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Mariana Carrera
Niels Skipper

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Do Physicians Follow the Golden Rule? Evidence of Imperfect Agency and Moral Hazard from Physicians' Self-Prescriptions

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ABSTRACT

Using data on prescriptions for cholesterol-lowering drugs (statins), we study differences in the treatments chosen by Danish physicians for themselves versus for their patients. We estimate that physicians discount patient health benefit relative to their own, valuing the additional potency of a stronger statin by significantly more if it is for their own use. We exploit variation in expected coinsurance to estimate that moral hazard accounts for a modest share, no more than 15%, of this additional valuation. Statin-using physicians also respond more quickly to a patent expiration, suggesting greater effort to stay informed on drug classes they personally use.

Mariana Carrera
Montana State University
and NBER
mariana.carrera@montana.edu

Niels Skipper
Aarhus University
Department of Economics and
Business Economics
nskipper@econ.au.dk

1. Introduction

Patients rely on physicians to select medical treatments for them, but physicians may face incentives that are misaligned with those of their patients (Arrow, 1963). For example, numerous studies show that private financial incentives influence physicians' use of costly medical services (see McGuire, 2000, and Johnson, 2014 for reviews). In many countries with national healthcare systems, physicians serve as dual agents, asked to act not only in the interest of patients but also as stewards of health care resources (Blomqvist, 1991). We explore how physicians discount their patients' potential health benefits, relative to how they value those benefits for themselves, when encouraged by payers to limit healthcare expenditures. If physicians systematically choose different treatments for themselves, they are not acting as perfect agents who help the patient demand "exactly those quantities of care that the patient would have chosen if he had the same information and knowledge the physician has" (Pauly, 1980). Importantly, the welfare implications depend on whether the physician's choices for self-treatment are socially optimal or distorted by moral hazard. In the presence of generous insurance, physicians may demand more than the efficient allocation of higher cost treatments for themselves.

In this paper, we study the cholesterol-lowering drugs chosen by primary care physicians in Denmark for their own use versus for their patients, from 2004 to 2015. Physician-patients are far more likely to personally use newer statins, which are both more effective in lowering cholesterol and more expensive than the older drug (simvastatin) recommended by the government. We exploit the patent expiration of one of the stronger statins, Lipitor (atorvastatin), to measure physicians' price elasticity of demand for statin potency and quantify the additional government expenditure physicians are willing to exchange for their own versus for their patients' benefit. We

then use variation in physician-patients' expected marginal coinsurance rate to estimate physicians' out of pocket willingness-to-pay and the moral hazard distortion.

In addition, we propose a new channel through which imperfect agency operates: physicians may expend greater effort, via information search, when choosing a drug for their own treatment. The potential for private health benefit may increase the incentive to follow news about price changes and clinical developments. If this acquired information is applied when prescribing to other patients as well, patients of statin-using physicians may receive different prescriptions than patients of non-statin-using physicians, as we find.

The Danish context is well-suited for studying physician agency and its welfare impacts. Physicians commonly self-prescribe, rather than relying on colleagues or visiting other physicians. Under a universal healthcare system, physicians and non-physicians have the same prescription drug coverage. This ensures that physicians are well aware of how patients' out-of-pocket costs are determined, unlike in the fragmented U.S. healthcare system. Importantly, physicians operate without direct monitoring of their prescribing patterns and do not have financial incentives to prescribe one statin over another. Lastly, our ability to link Danish prescribing claims with register data on employment, income, and education allows us to control for socio-economic factors which may influence price sensitivity, liquidity constraints, and general knowledge related to the use of chronic preventative drugs.

Our first key finding, that physician-patients are far more likely than other patients to be prescribed stronger statins, is robust to a broad range of controls for cardiac risk factors, past cardiac events, and socioeconomic characteristics. Our estimates suggest that Danish physicians value the added potency of the strongest statin, Crestor, by an additional 7.87-11.20 Danish Krone (DKK) per day, or DKK 2,873-4,088 per year (approximately US$ 440-625), when they

themselves, rather than a non-physician patient, stand to benefit from the drug, with the government covering three-quarters of this cost.

We then test whether this added valuation for more potent statins varies with expected out of pocket costs, driven by variation in expected coinsurance rates. The Danish coinsurance schedule for prescription drugs begins with a yearly deductible, after which cost sharing decreases with various thresholds of spending. We estimate that among physician-patients who can expect, based on low pharmaceutical spending in the previous year, to pay the bulk (87% on average) of their annual statin costs out of pocket, drug choice is only somewhat more price sensitive than among those who can expect lower rates of cost-sharing. Their additional valuation is reduced by ten to fifteen percent. This suggests that moral hazard, while present, is not the key factor behind physicians' more frequent use of stronger statins.

Our study contributes to an emerging literature on the choices of physicians as patients. Much of this literature has focused on the additional information possessed by physicians as "expert" patients. When being treated by other providers in a fee-for-service system, this information "can serve as an effective counterweight" against provider-induced demand (Johnson and Rehavi, 2016). But when a costly treatment is rationed by clinical guidelines, medically trained patients are more likely to bypass the guidelines to obtain it (Greve, Kristensen and Lydiksen, 2023). Recent work evaluates whether physician-patients adhere to medical guidelines to a greater degree than other patients in two settings. Frakes, Gruber and Jena (2021) find that physicians in the U.S. military health system are only slightly more likely to follow recommended best practices for high-value care; *e.g.* 75 percent of diabetic physicians use a statin, versus 71 percent of diabetic non-physician patients. In the context of Sweden, Finkelstein et al. (2022) study differences in adherence to medical guidelines between patients with access to expertise (doctors and their

relatives) and those without it. In the case of four specific guidelines about statin treatment, there are no significant differences, although their general finding is that physicians and their family members have lower adherence to medication-related guidelines.[1,2]

Our work makes three contributions to this literature. First, we focus on differential treatment along the intensive margin (choice of statin drug) in a drug class where the higher cost treatments are also more effective.[3] Unlike patients' adherence decisions, the drug prescribed is chosen by the physician. Thus, our focus is not on the information advantage of a physician-patient, but on agency; self-prescribing physicians need not rely on another person to choose a drug for them. Our finding that these physicians are more likely to use stronger and higher cost treatments than other patients suggests that they perceive these treatments as valuable. That they do not prescribe them more widely therefore implies a trade-off between cost-saving (the explicit goal of the relevant prescribing guideline) and dissemination of higher-quality treatments. This finding supports Finkelstein et al.'s conclusion that "access to expertise gives patients [who are physicians or related to one] information or confidence that prompts them to disregard guidelines that they do not perceive to be in their clinical interest" (Ibid., 4).

