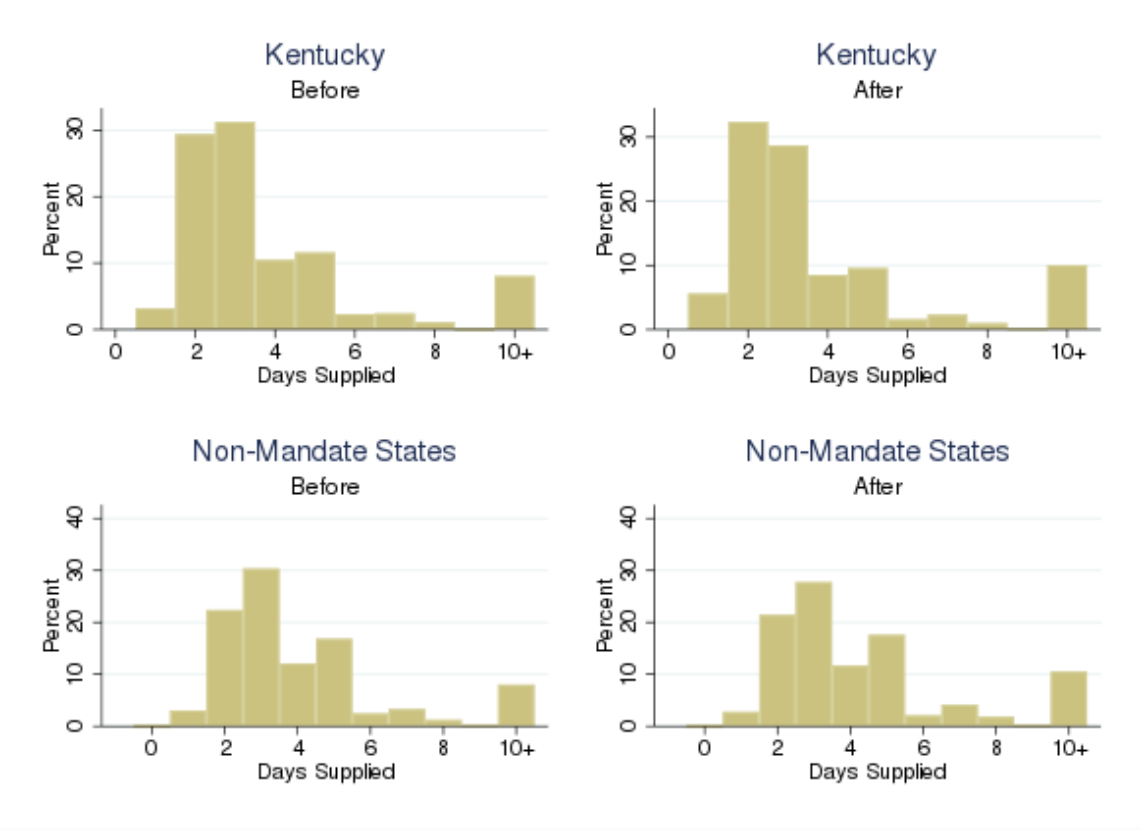
(vii) VT



(viii) WV

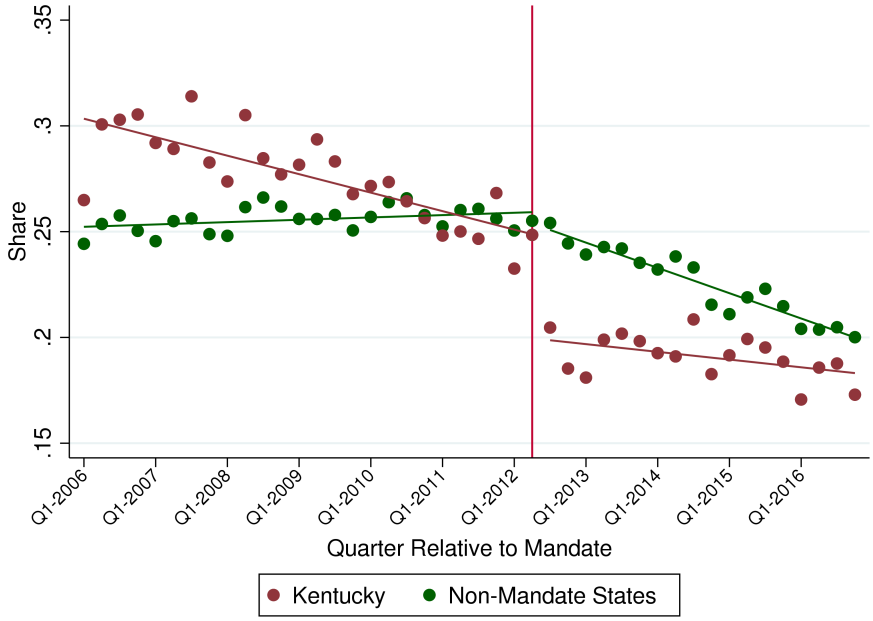
Note: Share of patients receiving an opioid following an ED visit in KY vs. non-mandate states using Optum data from 2006-2016. Vertical line represents introduction of KY mandate in Q3 of 2012.

