The Effects of Publicity on Demand: The Case of Anti-Cholesterol Drugs

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Motivations

Marketing textbooks often claim that publicity is important.

- Consumers may give more credence to publicity (e.g., media coverage) than advertising.
- Publicity could have strong impact on public awareness at a considerably lower cost than advertising.

However, we hardly see empirical works investigating the impact of news articles. Why?

- It is hard to systemically interpret news articles.

An Example

(Heart Disease Weekly, April 4, 2004)

- "**Pravachol** is an older statin made by Bristol-Myers Squibb, while the **newer and more potent Lipitor** is made by Pfizer. Last fall's study was financed by Pfizer, and this one was paid for by Bristol-Myers Squibb. **Lipitor** came out on top in both studies (effectiveness in reducing heart disease risks)."
- "Dr. Andrew Bodnar noted abnormal liver enzymes were more common in patients on **Lipitor** in the latest study and said **Pravachol** has an unsurpassed safety record."

Our Coding Approach

If we coded the previous article in a single-dimensional classification:

- The article could be coded as either positive or negative for Lipitor.
- The coding results would be misleading.

Our approach is to map the information to a multi-dimensional attribute space.

- Positive in reducing heart disease risks.
- Negative in side-effects.

Our Goals

Research questions

- What are the main drivers behind demand, publicity or standard marketing-mix?
- Is all publicity the same, e.g, short-term efficacy vs. long-term efficacy?
- To what extent does publicity affect market expansion and brand choice?
- Can a drug free-ride on the clinical evidence for other drugs in the same class?

Study the market of statins - a popular class of anti-cholesterol drugs.

Summary of Results

- Publicity seems more important in market expansion than in brand choice.
- Not all publicity is the same. Multi-dimensional coding scheme is necessary.
  - "Reducing heart disease risks" publicity plays a stronger role in market expansion than other publicity.
  - "Lowering cholesterol levels" publicity plays a minor role in brand choice.
- We find evidence that Lipitor and Crestor may be able to free-ride on the clinical evidence for reducing heart disease risks for older statins via detailing.

Previous Literature

- Studies on publicity usually investigate the impact of critics and product reviews (Basuroy et al. 2003; Berger et al. 2010; Chevalier and Mayzlin 2006; Godes and Mayzlin 2004).
- Pharm. marketing research mainly focuses on studying the effects of:
  - Detailing and journal advertising (Berndt et al. 1997; Ching and Ishihara 2010; Narayanan et al. 2005)
  - DTCA (Iizuka and Jin 2002 ; Wosinska 2002)
  - Clinical studies (Azoulay 2002; Ching and Ishihara 2010; Cockburn and Anis 2001)
- Chintagunta, Jiang and Jin (2009) create publicity variables based on the headline of news articles.

Background

Why prescription drugs?

- Patients might get informed on prescription drugs' efficacy through the media (e.g., newspapers, TV news, magazines).
- Post-marketing clinical studies keep generating publicity.

Why statins?

- Statin is an important market for public health and firms' profitability; Sales of Lipitor is $12.4 billion in 2008.

Why Canadian market?

- Pharm price changes are very infrequent due to the regulations.
- DTCA is strictly regulated in Canada.

Data (Sales and Promotions)

Monthly Canadian data for each statin between Mar 1993 and Dec 2004 from IMS Canada

- Number of prescriptions
- Cost of detailing
- Journal advertising pages

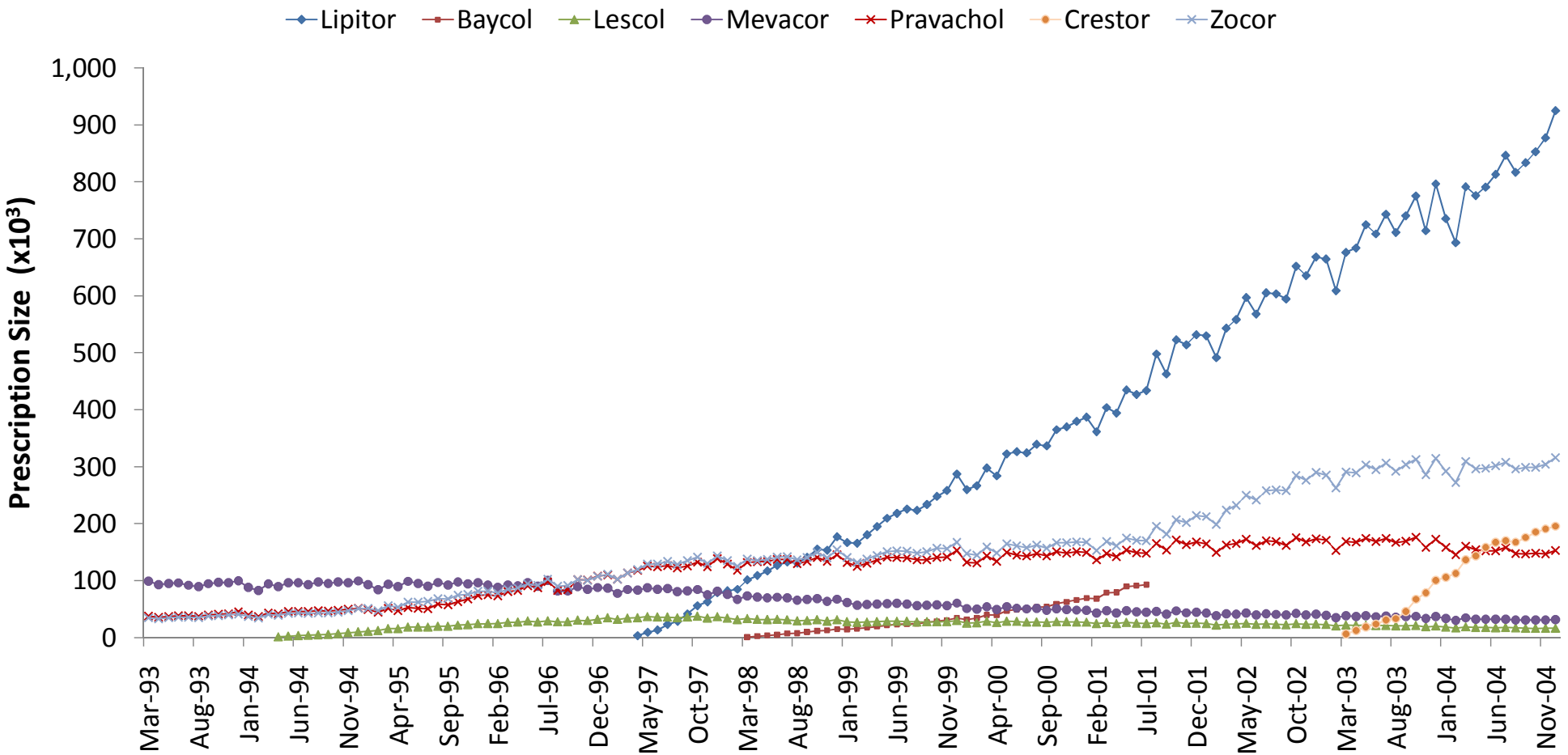
Monthly U.S. DTCA data for each statin between Jan 1995 and Dec 2004 from TNS Media Intelligence