Second, we use variation in expected cost-sharing to assess the role of moral hazard, which is crucial for welfare implications: Should physicians be prescribing stronger statins more broadly to

[1] See Finkelstein et al. (2022), Figure 1 for the point estimates and confidence intervals regarding statin use following diagnoses for heart attack, stroke, and ministroke. For "Take statins 0-1m after ischemic stroke diagnoses" the point estimate for access to expertise is negative but small, with the confidence interval ruling out a difference of around 4 percentage points. For the other three statin-related guidelines, point estimate markers lie on the zero line with tight confidence intervals.

[2] Boone (2024) discusses how physicians using discretion with clinical guidelines may yield better outcomes for patients in the context of hypertension diagnoses and treatment.

[3] Bronnenberg et al. (2015) study brand choice in the over-the-counter setting, holding active ingredient constant. They find that physicians and other health professionals purchase store-brands (*e.g.* generic ibuprofen versus Advil) more often than the general population, because they are better informed about the (lack of) differences between brand and generic versions of the same drug. In our context, however, there are important differences between the competing statins available for prescribing.

others, or less often to themselves? We find that physicians' own valuation of stronger statins is sufficiently large, even under a high expected coinsurance rate, to suggest that on the margin, the stronger statins are underutilized.

Third, our finding that patients of physicians who personally use statins are more likely to be prescribed atorvastatin after its patent expiration suggests a new channel through which imperfect agency, combined with inattention, can influence patient outcomes. Keeping up-to-date with medical advances has been noted as a theoretical example of costly, non-contractible effort that physicians might skimp on, but non-monetary factors motivating this effort have not been empirically studied.[4] To the best of our knowledge, the only other study of how physicians' lives shape their clinical practice is a concurrent paper by Gortz, Kristiansen, and Wang (2025) finding that male primary care physicians with daughters provide better care to female patients.

More broadly, our findings add to a literature on moral hazard in healthcare and the effects of prices and insurance on prescribing (see, *e.g.* Aron-Dine et al., 2015; Scott Morton and Kyle, 2011) and a separate literature exploring imperfect agency through the comparison of experts' choices for themselves versus others (*e.g.* Levitt and Syverson, 2008).

This paper proceeds with background on the relevant institutions and drugs (Section 2) followed by the data and our sample (Section 3). In Section 4, we provide descriptive comparisons of statin use between physicians and non-physician patients and discuss several possible explanations for the observed differences. Section 5 describes our methodology, Section 6 presents results, and Section 7 concludes.

2. Background

[4] In defining "quality" as a non-contractible input into the production of health for the patient, McGuire (2000) quotes McCall (1996): "several time-consuming activities, vital to providing good medical care, pay doctors nothing or next to nothing [including] conducting careful medical interviews, educating patients, staying up-to-date with medical advances."

In this section, we provide background on the Danish healthcare system, the statin drugs available during the time period we study, and national prescribing guidelines.

2.1 The Danish Healthcare System

Denmark has universal, tax-financed health insurance. Prescription drug coverage is part of the public health insurance plan and includes patient cost-sharing, with co-insurance rates determined by a patient's yearly accumulated expenditures on prescription drugs. Patients pay the full cost of prescription drugs up to the first DKK 925 (deductible).[5] After this threshold, the co-insurance rate is 50%. After reaching DKK 1,515 in annual expenditure, the coinsurance rate is reduced to 25%, and after reaching DKK 3,280 it is reduced to 15%. Finally, when expenditures reach DKK 17,738, the patient has met their out-of-pocket maximum (DKK 3,830), after which any additional drug purchases are fully covered. One year after the first purchase, the individual account is reset, and the deductible applies again on the next purchase, which marks the start of the next annual cycle. This is the only plan available, and there is no premium associated with it.

Pharmaceutical companies set their prices freely, reporting them to the Danish Medicines Agency every other week. One retail price applies uniformly at all pharmacies. For off-patent drugs, a reference price system sets reimbursement at the level of the lowest cost generic for a specific strength.[6] Generic substitution is mandated and required for insurance coverage in this setting, and observed fills of the branded version decline rapidly after patent expiration.[7] For this reason, we

[5] DKK 925 is approximately €120. Slight adjustments are made annually to the thresholds to correct for inflation. These were the thresholds in 2015.

[6] Consequently, patients receive reimbursement only up to the subsidy amount they would receive if purchasing the cheapest generic, regardless of the actual price paid. Furthermore, only the cost of this lowest-priced generic contributes to the patient's yearly expenditure thresholds in the prescription drug plan.

[7] For instance, the market share of "Lipitor" (name-brand) atorvastatin dropped from 43% in the first quarter of 2012 down to 3% in the fourth quarter, decreasing further to just 0.5% of atorvastatin prescriptions by 2015.

group prescriptions at the molecule level in our analysis, and assign prices based on the subsidy price (i.e. the price of the lowest cost generic).

General practitioners in Denmark play a role equivalent to primary care physicians (PCPs) in the U.S., so we refer to them as PCPs for simplicity. They serve as gatekeepers for specialists, who are located at hospitals. PCPs write more than 90% of outpatient prescriptions and account for 70% and 95% of statin initiations and total statin prescriptions, respectively.

Physicians are contractually required by the government to help ensure economically responsible use of pharmaceuticals.[8] To aid them in doing so, the Danish Institute for Rational Pharmacotherapy issues treatment recommendations based on comparative cost-efficacy, discussed in Section 2.3.

Finally, direct-to-consumer advertising for prescription drugs is illegal in Denmark, but drug companies advertise to doctors through journal advertisements and detailing. Importantly, free samples are highly limited, helping ensure that doctors have no special access to branded drugs outside of the prescription claims we observe. Unlike in other countries, self-prescribing by physicians is accepted and common. Of the physicians using statins in our sample, we estimate that 93% wrote their own prescriptions.[9]

2.2 The Statin Drug Class

Because of their proven efficacy at reducing cardiac events, statins are the most widely prescribed class of cholesterol-lowering drugs and one of the most highly utilized drug classes overall. We study the choice between three statins which account for 97% of statin prescriptions from 2004 to

[8] Danish GPs' contract with the state. Contract. 2006. Lauridsen, Norup and Rossell (2008).