Figure A2: Histograms of Opioid Days Supplied



Note: Histogram shows distribution of days supplied for opioid prescriptions in Kentucky relative to non-mandate states before and after Q3 of 2012, the introduction of the Kentucky mandate.

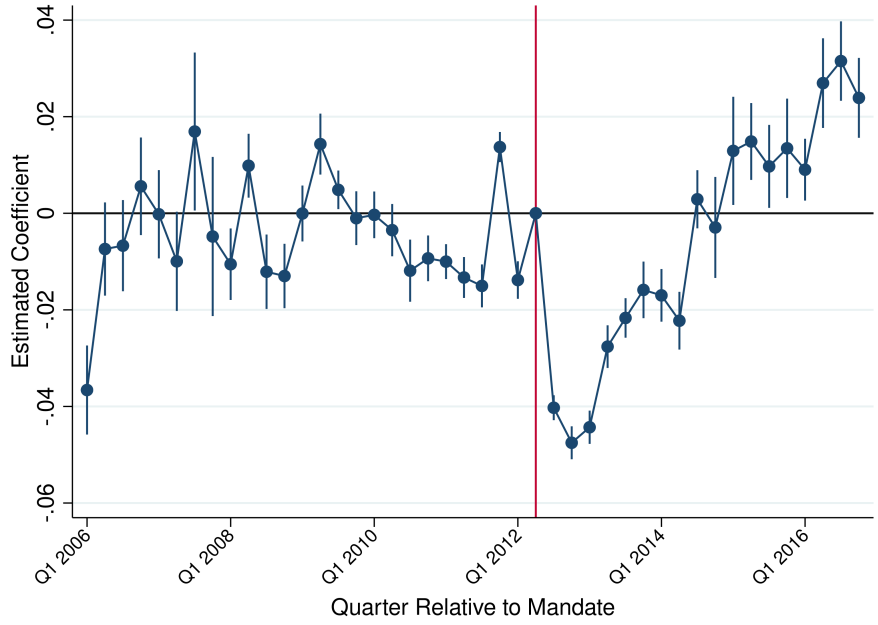
Figure A3: Rate of Opioid Prescriptions in Kentucky and Non-Mandate States



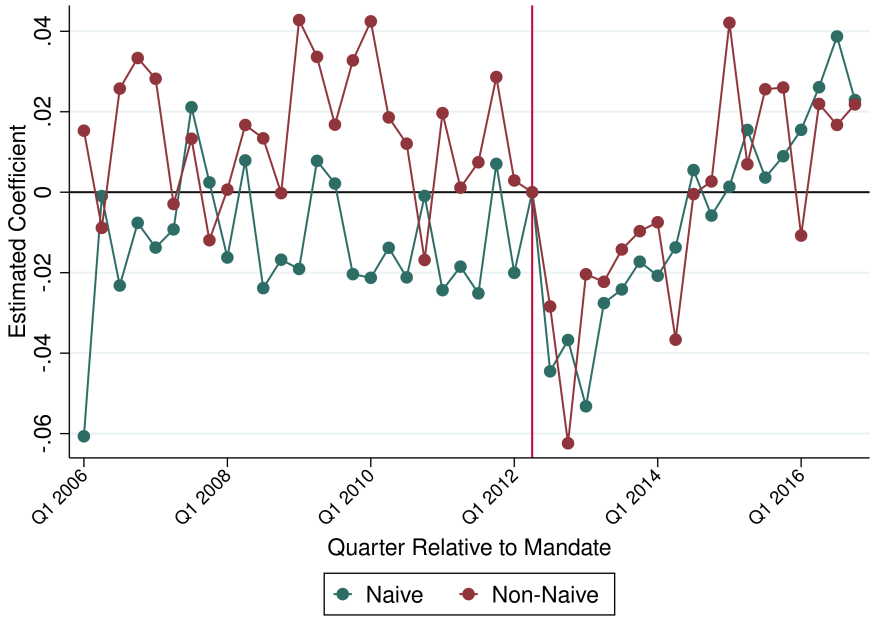
Note: Share of patients receiving an opioid following an ED visit in KY and non-mandate states using Optum data from 2006-2016. Vertical line represents introduction of KY mandate in Q3 of 2012.