Summary of Statins

Brand	Molecule	Entry Date	Generic Entry in Canada	Generic Entry in the US	Manufacturer	DDD*
Lipitor	atorvastatin	Apr-1997	2010(Exp.)	2011(Exp.)	Pfizer	20mg
Baycol	cerivastatin	Mar-1998	N/A	N/A	Bayer	0.2mg
Lescol	fluvastatin	Mar-1994	2011(Exp.)	2012(Exp.)	Novartis	60mg
Mevacor	lovastatin	Sep-1987	Apr-1997	Jun-2001	Merck	45mg
Pravachol	pravastatin	Nov-1991	Aug-2000	Apr-2006	Bristol-Myers Squibb	30mg
Crestor	rosuvastatin	Mar-2003	2012(Exp.)	2013(Exp.)	AstraZeneca	10mg
Zocor	simvastatin	Feb-1992	Mar-2003	Jun-2006	Merck & Co.	30mg

* Defined Daily Dose (DDD) is the assumed average maintenance dose per day for a drug used for its main indication in adults.

Monthly No. of Prescriptions for Statins



Landmark Clinical Trials for Statins

Title	Publication Date (mm/yy)	Release Date (mm/yy)	Journal	Drugs Studied	No of Subjects	Follow-up Period
4S	12/94	11/94	Lancet	Zocor	4,444	5.4 yrs
WOSCOPS	11/95	09/95	NEJM	Pravachol	6,595	4.9 yrs
CARE	10/96	03/96	NEJM	Pravachol	4,159	5 yrs
CURVES**	03/98	08/97	Am J Cardiol	Lipitor*, Zocor, Pravachol, Mevacor, Lescol	534	8 wks
AFCAPS/ TexCAPS	05/98	11/97	JAMA	Mevacor	5,705	5.2 yrs
LIPID	11/98	11/97	NEJM	Pravachol	9,014	6.1 yrs
MIRACL	04/01	11/00	JAMA	Lipitor	3,086	16 wks
LIPS	06/02	06/02	JAMA	Lescol	1,677	3.9 yrs
HPS	07/02	11/01	Lancet	Zocor	20,536	5 yrs
PROSPER	11/02	11/01	Lancet	Pravachol	5,804	3.2 yrs
ALLHAT- LLT	12/02	10/02	JAMA	Pravachol	10,355	4.8 yrs
ASCOT- LLA	05/03	10/02	Lancet	Lipitor	10,305	3.3 yrs
ALERT	06/03	06/03	Lancet	Lescol	2,102	5.1 yrs
REVERSAL	03/04	11/03	JAMA	Lipitor*, Pravachol	2,163	1.5 yrs
PROVE IT - TIMI	04/04	03/04	NEJM	Lipitor*, Pravachol	4,162	2 yrs
ALLIANCE	06/04	03/04	JACC	Lipitor	2,422	4.3 yrs
CARDS	08/04	06/03	Lancet	Lipitor	2,838	3.9 yrs
A to Z	09/04	07/04	JAMA	Zocor	4,498	2 yrs

** CURVES study is not a landmark study. Lipitor gained an approval from FDA with the study.

Data (Publicity)

- Collect 41,002 articles mentioning "statin" from Factiva between year 1986 and 2004
- Extract a headline, contents, publication date, and a source from each article
- Store the information into our own database
- Restrict the sample to 2,754 articles from "Canadian Accessible Sources"

Canadian Accessible Sources

- Online sources
- Canadian TV news, newspapers and magazines
- US TV news from big 4 TV stations (ABC, CBS, FOX and NBC) and CNN
- 8 US newspapers with more than 500,000 daily circulations
- 25 top selling US magazines