[9] Prescribers are identified in the claims by their clinic, which means that when a clinic has two or more physicians, we do not observe which physician wrote the prescription.

2015 in Denmark.[10] One of these, simvastatin, was available in generic formulations for that entire time period, and consequently, sold at a lower price than the branded statins. In November 2011, the patent for Lipitor (atorvastatin) expired, and generic entry followed rapidly. Its price dropped from DKK 5.98 to 0.50 in 2012 and further to 0.33 in 2013, where it remained stable (see Figure A1).

A unique feature of the statin drug class is that there are well-quantified differences in the potency of each drug for reducing cholesterol levels. Simvastatin is less potent than Lipitor (atorvastatin) and Crestor (rosuvastatin), as shown in Appendix Table A1. Although any statin can be prescribed in a higher dose to achieve larger cholesterol reductions, high doses are used less frequently than low or moderate doses. This is because for each statin, higher doses cause more side effects, primarily muscle pain and digestive problems (Jaam et al. 2022). There is no clinical evidence that either atorvastatin or rosuvastatin are more likely to cause side effects than simvastatin at equivalent dosages.

This period coincided with an expansion in the evidence supporting the use of statins in a broader population and the use of stronger statins in particular. On November 20, 2008, the JUPITER study was published in *The New England Journal of Medicine* (JUPITER Study Group, 2008), finding that apparently healthy individuals, with low-to-normal LDL levels and no known cardiovascular disease, but elevated markers of inflammation, could reduce their risk of major cardiovascular events by taking Crestor (rosuvastatin).

2.3 Prescribing Guidelines

The Danish Institute for Rational Pharmacotherapy's first-choice treatment recommendations in all drug classes are communicated to physicians via monthly bulletins. At the start of the time

[10] Since the remainder are divided among different drugs with miniscule shares, we include only these three statins in our sample.

period we study, the first-line recommendation for the statin drug class was simvastatin (brand-name *Zocor*), the only commonly used statin available as a generic. If the targeted reduction in cholesterol was not achieved, then switching to a more potent statins, namely atorvastatin (*Lipitor*) or rosuvastatin (*Crestor*), was recommended. After the release of JUPITER study results, there was public debate about whether Crestor should become the first-line recommendation, but no official change was made.[11] After Lipitor's transition to generic status in November 2011, generic atorvastatin joined simvastatin as a recommended first-line statin. Later, in 2016, the US Preventive Service Task Force (USPSTF) released new recommendations moving away from specific targets of cholesterol levels and instead promoting more general use of statin therapy in adults aged 40 to 75 with at least one other cardiovascular risk factor (hypertension, diabetes, dyslipidemia, or smoking) (Pagidipati, et al., 2017).

While the data show that the vast majority of treatment initiations are in line with Danish guidelines, there is no monitoring nor potential consequences of prescribing that disregards these guidelines. Primary-care physicians do not receive fees for prescribing medications and face no financial incentives to favor one statin over another.

3. Data and Sample

We use administrative data on all statin prescriptions over the period 2004-2015 provided by the Danish Health Data Authority. The claims data contains date of purchase and information on the prescribed drug (price, quantity, molecule, brand/generic) as well as identifiers for both patients (*personnummer*/social security number) and prescribers (*ydernummer*/clinic ID). Importantly, we can link physicians by *personnummer* to the clinics where they work, allowing us to identify statins

[11] Discussion found in physician bulletin *Månedsskrift for Almen Praksis*, April 2009 (in Danish)

used by primary care physicians for their own treatment. We merge in selected medical claims information as well as demographic data provided by Statistics Denmark.

3.1 Sample Definition

Our analysis is focused on statin prescriptions written by general practitioners (PCPs) as opposed to specialists.[12] Not only are PCPs responsible for 95% of statin prescriptions, but they have substantial experience prescribing statins and are more likely to self-prescribe them for personal use. Henceforth, we use "physician-patients" to refer to PCPs purchasing statins for their own use. For comparability, we also limit our non-physician sample to prescriptions written by PCPs.

In order to draw valid comparisons of statin usage between non-physician and physician-patients, we focus on employed adults ages 40-70. While this age range covers only 21% of all statin users, it captures 98% of physician-patients using statins. Because active PCPs are necessarily employed, and employment is positively correlated with health and income, we only consider employed adults. In addition, to home in on physicians' treatment choices for patients they have an opportunity to treat, we limit the non-physician sample to patients who had at least one PCP contact, via either office visit or telehealth, in a given year.[13] The total number of year-by-individual observations is 5,570 for physician-patients and 1,197,637 for non-physician patients.

For some subsample analyses, we focus on the 31.1% of statin prescriptions from PCP clinics in which there is only one prescribing physician, i.e. solo practices. These prescriptions can be linked

[12] All results are qualitatively similar when we include prescriptions written outside of PCP clinics. However, these are primarily from hospitals, in which case we do not observe prescriber identifiers. Therefore, we cannot look specifically at prescriptions written by cardiac specialists, for example.

[13] This yields an unbalanced panel over the 2004-2015 period, since some patients saw PCPs in only some of the years, and patients can age into or out of the sample.

to the age, gender, and statin-using status of the prescriber. For prescriptions originating in joint practices, by contrast, we do not observe which physician wrote each prescription.

3.2 Demographic and Health Variables

Demographic variables include age, sex, education level, and income. Age and sex are known correlates of cardiac risk while education and income could influence the physician's perception of a patient's price sensitivity and likely compliance.

Cardiac risk-related characteristics correlate with both extensive margin use of statins and choice of different statins (Dunn, 2012). To capture risk factors beyond age and sex, we construct the Charlson Comorbidity Index[14] (Charlson et al., 1987) and use indicators for prior hospital admissions for acute myocardial infarction (AMI, *i.e.* heart attack), cerebral infarction (stroke), and transient ischaemic attack (mini-stroke) within the past five years. We also include the sum of total inpatient hospital days in the previous year. These are all measures used in other research examining adherence to guidelines for statin prescribing (Finkelstein et al., 2022; Frakes, Gruber, and Jena, 2021).