Figure A4: Event Study of of Opioid Prescriptions Relative to KY Mandate Including a Kentucky-Specific Time Trend

(i) All



(ii) By Naive Status



Note: Each graph includes point estimates from the event study (normalized to 0 in Q2:2012) and 95% confidence intervals which are adjusted for within-state clustering. Outcome is the share of patients receiving a non-opioid analgesic following an ED visit. Panel A shows the full sample, Panel B shows separate event study coefficients for opioid naive and non-naive samples. Specification includes a Kentucky-specific linear trend.

Figure A5: Rate of Opioid Prescriptions in Kentucky by Naive Status

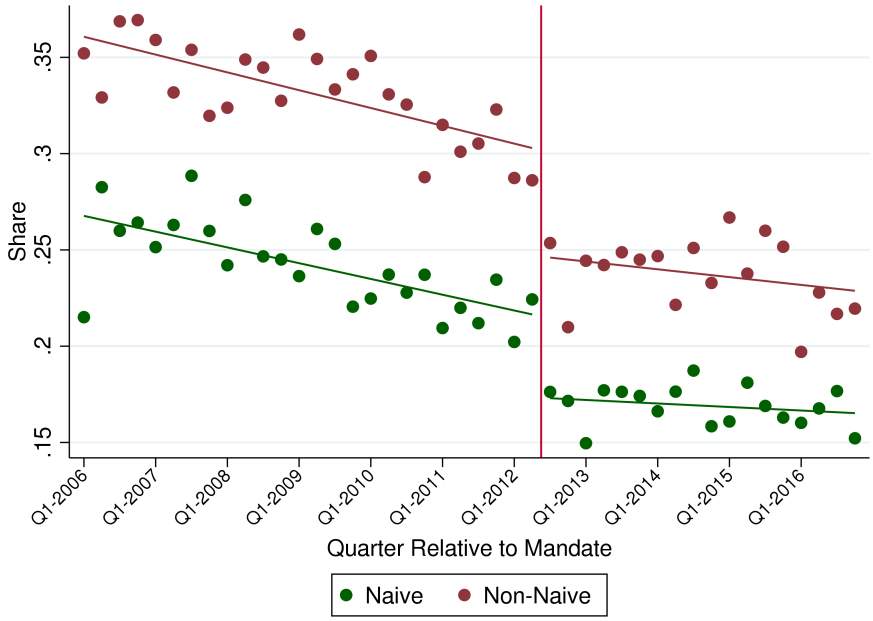
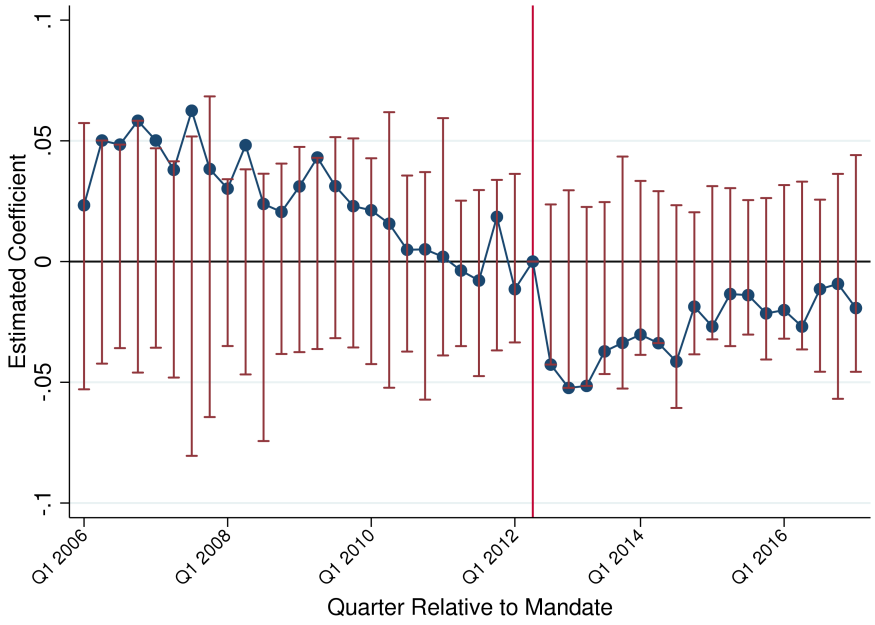