Classification

Classify articles along three dimensions

(1) lowering cholesterol levels (short-term efficacy)

(2) reducing heart disease risks (long-term efficacy)

(3) side effects

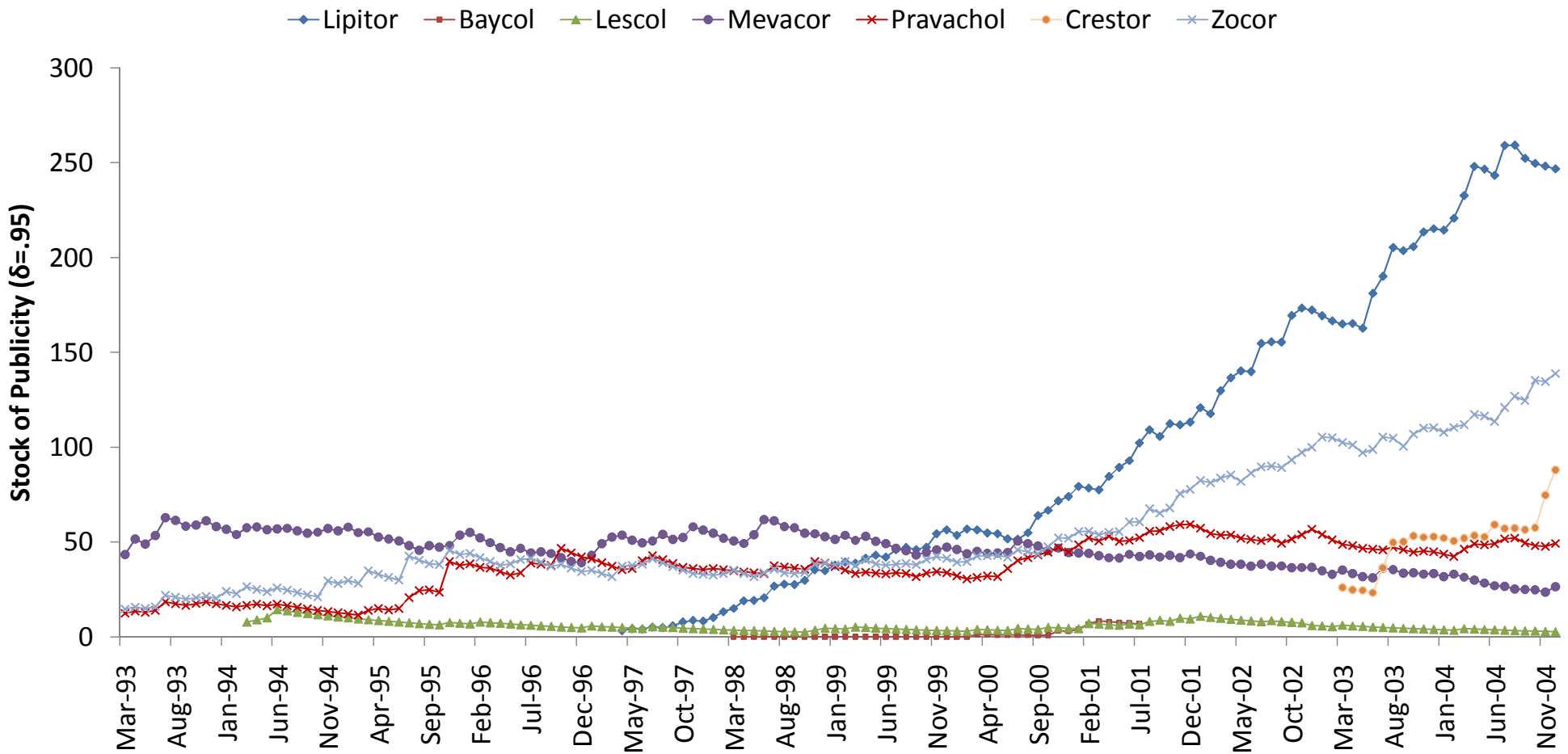
Why do we need to distinguish (1) and (2)?

- Lowering cholesterol levels does not necessarily guarantee reducing chances of having heart attack.