In addition, we observe patients' use of other prescription drugs indicative of cardiovascular risk factors, designated as 'indicator drugs' for statin treatment by the Danish Health Authority: nitrates, acetylsalicylic acid, beta blockers, anti-diabetic agents, diuretics, ACE-inhibitors, ARBs, and warfarin and indicate treatment for hypertension, diabetes, dyslipidemia. [15]

3.3 Descriptive Statistics: Statin Prescribing and Statin Users

[14] We construct the Charlson Comorbidity following Quan et al. (2005).

[15] The Danish Health Authority created this list of indicator drugs in order to flag for physicians those patients who could benefit from statin therapy according to the risk factors highlighted in 2016 US guidelines. Our sample ends in 2015, prior to the formal release on these updated recommendations. However, this formal change followed years of debate and a gradual shift in clinical practice.
https://www.sst.dk/da/rationel-farmakoterapi/maanedsbladet/2011/maanedsblad_nr_4_april_2011/kolesterol_-_hvornaar_er_forebyggende_behandling_med_statin_indiceret (In Danish)

Prior to Lipitor's patent expiration, 84% of filled prescriptions were for simvastatin, 10% for Lipitor, and 6% for Crestor.[16] Lipitor/atorvastatin's prescribing share increased rapidly following its patent expiration, reaching 33% in 2015 (see Appendix Figure A2).

Table 1 shows descriptive statistics for our sample, based on the first observed fill of each individual in the 2004-2015 time period. We distinguish between those who were already using statins before 2004 (112,163 non-physicians, 300 physicians) and those who purchased their first prescription in our observation period (171,588 non-physicians, 834 physicians). For pre-2004 users, physician statin users are on average older (59 vs. 54 years) and more likely to be male (86%) than non-physician statin users (67%), reflecting that males are overrepresented in the medical profession. Only 5% of non-physicians have a Master's degree or higher education level, and the average physician earns 2.4 times as much as the average non-physician in the sample. These differences in demographics are similar for those initiating treatment during our sample period.

Table 1 also shows how indicators of health status vary between the non-physician and physician statin users in our sample. Comparing the first two columns, non-physician statin users appear to be in worse health than physician statin users based on the Charlson Comorbidity Index (0.44 vs. 0.32, $p<0.001$), past cardiac events, and higher hospitalized inpatient days (9.7 vs. 6.5, $p<0.001$). However, among those initiating statin treatment during our sample period, these characteristics do not differ between physician patients and non-physicians. Very few statin initiators have had a prior AMI or stroke; this is consistent with our sample restriction to patients being prescribed a statin in primary care rather than at a hospital.

[16] While these numbers pertain to our sample of employed individuals ages 40-70, the distribution is similar when including prescriptions outside the sample: 85.0% for simvastatin, 10.2% for Lipitor, and 4.8% for Crestor.

Despite the fact that Charlson scores and past hospitalizations suggest pre-2004 physician statin users are in better health than non-physician statin users, physicians are more likely to be using at least one indicator drug among pre-2004 users (81% vs. 73%, $p<0.001$) and statin initiators (64% vs. 53%, $p<0.001$). Their number of distinct indicator drugs is also significantly higher, with physician-patients averaging 1.97 and 1.24 indicator drugs among pre-2004 users and statin initiators, respectively. This likely reflects that physicians are generally more likely to use prescription drugs than non-physicians (Anderson et al., 2023). In Tables A2 and A3, we report usage rates of specific indicator drugs as well as standard deviations for all variables. Physicians appear more likely than non-physician patients to use antihypertensive medications and warfarin, an anticoagulant.

Lastly, Table 1 reports the share of patients who reached each of the co-insurance levels described in section 2.1 in the prior subsidy year. Consistent with their higher usage of indicator drugs, physicians are 15 percentage points less likely to have remained in the deductible region the entire previous year.[17] While reaching the out-of-pocket maximum is rare (<1%), physicians are more likely to be in the penultimate co-insurance tier of 15%. Overall, this is consistent with physicians using more chronic drugs and implies that on the margin, physician-patients pay smaller out-of-pocket prices for their statin prescriptions than nonphysicians.

4. Statin Usage of Physician- and Non-Physician Patients

This section describes the differences in statin usage between the physician-patients and non-physician patients in our sample. In Section 4.1, we show that physicians and comparable non-

[17] Recall that the deductible is met once annual pharmaceutical expenditures have reached DKK 925 (approximately €120). Therefore, physicians are more likely to have exceeded this threshold of spending.

physicians are similarly likely to use a statin on the extensive margin. On the intensive margin, however, we see striking differences (Section 4.2) and discuss possible explanations (Section 4.3).

4.1 Extensive Margin: Physician-patients use statins at similar rates as non-physicians.

The use of statins increased from 5.8% to 13.4% of the adult population in Denmark over the period we study, and Figure 1 shows how their usage evolved among PCPs and non-physicians.[18] While the trends over time are quite similar, the share of PCPs using statins is consistently about 4 percentage points larger (Panel A). Panel B shows that age and sex differences explain most of this gap. The regressions presented in Appendix Table A4 confirm that with controls for demographic factors and health indicators, physician-patients are no more likely to use a statin on the extensive margin than non-physicians. This is consistent with the findings of Frakes, Gruber, and Jena (2021) and Finkelstein et al. (2022) that extensive margin statin use among populations with relevant comorbidities is largely comparable between physicians and non-physician patients.

4.2 Intensive Margin: Physicians are more likely to use stronger statins.

Turning to the choice of statin, we plot raw shares in Figure 2, with panels on the left-hand side reflecting all statin users in each year, and panels on the right-hand side reflecting initiations of statin treatment. Several patterns emerge from these figures.

First, recall that the national prescribing guidelines specified simvastatin for initial treatment up until 2012 when Lipitor became available as a generic. The panels on the right-hand side show that prescribers adhered closely to this guideline, with 98% of non-physician patients starting treatment with simvastatin prior to 2012. By contrast, 10-20% of physician-patients started with either Lipitor or Crestor during this period.

[18] Within our sample of employed persons, ages 40 to 70, statin usage rates increased from 4.1% in 2004 to 8.7% in 2015.

One interpretation of this difference on its own could be that physician-patients are likely to disregard the guideline for starting with simvastatin if they believe a stronger statin will be a better match for them, whereas non-physician patients would be receive simvastatin first, before a switch to their "better match" drug. If this were the case, we would expect convergence in "all prescriptions," but we see no evidence of this in the left-side panels. Both physicians and non-physicians receive stronger statins at higher rates in "all prescriptions" than in initial prescriptions, but the gap between physicians and non-physicians is no smaller.