Figure A6: Event Study of Opioid Prescriptions Relative to KY Mandate. Confidence Intervals from 5th and 95th Percentile of Coefficients from Permutation Test

(i) All



(ii) By Naive Status

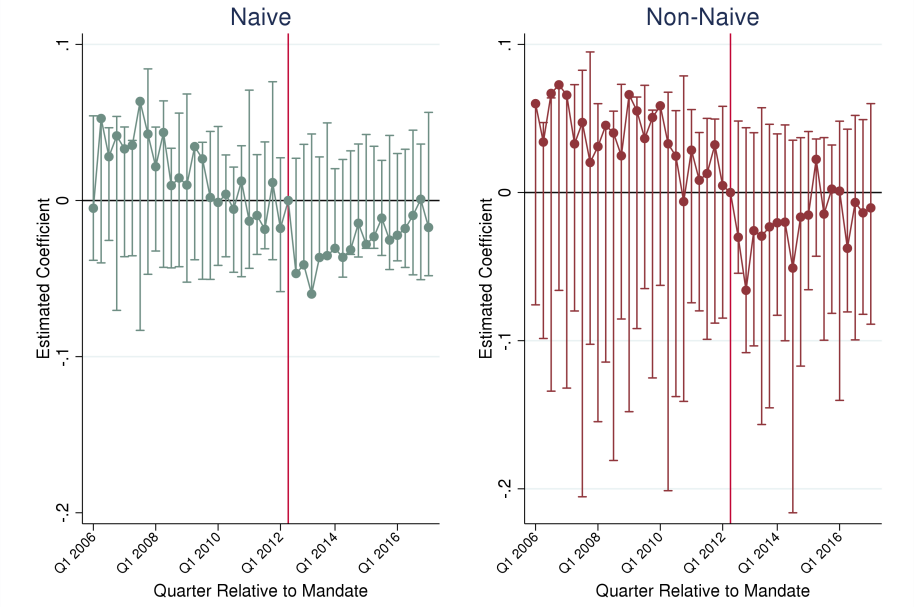
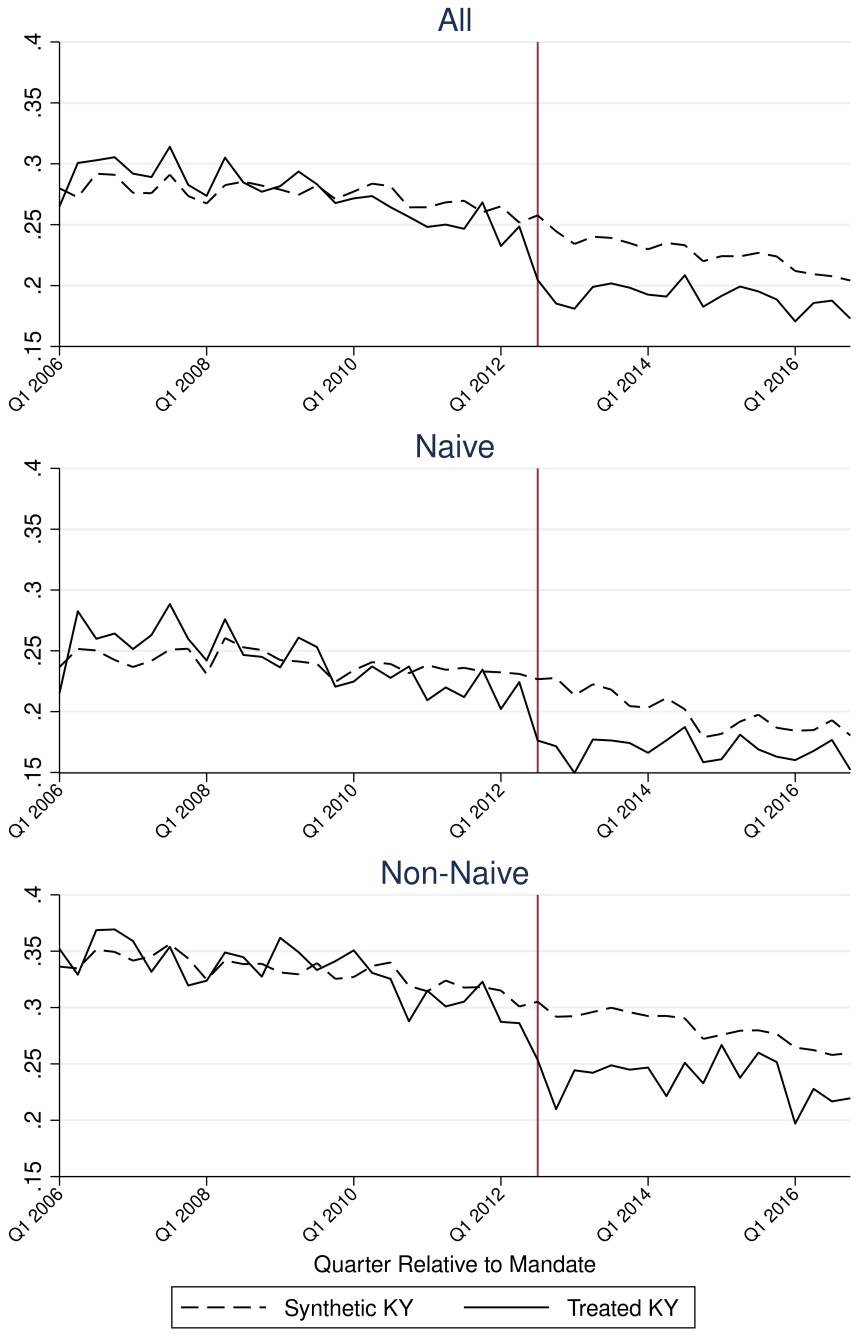