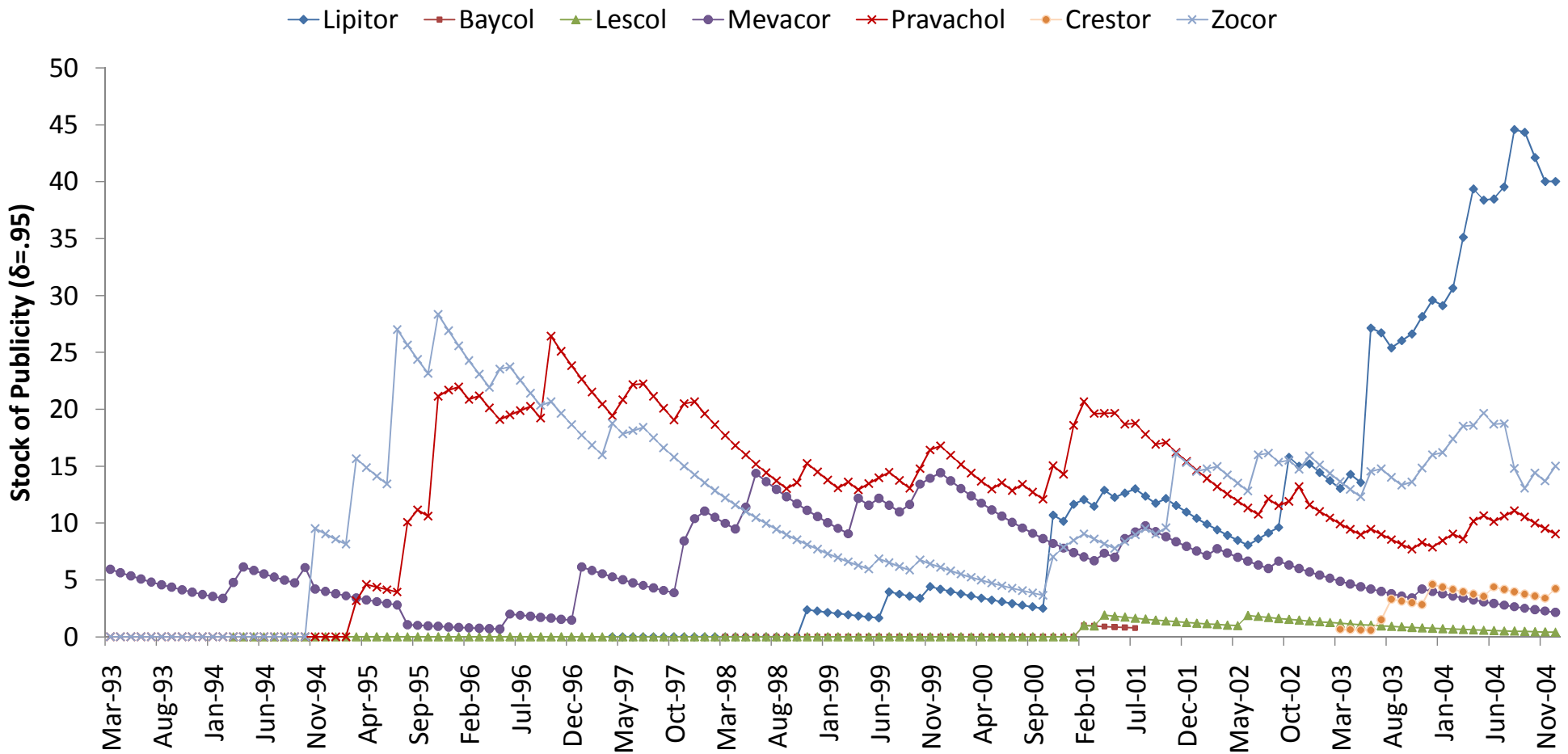
Classification (cont'd)

- Classify each article into comparison vs. non-comparison for each dimension
  - For non-comparison articles, we assign each drug "+1" or "-1" if the article shows positive or negative attitude towards the focal drug.
  - For comparison articles, we assign "+1" to the drug which the article favors most for each dimension. All other compared drugs are assigned "-1."

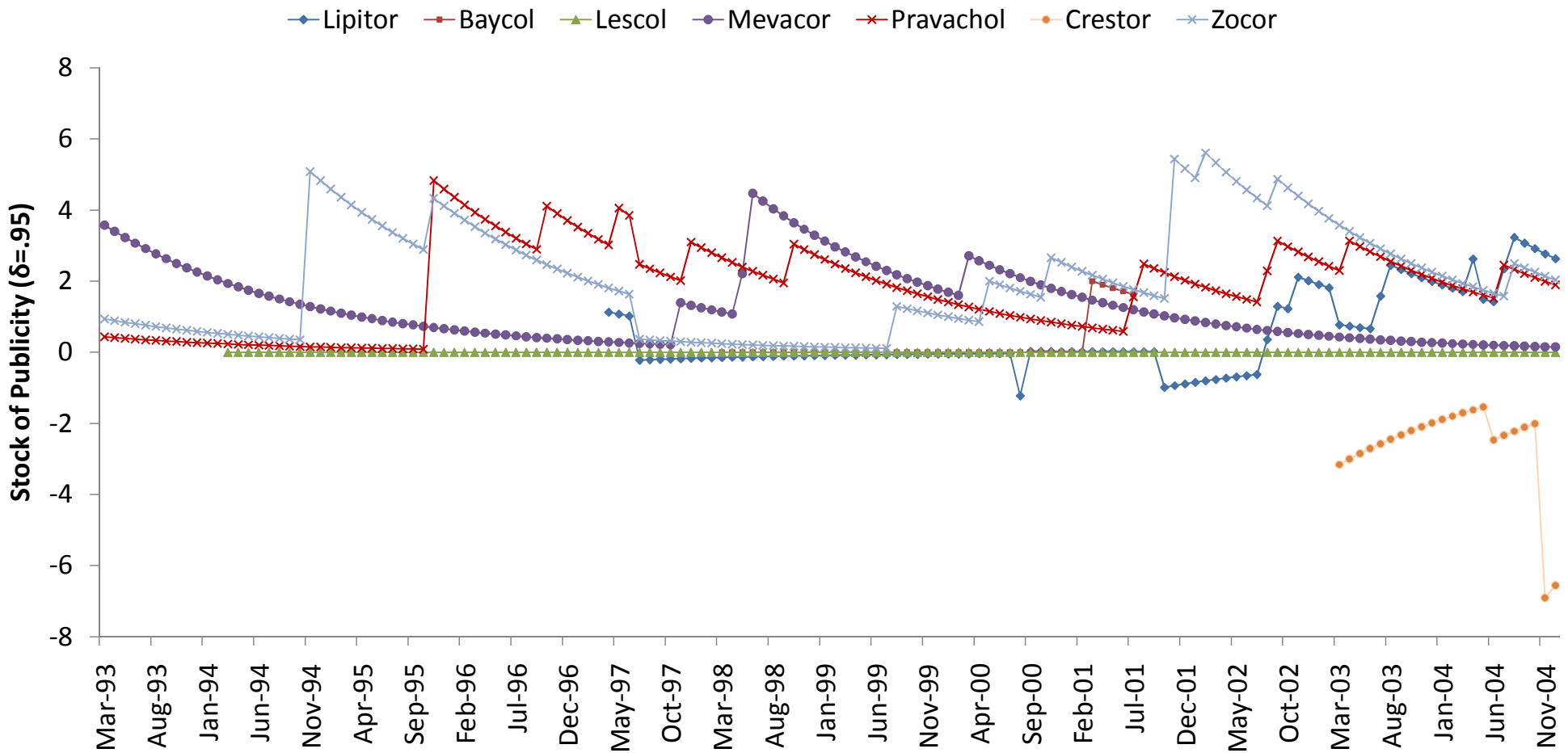
Stocks of Lowering Cholesterol Levels Non-Comparison Publicity