The prescribing shares in Figure 2 also reveal a sharp prescribing response to Lipitor's patent expiration, with a faster increase in the use of Lipitor among physician-patients. Lastly, recall that a clinical trial showing a strong positive effect of Crestor on mortality was published in late 2008. From 2008 to 2011, it appears that physician-patients grew increasingly likely to receive Crestor when initiating statin treatment, although this reversed upon Lipitor's patent expiration. Meanwhile, the rate of non-physician patients initiating treatment with Crestor never exceeded one percent.

To verify that physicians' higher use of stronger statins is not explained by differences in demographic factors or health conditions, Figure A4 shows the differences by year between physician-patient and non-physician use of each drug, controlling for all the variables summarized in Table 1.

4.3 Potential Reasons for Physicians' Higher Use of Stronger Statins

The prior section shows that to the extent we can observe them, neither cardiac risk factors (age, sex, chronic conditions and Charlson comorbidity score, past cardiac events) nor socioeconomic status explain physicians' higher use of stronger statins relative to non-physician patients.

A natural question to ask is whether doctors are internalizing their patient's compliance decision and avoiding prescribing the stronger drugs because of their higher prices. While they themselves may prefer to pay higher prices for a more potent statin, physicians may fear that the added out-of-pocket costs would lead patients to delay or avoid refilling prescriptions for more costly statins. While we cannot rule out this concern on the part of the physician, several facts suggest that it is not likely to account for a large share of the prescribing difference we observe. First, statin persistence and adherence are relatively high in Denmark: Svensson et al. (2015) find 84% persistence and an average medication possession ratio (MPR) of 93% for Danish statin users in 2004-2010. They report that nonpersistence is more common among young (age<45) and very old (age>75) patients, implying higher rates of persistence for our sample of employed adults of ages 40-70.

Second, out-of-pocket costs in the Danish system are capped at a level quite low by U.S. standards, equivalent to approximately $600/year for all prescription drugs. The difference in average out-of-pocket costs was approximately 3 DKK per day (less than $0.50 USD) between Lipitor and simvastatin in the period before Lipitor's patent expiration (see Appendix Figure A3). Using prior estimates of the price elasticity of adherence in the Danish setting, we would expect this difference to reduce adherence by an arguably insignificant 2.7 percentage points (Koulayev, Simeonova, and Skipper, 2017). Furthermore, studies in the U.S., where cost-related adherence to statins is indeed a policy concern among low to middle income populations, find that higher income patients are far less price-sensitive—in some populations, not at all—in their adherence decisions.[19] Yet, controlling for income and education has little effect on our estimates.

[19] Carrera et al. (2018) estimates the price-sensitivity of statin adherence in a U.S. sample of employer-sponsored plans. For patients with salaries below $50,000, a $10 increase in monthly copay reduces adherence probability by 3.3 or 7%. For patients with salaries above $80,000, adherence is both higher at baseline and much less elastic, with

The third relevant fact is that after Lipitor's patent expiration, when it becomes nearly as inexpensive as simvastatin and joins simvastatin as a recommended first-line treatment in the government's prescribing, physicians remain more likely to receive Lipitor in both initial and non-initial prescriptions (see Appendix Figure A4, Lipitor panels). This suggests that concerns about patients' out of pocket costs and potential non-adherence cannot explain all of the differences in prescribing that we see.

Another potential reason why physicians choose stronger statins for themselves is that they perceive greater uncertainty associated with newer and more potent medications, and take a more risk-averse approach in prescribing to their patients than to themselves. This could follow from malpractice or reputation concerns, but we would expect these concerns to diminish as the clinical evidence base supporting a newer drug grows stronger. In the case of statins, the evidence base in support of Crestor in particular, and high intensity treatment more generally, increased significantly with the publication of the Jupiter trial in late 2008. Instead of leading to a decrease in the gap between physicians' and non-physicians' receipt of Crestor or Lipitor, this appears to have led to an increase in the gap, as only physicians began receiving Crestor at higher rates.

Physicians' increasing use of Crestor after new evidence of its efficacy, as well as their faster uptake of generic atorvastatin after Lipitor's patent expiration, suggests physicians may pay closer attention to developments in the statin drug class when they themselves use a statin. This hypothesis, which we explore further in Section 5.4, is consistent with imperfect agency: physicians may care more about their own health benefits and thus have a greater incentive to seek information.

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a $10 copay reducing adherence probability by less than one percentage point. Similarly, among VA patients, Kazerooni, Bounthavong, and Watanabe (2013) found that the statin adherence of those in the bottom three quintiles of income was significantly affected by copay, whereas that of patients in the top two quintiles was not.

Taken together, these findings suggest that physicians view the more potent statins favorably but are constrained from prescribing them more widely because of explicit guidelines or an implicit responsibility to internalize national healthcare costs. This motivates our empirical analysis using drug price changes to estimate by how much more physicians value their own treatment with a stronger statin.

5. Methodology

Here we present a simple model in which prescribing physicians trade off treatment quality against treatment costs differently for their patients and themselves. We discuss the identification of price effects in 5.2 and our empirical estimation in 5.3.

5.1 Conceptual Framework

We first consider a physician choosing a drug to self-prescribe for own use. Assuming perfect information on the prices of drugs and their expected therapeutic benefits, a self-prescribing physician will choose the statin *j* that maximizes the utility function:

$$U_{ijt} = \mathrm{E}\left[w_{ij}\middle|X_i\right] - \alpha\,\mathrm{E}[\mathrm{OOP_{ijt}}] - \Phi P_{\mathrm{jt}} - C * 1\{j \notin R_t\} + \epsilon_{ijt} \qquad (1)$$

where $\mathrm{E}[w_{ij}|X_i]$ is the expected health benefit of drug *j* for physician-patient *i* with characteristics X_i, P_{jt} is the drug's price in period *t*, and E[OOP] is the expected amount of that price paid out-of-pocket. While α captures a physician-patient's *additional* price sensitivity to expected costs paid out-of-pocket, Φ captures the general disutility of the total price, whether it is paid by the patient or the government insurer. If moral hazard is present, we expect $\alpha > 0$, indicating a stronger response to out-of-pocket costs than to government paid costs. If the prescriber perceives additional disutility for prescribing a drug that is not currently recommended by the government as a first-line statin, $C > 0$ captures that disutility. The indicator function $1\{j \notin R_t\}$ activates C

when drug j is not in R_t, the set of guideline-recommended choices at time t. This set includes only simvastatin until late 2011 when atorvastatin (generic Lipitor) is added.