Figure A7: Trends in Opioid Prescriptions in Kentucky and Synthetic Kentucky, Overall and by Naive Status

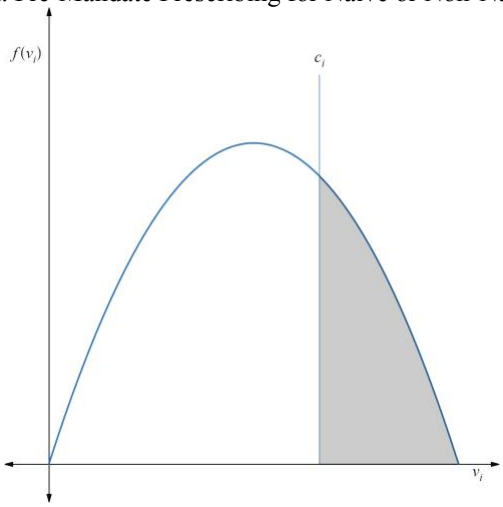


Appendix B

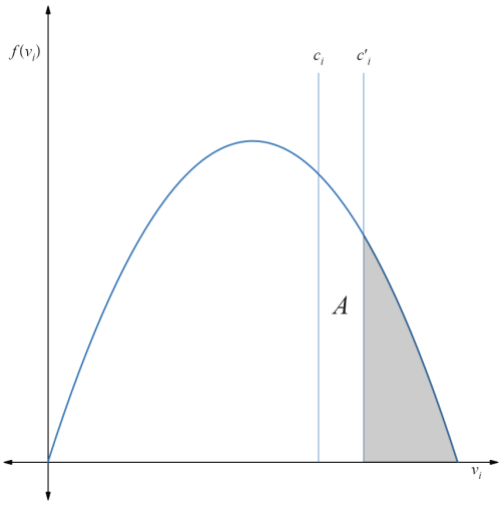
B.1 Modelling Information and Hassle Costs