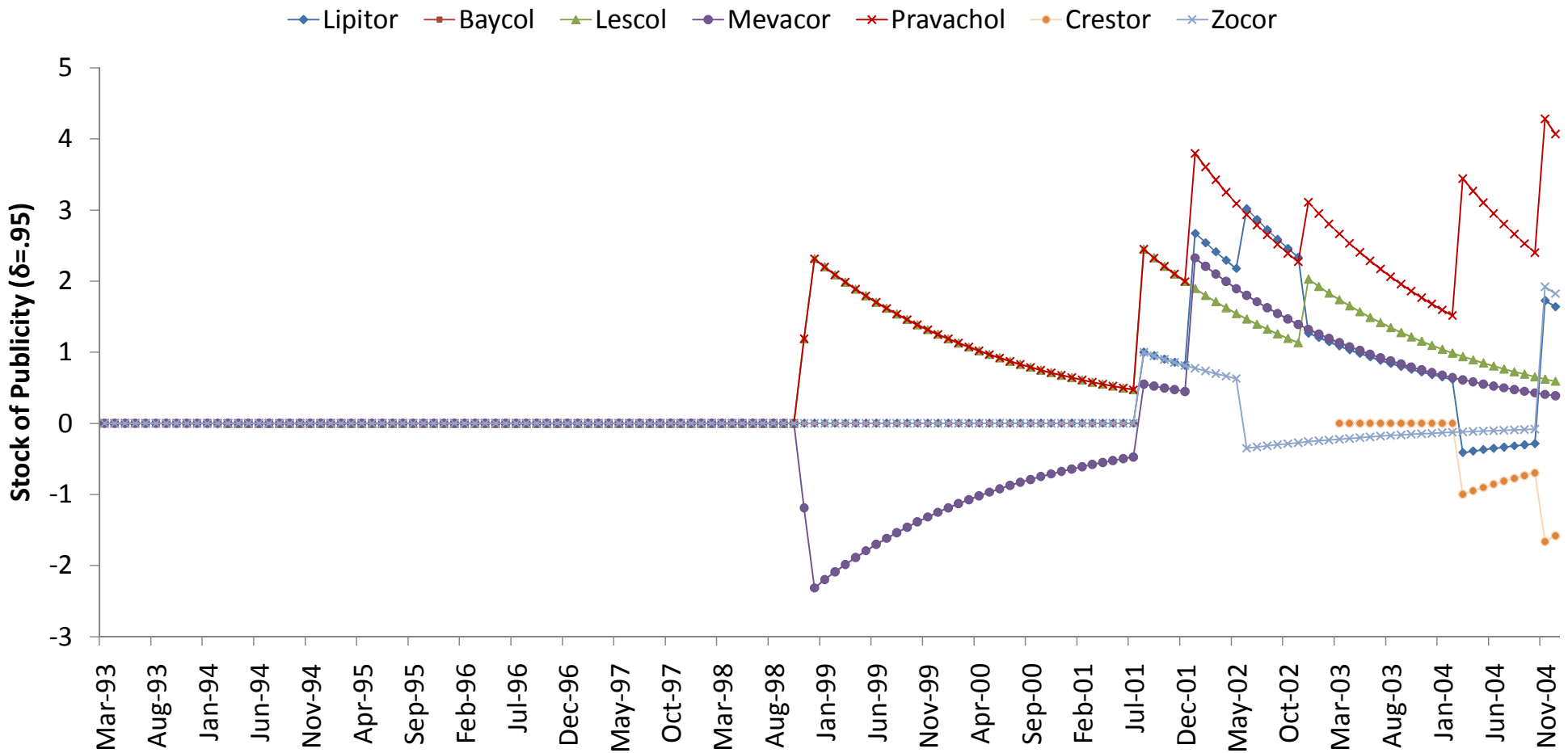
Stocks of Reducing Heart Disease Risks Non-Comparison Publicity



Stocks of Side-effects Non-Comparison Publicity



Stocks of Side-effects Non-Comparison Publicity



Basic Modeling Framework

- We adopt a reduced form approach.
- The framework is similar to Berndt et al. (1997).
  - Market expansion model determines the number of patients who decide to adopt statins.
  - Brand choice model determines the conditional market shares of each statin (conditional on adopting statins).