The average physician's willingness to pay for a stronger statin's health benefit relative to simvastatin, for self-treatment, is the difference between drug j's $\mathrm{E}[w_{ij}|X_i]$ and the expected health benefit from simvastatin, $\mathrm{E}[w_{i0}|X_i]$, divided by $\alpha + \Phi$.

In the case of prescribing to another patient, perfect agency would require that the physician maximize the same utility model, with equivalent parameters except for α, since other patients might face more disutility from out-of-pocket costs than physician-patients.

We propose the following utility model for the prescribing physician, with indicators for whether the physician is self-prescribing (*Self*) or prescribing to another patient (*Other*):

$$U_{ijt} = (\theta Other + 1Self)(\mathrm{E}[w_{ij}|X_i]) - (\tilde{\alpha}_i Other + \alpha Self)\mathrm{E}[\mathrm{OOP}_{ijt}]) - \Phi \mathrm{P}_{jt} - C * 1_{j \notin R_t} + \epsilon_{ijt} \quad (2)$$

We assume that both the disutility of the total price of the drug and the disutility of disregarding a guideline do not vary with who is receiving the drug. If $\theta < 1$ then the clinical value or efficacy of a drug will be weighted more heavily relative to cost when a physician prescribes to himself or herself than to another patient. We will test this empirically while controlling for health risk factors (in X_i) that might differ between physician-patients and others.

The parameter $\tilde{\alpha}_i$ represents the physician's sensitivity to patient i's out of pocket cost, which may differ from the α they use when self-prescribing. It might be smaller in magnitude ($\tilde{\alpha}_i < \alpha$) if the prescriber does not internalize patients' disutility of out-of-pocket costs. On the other hand, physicians may perceive that their patients are more price sensitive than they themselves are, in which case $\tilde{\alpha}_i$ might be greater than α.

5.2 Identification of price elasticity of prescribing

In order to quantify the additional value self-prescribing physicians place on a stronger statin when it is for their own use, we must credibly estimate the price elasticity of prescribing in this setting. Our sample contains both temporal variation in the prices set by drug manufacturers and a large drop in the price of atorvastatin when the patent of Lipitor expired. We consider these in turn:

First, there are well-known endogeneity concerns associated with prices chosen by manufacturers: price increases (decreases) may be responses to increases (decreases) in a product's demand or perceived quality. This leads estimated price elasticities of demand to be biased towards zero (Villas-Boas and Winer, 1999). Another challenge, specific to prescription drugs, is that prescribers are unlikely to be aware of recent price fluctuations when writing prescriptions. This also leads the estimated demand response to understate the prescriber's actual disutility from drug price.

Patent expirations, in contrast, generate a large and exogenous price shock that prescribers are more likely to observe given their media coverage. Thus, they are often used as instruments for price in models of prescribing demand (*e.g.,* Carrera et al., 2018; Grennan et al., 2024). In our scenario, however, the patent expiration of Lipitor coincided with its addition to the recommended list for first-line statin treatment. If prescribers respond to this change in recommendation for reasons unrelated to valuing government cost savings (if $C>0$ in equation 1), then using the patent expiration as an instrument for price will overstate the true effect of price on prescribing.

Given their expected biases in opposite directions, we will use alternate specifications that isolate each of these sources of price variation to bound physicians' price elasticity of prescribing and consequently bound our estimates of self-prescribing physicians' additional willingness to pay for stronger statins for themselves.

5.3 Empirical Framework

Building on the theoretical model of physician drug-choice behavior, we now outline our empirical approach. In the first set of specifications, we estimate one parameter capturing the overall disutility of drug price in the prescribing decision, disregarding whether that price is paid by the patient or the government insurer. This is equivalent to assuming no moral hazard, or $\tilde{\alpha} = \alpha = 0$ in equation 2. Let the indirect utility that the physician perceives from prescribing drug *j* to patient *i* in time *t* be:

$$U_{ijt} = (\alpha + \beta\ PhysicianPatient_i)\ w_j - \Phi \mathrm{P_{jt}} + \epsilon_{ijt} \qquad (3)$$

where PhysicianPatient is a dummy variable equal to one if the recipient of the prescription is a primary care physician. *w* represents the expected therapeutic benefit of a drug, which in some specifications we will capture with drug fixed effects and in other specifications with a unidimensional measure of clinical efficacy. The goal is to estimate the added monetary valuation a physician places on a drug of efficacy w_j when prescribing to himself or herself as opposed to another patient. This added valuation is estimated as β / Φ.

As a first pass at bounding the effect of price in prescribing within our model, following the approach motivated in section 5.2, we estimate this model using Lipitor's patent expiration as an instrument for price as well as using only other price variation. We apply the Berry (1994) inversion to linearize the demand model to market shares s_{jpt} of drug *j* within markets defined by year and physician vs. nonphysician patients (p = 1 for physician-patients and 0 otherwise), obtaining the following specification, where w_{jt} represents the expected clinical value of drug *j*.

$$\ln(s_{jpt}) - \ln(s_{0pt}) = (\beta_j PhysicianPatient + 1)(w_{jt} - w_{0t}) - \Phi(\mathrm{P_{jt}} - \mathrm{P_{0t}}) + \xi_{\mathrm{jt}} \qquad (4)$$

This equation can be estimated with OLS or IV, using Lipitor's patent expiration as an instrument for $(\mathrm{P_{jt}} - \mathrm{P_{0t}})$. The dependent variable is the difference between the log share of a stronger statin (j = {Crestor, Lipitor}) and the log share of simvastatin (j = 0) which we define as the baseline

choice or outside option. On the right-hand side, we include the price difference between drug *j* and simvastatin, fixed effects for Lipitor and Crestor to capture the average perceived added benefit of drug *j* relative to simvastatin, and interaction terms between the drug fixed effects and a dummy variable for physician (*PhysicianPatient=1*). We will report estimates of Φ, the prescriber's response to drug price, as well as estimates of $\frac{\beta_j}{\Phi}$, the additional price a prescriber would accept for drugs j = {Crestor, Lipitor} if the prescriber is also the patient receiving the prescription. As discussed earlier, we interpret the estimates of $\frac{\beta_j}{\Phi}$ as lower bounds on the valuation when using Lipitor's patent expiration as an IV for price, because the observed response to the patent expiration might overstate the price elasticity if prescribers are also influenced by the guideline change.