Figure B1: Decomposing Information and Hassle Cost Effects

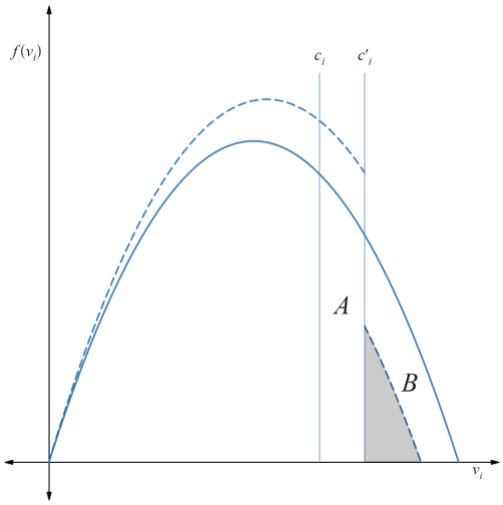
Panel A. Pre-Mandate Prescribing for Naïve or Non-Naïve Patient



Panel B. PDMP Mandate Effect for Naïve Patient



Panel C. PDMP Mandate Effect for Non-Naïve Patient



Note: These figures show information and hassle cost effects for the providers who would not voluntarily search the PDMP pre-mandate for a given patient type, since the mandate is only binding for this group. The solid line in each panel is the ex-ante distribution of provider beliefs about net benefits v_i; the dashed line is a potential ex-post distribution of updated provider beliefs. For naïve patients, the ex-ante and ex-post distribution of beliefs are effectively the same since any updating of beliefs will not affect prescribing (see Appendix B.2 cases 2 and 3). The shaded area under each density function represents the share of patients receiving opioid prescriptions. In Panel A, patients receive an opioid in the pre-mandate period if $v_i \geq c_i$. In Panel B, the reduction in prescribing to naïve patients is denoted by the area labeled A and is due entirely to hassle costs. In Panel C, the reduction due to hassle costs for non-naïve patients is the same as for naïve patients (A). The reduction due to information is denoted by the area labeled B. In this hypothetical case, provider updating shifts the distribution of net benefits down by a constant amount. For a given distribution of ex-ante provider beliefs, the information effect is recovered by subtracting the reduction in prescribing to the naïve from the reduction to the non-naïve ([A+B] – A = B).

B.2 Predicted Information Effects for Naïve and Non-Naïve Patients

In this section, we provide predictions for how prescribing adjusts in response to *information* obtained as a result of the PDMP mandate. To understand how Kentucky's mandate could have affected opioid prescribing through the information channel, we must consider PDMP search and prescribing in the absence of the mandate. Prior to the mandate, providers could search the PDMP and get information or prescribe solely based on the observable characteristics of the patient (i.e., signals that are correlated with opioid history), independent of search. How prescribing changes after the mandate depends on the provider's initial PDMP search behavior and the provider's initial beliefs about the value of prescribing an opioid to the patient, e.g., the non-naïve status of a patient based on observable characteristics and the clinical benefit based on the diagnosis. We show that in all cases, prescribing weakly decreases after the mandate.

PDMP search behavior and prescribing decisions across provider-patient pairs in the pre-mandate period can be grouped into three cases: 1) providers who searched the PDMP for a given patient, 2) providers who did not search and did not prescribe because they believed the patient had a low net benefit from an opioid prescription (based on beliefs that they were non-naive and/or had low clinical benefit), and 3) providers who did not search but prescribed because they believed the patient had high net benefit from an opioid prescription (based on beliefs that they were naïve and/or had a high clinical benefit). We present these three pre-mandate scenarios and the subsequent search/prescribing behavior in the post-mandate period that would follow from these initial behaviors.

Case 1. Provider Searches Pre-mandate: We first consider providers who searched the PDMP pre-mandate for a given patient type. Providers who incurred the cost to search for a given type of patient pre-mandate will also incur the cost to search post-mandate. Thus, the mandate

provides no new information to the provider and their prescribing should be unchanged. For simplicity, we do not include these providers in Figure B1 since their behavior is unchanged by the mandate.