Model (Market Expansion)

- Market expansion model determines the number of potential patients who decide to adopt statins.
- We use Canadian Heart Health Survey to estimate the number of potential patients with a high cholesterol problem.

Model (Market Expansion)

$$ln(\frac{S_{statin,t}}{S_{outside,t}}) = f(STK\_mkting_t^s, STK\_clinical_t^s, STK\_publicity_t) + \nu_t$$

- $S_{statin,t}$ denotes share of patients adopting statins.
- j indexes drugs, t indexes time.
- $STK\_mkting_t^s = \sum_j STK\_mkting_{jt}$: carryover rate = 0.95
- $mkting_{jt}$: $detail_{jt}, journal\_ad_{jt}, DTCA_{jt}$
- $STK\_clinical_t^s = \sum_j STK\_clinical_{jt}$: carryover rate = 1
- We interact $STK\_clinical_t^s$ with $STK\_mkting_t^s$ to see if the accumulated knowledge increases the effectiveness of detailing.

Model (Market Expansion)

- We assume that two types of publicity affect the market expansion of statins.

  (a) general publicity (e.g., statins reduce heart disease risks)

  (b) brand specific publicity (e.g., Lipitor reduces heart disease risks)

- $STK\_publicity\_X_t$ denotes a goodwill stock of type (a) publicity in dimension X. $(X = LC, RH, SE)$

- $STK\_publicity\_Y_t^s$ denotes sum of stock of type (b) publicity across statins. $(Y = NC, C)$

- Carryover rate $= 0.95$

Results (Market Expansion)

Variables	(1)		(2)		(3)		(4)	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
$\log(STK\_detail^s_t)$	1.5895*	0.1134	0.5112*	0.0539	0.7777*	0.0945	0.7664*	0.0907
$STK\_clinical^s_t * \log(STK\_detail^s_t)$	0.9301*	0.0368	0.6299*	0.0357	0.5966*	0.0358	0.4511*	0.0504
$\log(STK\_journal^s_t)$	-0.8470*	0.1495			-0.3681*	0.1091	-0.2445	0.1282
$\log(STK\_dtca^s_t)$							-0.0083	0.0054
$\log(STK\_lc_t)$			0.0142	0.0160	0.0293	0.0161	-0.0040	0.0263
$\log(STK\_rh_t)$			0.2048*	0.0170	0.1857*	0.0173	0.1788*	0.0172
$\log(STK\_se_t)$			-0.0408*	0.0158	-0.0274	0.0157	0.0099	0.0167
$\log(STK\_NC^s_t)$							0.2870*	0.0892
$\log(STK\_C^s_t)$							0.0217	0.0221
Constant	-21.3785*	0.8468	-10.4680*	0.8012	-12.0945*	0.9103	-14.2212*	0.9555
R^2	0.9788		0.9906		0.9913		0.9927	

Note * $p<0.05$.

lc: lowering cholesterol rh:reducing heart disease se:side-effects

NC: Non-Comparison C: Comparison

Results (Market Expansion)

The impact of publicity varies depending on the contents.

- "Reducing heart disease risks" publicity is more important than other types of publicity in the market expansion.
- Not all publicity is the same.
- Multi-dimensional coding scheme is necessary to capture different impacts.

Model (Brand Choice)

$$U_{ijt} = f_j(STK\_mkting_{jt}, STK\_clinical_{jt}, STK\_publicity_{jt}) + \xi_{jt} + \epsilon_{ijt},$$

$$ln(\frac{S_{j,t}}{S_{mevacor,t}}) = f_j(.) - f_{mevacor}(.) + \tilde{\xi_{jt}}$$

$$f_j(.) = \gamma_j + \gamma_{mkting} * ln(STK\_mkting_{jt}) + \gamma_{publicity} * ln(STK\_publicity_{jt})$$

- We assume that only brand specific publicity affect the demand in the brand choice stage.
- $publicity_{jt}$ reducing heart disease risks (rh_{jt}), lowering cholesterol (lc_{jt}), side-effects (se_{jt}); for each dimension, we further distinguish them into comparison ($\_c$) or non-comparison ($\_nc$) articles.

Model (Brand Choice)

We allow the effectiveness of detailing to depend on $STK\_clinical_{jt}$ and LC_rank_j.

- $STK\_clinical_{jt}$ denotes the accumulated knowledge through landmark clinical trial results.
- LC_rank_j denotes the effectiveness in lowering cholesterol derived from non-landmark clinical studies. (1-Lescol; 2-Mevacor; 3-Pravachol; 4-Zocor; 5-Lipitor; 6-Crestor and Baycol)

We also want to test the hypothesis that Lipitor and Crestor (stonger and newer statins) may be able to free-ride the landmark studies for older statins.

- Replace Lipitor's and Crestor's $STK\_clinical_{jt}$ with $STK\_clinical_t^s$. This modified variable is named $ModSTK\_clinical_{jt}$.