To estimate a lower bound on Φ and a corresponding upper bound on $\frac{\beta_j}{\Phi}$, we estimate two modified versions of equation 4 that include an indicator *Recommended* interacted with Lipitor, with and without an additional variable *Time Post Patent Expiration* to capture gradual diffusion of information regarding Lipitor's availability as a generic. By separately capturing the change in prescribing associated with Lipitor's patent expiration, these models allow us to estimate prescribers' price responsiveness to other price changes made by drug manufacturers, which we consider a lower bound on the true price effect.

The advantage of the log-shares approach is that it allows us to directly compare the results of this specification, the instrumental variables specification, and our main specification using all sources of price variation. The disadvantage is that we cannot include demographic or health control variables because the cell sizes are too small among the physician-patient subpopulations. For this reason, we only use the log-shares approach initially, to establish that the specification using patent expiration as an IV for price yields a similar estimate of price elasticity as a basic specification

using all sources of price variation and no instruments. In the rest of our results, we use a multinomial logit model where we can easily add control variables. Specifically, we estimate a multinomial logit model of drug-choice, McFadden's alternative-specific choice-model (McFadden, 1974).

We also adopt a more parsimonious model that estimates physicians' additional willingness to pay for added potency via one variable rather than separate estimates for Lipitor and Crestor. As a unidimensional measure of clinical efficacy, we use the expected percentage reduction of LDL cholesterol for each statin at its average dose. This measure has been used in prior research as a measure of comparative drug efficacy (*e.g.* Carey, Lieber, and Miller, 2021) and is appropriate in our setting under the assumption that the only reason physicians place greater value on Crestor and Lipitor is because of their greater efficacy. We rescale this value to range from 0 (simvastatin) to 1 (Crestor), with Lipitor roughly in the middle (0.54) and interact this value with the indicator for PhysicianPatient. We estimate:

$$U_{ijt} = \beta PhysicianPatient_i * Potency_j - \Phi \mathrm{P_{jt}} + X_i B * D_j + \epsilon_{ijt} \quad (5)$$

where $Potency_j$ is the degree to which drug j lowers cholesterol relative to simvastatin, the outside option. β captures the added valuation placed on the potency of drug j when the recipient is a PhysicianPatient. The model also includes intercepts for Lipitor and Crestor, D_j, which are interacted with covariates to allow patients of different ages, health conditions, and socioeconomic status to value drugs differently. The outside option, j = 0, again corresponds to generic simvastatin, and the unobservable ϵ_{ijt} is assumed to be a standard i.i.d. type I extreme value error term.

We consider both a sample of initial prescriptions and one of non-initial prescriptions. Because state dependence is strong in refills of chronic drugs, we control for the last-filled statin when

analyzing non-initial prescriptions (Feng, 2024). We estimate an upper bound on Φ in the above specification using all sources of price variation, and a lower bound by estimating the following specification, in which Lipitor's patent expiration is permitted to shift prescribing differently than other price changes over this time period:

$$U_{ijt} = \beta PhysicianPatient * Potency_j - \Phi \mathrm{P_{jt}} + \delta \mathrm{Recommended_{jt}} + \gamma \mathrm{TimeSince_{jt}} + X_i B * D_j + \epsilon_{ijt} \quad (6)$$

To test whether initial prescriptions in our setting are more sensitive to patients' out-of-pocket costs than to government-paid costs, we exploit the fact that patients with different levels of non-statin prescription drug usage face different marginal out-of-pocket prices for the same statins. Recall that a patient's coinsurance rate decreases from 100% (deductible region) to 50, 25, 15, and eventually 0%, as their pharmaceutical spending surpasses certain thresholds each year. For the sample of patients initiating statin therapy, we study how sensitivity to drug price differs with the lowest rate of coinsurance attained in the prior subsidy year, a proxy for the expected marginal coinsurance a patient will face for new statin prescriptions.

We estimate the following specification:

$$U_{ijt} = \beta PhysicianPatient * \ Potency_j - \Phi_1 \mathrm{P_{jt}} - \Phi_2 ExpectedOOP_{ijt} + XB * D_j + \epsilon_{ijt} \quad (7)$$

where *Expected OOP* is equal to the patient's previous year lowest coinsurance rate multiplied by $\mathrm{P_{jt}}$. Of course, having had higher prescription drug expenses in the past may correlate with need for a stronger statin for unobserved health reasons. Thus, we allow these groups to hold different baseline valuations of statin potency by including interactions between each tier of expected coinsurance and potency. The assumption necessary to yield valid estimates of self-prescribing physicians' added valuation of statin potency is that the unobserved health of physician-patients is not changing differently than that of nonphysician-patients across categories of prior year pharmaceutical spending.

Lastly, we also estimate a specification in which the response to expected coinsurance is allowed to vary between physicians and non-physician patients.

$$U_{ijt} = (\beta\, Self_i + \mathrm{X_i B})\, Potency_j - \Phi_1 \mathrm{P_{jt}} - \Phi_2 E\left[OOP_{ij}\right] - \Phi_3 Self_i * E\left[OOP_{ij}\right] + \epsilon_{ijt} \qquad (8)$$

In this specification, Φ_3 estimates any additional disutility a prescriber receives per unit of expected out of pocket cost for which the prescriber himself or herself is responsible, as opposed to a unit of expected out of pocket cost to be paid by another patient, and β divided by the sum $\Phi_1 + \Phi_2 + \Phi_3$ becomes the welfare-relevant parameter capturing the physician's added valuation of statin potency.

We estimate all empirical specifications on all initial prescriptions as well as on a subset limited to self-prescribing statin-using physicians and the patients receiving prescriptions from their clinics. This is the closest we can get to controlling for prescriber in this analysis, since it is not feasible to include fixed effects for over 1,000 clinics in the conditional logit model. Instead, we aim to rule out the possibility that physicians are disproportionately receiving prescriptions from doctors who value stronger statins more highly by limiting the sample to physicians and nonphysicians receiving prescriptions from the same clinics.