Case 2. Provider does not search and does not prescribe pre-mandate because she believes the patient has low net benefit, $v_i < c_i$: In the second case, we consider providers who did not search the PDMP pre-mandate for patient types they believed had a low net benefit from receiving an opioid. The reasons for this low benefit could be that the provider believes the patient is non-naive based on ex-ante observable characteristics, such as exhibiting problematic behaviors (e.g., showing up intoxicated or clearly under the influence of opioids) or clinical information provided in other electronic health records indicating opioid abuse. Furthermore, the provider may believe the patient has low clinical benefit from an opioid (based on their diagnosis) regardless of opioid history. In this case, which corresponds to $v_i < c_i$ in Figure B1, providers would not prescribe an opioid to this patient type prior to the mandate.

After the mandate, patients of the type believed ex-ante to have low net benefit will continue to be viewed as such (i.e., $v_i < c_i'$ given that $v_i < c_i$) and the provider will continue to be unwilling to prescribe an opioid. Since the provider does not intend to prescribe an opioid for this patient type, they will not search the PDMP for these patients and there will be no updating of information about non-naïve status. The key insight here is that a patient type not even considered for an opioid in the absence of the mandate should not, once a mandate is in place, be considered for an opioid prescription. This implies that an opioid naïve patient believed to be low benefit because they are misclassified as non-naïve will not suddenly receive an opioid once the mandate goes into effect.

Case 3. Provider does not search but prescribes pre-mandate because she believes patient has high net benefit, $v_i \geq c_i$: In the third case, we consider providers who did not search the PDMP pre-mandate for a patient type believed to have a high net benefit from receiving an opioid. Pre-mandate this patient type received an opioid because they were believed to be naïve and/or have high clinical benefit based on their diagnosis. This case corresponds to $v_i \geq c_i$ in Figure B1.

For this patient type, the mandate will now require that the doctor searches the PDMP before prescribing them an opioid. How the information in the PDMP affects ex-post prescribing depends on whether the patient is opioid naive or non-naive.[1]

3a. Patient is opioid naïve: For patients who are opioid naïve, the information gained in the PDMP could be positive but there is no effect on prescribing. Some patients were initially believed to be naïve and search simply confirms this ex-ante belief. Other patients were mistakenly considered non-naïve but still prescribed opioids because providers deemed them to have high clinical benefit based on their diagnosis. For these patients, PDMP search causes the provider to positively update their beliefs about the net value of opioids to the patient. But because they would have received an opioid pre-mandate, this information has no effect on prescribing. For this reason, we represent the distribution of v_i as unchanged after the mandate for naïve patients in Figure B1.[2]

3b. Patient is opioid non-naïve: For patients who are opioid non-naïve, PDMP search could provide negative information and prescribing will weakly decline. Specifically, based on

[1] For simplicity, we categorize opioid history as naïve or non-naïve in our framework, but we recognize that within the non-naïve category there are patterns of prescription fills that would be classified as more or less problematic. It would not change the basic predictions from our model to take these more nuanced classifications into account.
[2] In practice, the distribution of v_i could change such that there is more mass at higher values of v_i. However, since no naïve individuals who were above the threshold for prescribing will be shifted to below the threshold and vice versa, the area under the distribution (above c_i') will remain the same pre- and post-mandate. Thus, for simplicity we represent this as no change in the distribution since it has no impact on prescribing.

search post-mandate, the provider will discover that some patient types who they believed to be naïve are actually non-naïve. They will negatively update their beliefs which will shift the distribution of v_i in Figure B1. Thus, the information in the PDMP will weakly reduce prescribing to the non-naive.

The above scenarios clarify that prescribing weakly decreases as a result of the information provided after the PDMP mandate.[3] Information causes prescribing to weakly decrease for the non-naïve and does not affect prescribing to the naïve. With the mandate, doctors will only get new information through search for patient types that absent the mandate would not have been subject to search but would have been prescribed an opioid (Case 3). Furthermore, this information will only negatively affect beliefs and thereby prescribing for those who are non-naïve (Case 3b).

[3] The above framework is based on a rational model of provider decision making. Large psychological costs of searching or other behavioral biases could generate different predictions. For example, if the mandate enables some prescribers to overcome psychological barriers to searching such that the mandate pushes them to consider some patients for opioids who were never even considered previously, then prescribing could increase to opioid naïve patients. In practice, however, we do not observe an increase in opioid prescribing suggesting this type of model may be unlikely.