Results (Brand Choice)

Variables	(1)		(2)		(3)		(4)	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
$\log(STK\_detail_{jt})$	0.2211*	0.0365	1.0666*	0.0462	0.2621*	0.0379	1.2316*	0.0474
LC_rank *$\log(STK\_detail_{jt})$	0.0158	0.0150	-0.6553*	0.0320	0.0015	0.0149	-0.7393*	0.0319
LC_rank^2 *$\log(STK\_detail_{jt})$			0.1132*	0.0051			0.1234*	0.0050
$\log(STK\_clinical_{jt})$ *$\log(STK\_detail_{jt})$	-0.1229*	0.0424	-0.0382	0.0310				
$\log(ModSTK\_clinical_{jt})$ *$\log(STK\_detail_{jt})$					0.0089	0.0519	0.2565*	0.0373
$\log(STK\_journal_{jt})$	0.4049*	0.0284	0.3205*	0.0210	0.4074*	0.0287	0.3039*	0.0203
$\log(STK\_DTCA_{jt})$	0.0064	0.0047	0.0204*	0.0034	0.0055	0.0047	0.0184*	0.0033
$\log(STK\_lc\_NC_{jt})$	0.0721*	0.0358	0.0190	0.0261	0.0864*	0.0375	0.0718*	0.0259
$\log(STK\_lc\_C_{jt})$	0.2495*	0.0384	0.1131*	0.0285	0.2400*	0.0390	0.0731*	0.0278
$\log(STK\_rh\_NC_{jt})$	0.1366*	0.0235	0.1231*	0.0170	0.1005*	0.0237	0.0542*	0.0165
$\log(STK\_rh\_C_{jt})$	-0.2785*	0.0308	-0.1893*	0.0227	-0.2754*	0.0317	-0.1473*	0.0225
$\log(STK\_se\_NC_{jt})$	-0.0480	0.0297	-0.0407**	0.0216	-0.0814*	0.0322	-0.1264*	0.0224
$\log(STK\_se\_C_{jt})$	-0.0127	0.0274	0.0145	0.0199	-0.0061	0.0276	0.0289	0.0192
$\log(STK\_debate_{jt})$	0.0499*	0.0183	-0.0396*	0.0138	0.0576*	0.0184	-0.0335*	0.0132
R^2	0.9660		0.9821		0.9655		0.9835	

Note * p<0.05 ** p<0.1

lc: lowering cholesterol rh:reducing heart disease se:side-effects
NC: Non-Comparison C: Comparison

Results (Brand Choice)

Variables	(1)		(2)		(3)		(4)	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
$\log(STK\_detail_{jt})$	0.2211*	0.0365	1.0666*	0.0462	0.2621*	0.0379	1.2316*	0.0474
LC_rank *$\log(STK\_detail_{jt})$	0.0158	0.0150	-0.6553*	0.0320	0.0015	0.0149	-0.7393*	0.0319
LC_rank^2 *$\log(STK\_detail_{jt})$			0.1132*	0.0051			0.1234*	0.0050
$\log(STK\_clinical_{jt})$ *$\log(STK\_detail_{jt})$	-0.1229*	0.0424	-0.0382	0.0310				
$\log(ModSTK\_clinical_{jt})$ *$\log(STK\_detail_{jt})$					0.0089	0.0519	0.2565*	0.0373
$\log(STK\_journal_{jt})$	0.4049*	0.0284	0.3205*	0.0210	0.4074*	0.0287	0.3039*	0.0203
$\log(STK\_DTCA_{jt})$	0.0064	0.0047	0.0204*	0.0034	0.0055	0.0047	0.0184*	0.0033
$\log(STK\_lc\_NC_{jt})$	0.0721*	0.0358	0.0190	0.0261	0.0864*	0.0375	0.0718*	0.0259
$\log(STK\_lc\_C_{jt})$	0.2495*	0.0384	0.1131*	0.0285	0.2400*	0.0390	0.0731*	0.0278
$\log(STK\_rh\_NC_{jt})$	0.1366*	0.0235	0.1231*	0.0170	0.1005*	0.0237	0.0542*	0.0165
$\log(STK\_rh\_C_{jt})$	-0.2785*	0.0308	-0.1893*	0.0227	-0.2754*	0.0317	-0.1473*	0.0225
$\log(STK\_se\_NC_{jt})$	-0.0480	0.0297	-0.0407**	0.0216	-0.0814*	0.0322	-0.1264*	0.0224
$\log(STK\_se\_C_{jt})$	-0.0127	0.0274	0.0145	0.0199	-0.0061	0.0276	0.0289	0.0192
$\log(STK\_debate_{jt})$	0.0499*	0.0183	-0.0396*	0.0138	0.0576*	0.0184	-0.0335*	0.0132
R^2	0.9660		0.9821		0.9655		0.9835	

Note * $p<0.05$ ** $p<0.1$

lc: lowering cholesterol rh:reducing heart disease se:side-effects
NC: Non-Comparison C: Comparison

Results (Brand Choice)

The impact of publicity varies depending on the contents.

- "Lowering cholesterol levels" publicity plays the strongest role among all types of publicity in the brand choice stage.
- Not all publicity is the same.
- We find evidence that Lipitor and Crestor may be able to free-ride on the clinical evidence for older statins via detailing.

Endogeneity Issues

Are advertising activities endogenous?

- Typically, the endogeneity problem is due to unobserved product characteristics (omitted variable bias).
- Previous research usually have detailing and journal ad., but do not have publicity variables

Is publicity endogenous?

- The completion times and outcomes of the clinical studies (and hence its related publicity) are not controlled by the drug companies, and hence should be largely uncorrelated with the remaining demand shocks.
- We also exclude articles that are just about sales.

Brand Choice

Possible explanations for RH_C being negative

- Most of the RH_C are concentrated in Nov 2003 and March 2004, when two landmark studies are released.

Possible explanations for SE_NC being negative

- It could be that patients are very sensitive to the term "side-effects."

Does controlling for publicity matter?

- We re-run the regressions in the market expansion and brand choice stages by removing the publicity variables.

Market Expansion

Variables	(4)		(5)		(6)	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
$\log(STK\_detail^{s}_{t})$	0.7664*	0.0907			1.5908*	0.1150
$STK\_clinical^{s}_{t}*\log(STK\_detail^{s}_{t})$	0.4511*	0.0504			0.9283*	0.0440
$\log(STK\_journal^{s}_{t})$	-0.2445	0.1282			-0.8555*	0.1867
$\log(STK\_dtca^{s}_{t})$	-0.0083	0.0054			0.0005	0.0064
$\log(STK\_lc^{s}_{t})$	-0.0040	0.0263	-0.0504	0.0291		
$\log(STK\_rh^{s}_{t})$	0.1788*	0.0172	0.3243*	0.0193		
$\log(STK\_se^{s}_{t})$	0.0099	0.0167	0.0453	0.0283		
$\log(STK\_NC^{s}_{t})$	0.2870*	0.0892	0.8759*	0.1188		
$\log(STK\_C^{s}_{t})$	0.0217	0.0221	-0.0520	0.0263		
Constant	-14.2212*	0.9555	-6.9134*	0.5255	-21.3417*	0.9775
R^2	0.9927		0.9820		0.9788	

Note * $p<0.05$.

Brand Choice

Variables	(4)		(5)		(6)	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
$\log(STK\_detail_{jt})$	1.2316*	0.0474			1.2672*	0.0483
LC_rank *$\log(STK\_detail_{jt})$	-0.7393*	0.0319			-0.7448*	0.0331
LC_rank^2 *$\log(STK\_detail_{jt})$	0.1234*	0.0050			0.1270*	0.0052
$\log(ModSTK\_clinical_{jt})$ *$\log(STK\_detail_{jt})$	0.2565*	0.0373			0.2589*	0.0221
$\log(STK\_journal_{jt})$	0.3039*	0.0203			0.2624*	0.0202
$\log(STK\_DTCA_{jt})$	0.0184*	0.0033			0.0253*	0.0032
$\log(STK\_lc\_NC_{jt})$	0.0718*	0.0259	1.0520*	0.0497		
$\log(STK\_lc\_C_{jt})$	0.0731*	0.0278	-0.3081*	0.0760		
$\log(STK\_rh\_NC_{jt})$	0.0542*	0.0165	-0.0530	0.0389		
$\log(STK\_rh\_C_{jt})$	-0.1473*	0.0225	0.1985*	0.0614		
$\log(STK\_se\_NC_{jt})$	-0.1264*	0.0224	-0.0962**	0.0558		
$\log(STK\_se\_C_{jt})$	0.0289	0.0192	0.4115*	0.0527		
$\log(STK\_debate_{jt})$	-0.0335*	0.0132	-0.1065*	0.0329		
R^2	0.9835		0.8434		0.9796	

Note * $p<0.05$ ** $p<0.1$

Elasticity

Variables	Lipitor	Baycol	Lescol	Mevacor	Pravachol	Crestor	Zocor
log(STK_detail_{jt})	0.7496	1.1751	1.1905	1.1091	1.0195	1.1684	0.9775
LC_rank *log(STK_detail_{jt})	-0.4500	-0.7054	-0.7146	-0.6657	-0.6120	-0.7014	-0.5868
LC_rank^2 *log(STK_detail_{jt})	0.0751	0.1177	0.1193	0.1111	0.1022	0.1171	0.0979
log($ModSTK\_clinical_{jt}$) *log(STK_detail_{jt})	0.1561	0.2447	0.2479	0.2310	0.2123	0.2433	0.2036
log($STK\_journal_{jt}$)	0.1850	0.2900	0.2937	0.2737	0.2516	0.2883	0.2412
log(STK_DTCA_{jt})	0.0112	0.0176	0.0178	0.0166	0.0152	0.0175	0.0146
log($STK\_lc\_NC_{jt}$)	0.0437	0.0685	0.0694	0.0647	0.0594	0.0681	0.0570
log($STK\_lc\_C_{jt}$)	0.0445	0.0697	0.0707	0.0658	0.0605	0.0693	0.0580
log($STK\_rh\_NC_{jt}$)	0.0330	0.0517	0.0524	0.0488	0.0449	0.0514	0.0430
log($STK\_rh\_C_{jt}$)	-0.0896	-0.1405	-0.1424	-0.1326	-0.1219	-0.1397	-0.1169
log($STK\_se\_NC_{jt}$)	-0.0769	-0.1206	-0.1222	-0.1138	-0.1046	-0.1199	-0.1003
log($STK\_se\_C_{jt}$)	0.0176	0.0276	0.0279	0.0260	0.0239	0.0274	0.0229
log(STK_debate_{jt})	-0.0204	-0.0320	-0.0324	-0.0302	-0.0277	-0.0318	-0.0266

Conclusion

- Our results suggest that not all forms of publicity are equal.
  - Reducing heart disease publicity plays a non-trivial role in market expansion
  - Compared with detailing and journal advertising, publicity plays a relatively minor role in determining brand choice.
- We find evidence that Lipitor and Crestor may free-ride on the landmark studies for older statins.