6. Results

In this section, we present results of the empirical specifications described in Sections 5.3-5.4.

6.1 Price Effects on Prescribing

First, in Table 2, we contrast the estimated effects of price on prescribing when including versus excluding Lipitor's patent expiration as a source of price variation, using the log-shares specification of equation 4. The disutility derived from the costs of the drug (Φ) is assumed to be the same whether it is a prescription for oneself or another, and regardless of the expected share of coinsurance. If physicians are more willing to prescribe expensive statins to themselves than to

their other patients, it indicates that they are willing to trade away a larger sum of patient and government expenditures for health benefit when they themselves are the patients receiving those benefits.

In column 1, the price coefficient of -0.28 estimates price sensitivity using all sources of price variation. In columns 2 and 3, we estimate price sensitivity from price variation *excluding* the price shock to Lipitor/atorvastatin following its patent expiration. In column 4 we show the IV estimates which instead isolate the effect of Lipitor's patent expiration on prices. Consistent with the direction of likely biases in each of these sources of price variation, the coefficient in the IV specification (-0.27) is larger in magnitude than the coefficient in the specification based on other price variation (-0.13). Also, the estimate from the OLS specification using all price variation (-0.28) is almost identical to that of the IV specification, because the patent expiration generated the largest price change during this time period. Our take-away from this analysis is that baseline estimates of price sensitivity are driven by the patent expiration of Lipitor and can be interpreted as upper bounds on prescribing responsiveness to price. When controlling for Lipitor's patent expiration, we obtain lower bounds on this parameter.

6.2 Physicians' Additional Valuation of Statin Potency for Self-Treatment

The estimates at the bottom of the Table 2 quantify, in Danish currency (DKK) per daily dose, physicians' additional willingness to pay for Lipitor or Crestor when they themselves, as opposed to another patient, obtain the clinical benefit. Since these values are computed by dividing the estimated additional utility physicians receive from these stronger statins by the estimated disutility in prescribing higher priced drugs, we obtain an upper (lower) bound in the specification that uses a lower (upper) bound for price responsiveness to prescribing. For initial prescriptions, these bounds indicate that on average, physicians are willing to exchange an additional DKK 7.68-

16.7 per day for Lipitor, and an additional DKK 9.98-21.7 per day for Crestor, if they themselves receive the drug's benefit. Based on the average coinsurance of 24% paid for statins, these values equate to an additional DKK 2130-4633 (approx. US$304-662) paid by the government per year and DKK 673-1463 (approx. US$96-209) paid by the physician-patient per year for Lipitor, or DKK 2768-6020 (approx. US$395-860) and DKK 874-1900 (approx. US$125-272) paid by the government and physician-patient, respectively, for Crestor.

Table 3 shows the estimates of equations 5 and 6, using the alternative-specific logit estimation to include controls for demographic factors and health indicators. The coefficient of interest, the interaction between physician-patient and potency, is strongly positive in all specifications. The main effect of potency is found to be negative, because in practice, non-physician patients receive Crestor and Lipitor far less often than simvastatin. At the bottom of Table 3, we report the estimates of $\frac{\beta}{\Phi}$, which quantifies physicians' additional willingness to pay for a drug of added potency = 1 (Crestor versus simvastatin) when they themselves obtain the health benefit. Columns 1 and 2 show estimates for the sample of non-initial prescriptions, and columns 3 through 6 for initial prescriptions. Adding patient-level controls for income and education slightly reduces the additional willingness to pay in both samples. Our estimate for non-initial prescriptions implies that a self-treating physician considering switching their own statin prescription is willing to accept a price difference between Crestor and simvastatin that is DKK 9.64 higher, and a price difference between Lipitor and simvastatin that is DKK 5.21 higher,[20] than she would accept for switching another patient of similar health and socioeconomic variables. For initial prescriptions, the physician's additional willingness to pay is reduced from 9.43 to 7.87 DKK with the addition of income and education controls. We interpret 7.87 DKK as the lower bound and the column 6

[20] This is DKK 9.64 multiplied by 0.54, Lipitor's potency on the scale from simvastatin (0) to Crestor (1).

estimate of 11.2 DKK as the upper bound, as we did in Table 2 for the corresponding specifications.

For completeness, we also estimate a version of the alternative-specific logit model that is more directly comparable to the log-share regressions reported in Table 2, replacing the potency variable with fixed effects for Lipitor and Crestor. The resulting willingness to pay estimates for the two drugs are broadly similar to those obtained from the log-share specifications in Table 2 (see Appendix Table A5).

In Appendix Table A6, we replicate Table 3 among the subset of patients receiving prescriptions from self-prescribing physicians who initiated their own statin treatment as well. This restriction reduces the sample by a little more than fifty percent but allows us to compare what physicians prescribe to themselves against what the same physicians prescribe to other patients. [21] The results do not change in any economically meaningful way.

6.3 Physicians' Additional Valuation of Potency by Expected Coinsurance Rate

Table 4 reports the estimates of equation 7, which adds the variable *Expected OOP* to the prior specifications. This variable represents the predicted marginal out-of-pocket payment for a new statin if other pharmaceutical expenses remain in the same range. Its coefficient is indeed negative and statistically significant ($p<0.01$), consistent with prescribers responding more strongly to the portion of a drug's price expected to be paid out of pocket. The relative magnitude of the coefficients suggests that expected out of pocket costs carry a disutility 9-19% larger than if they were paid by the government, depending on the specification.

[21] In our dataset, we identified 834 physicians who began using a statin during the observation period, with treatment initiated by a PCP. Of these, 776 (93%) had prescriptions issued within the clinics where they worked. These 776 prescribing physicians were employed across 837 different clinics throughout the sample period. Our sub-analysis focuses on the prescriptions issued within these clinics.

Estimates of the physician's added valuation of potency for self-treatment are shown at the bottom of the table for two scenarios: having reached 0% coinsurance in the previous year and having remained in the deductible region the entire previous year.[22] The estimates show a modest reduction, by 10-15%, when physician-patients expect to pay the majority of the costs themselves.[23] For example, in the column 2 specification, in which the entire prescribing response to Lipitor's patent expiration is attributed to its price drop, we find that if all costs are expected to be paid by the government, a physician-patient values a potency increase of 1 (Crestor over simvastatin) by DKK 8.35 per day more than the same potency increase is valued for a non-physician patient. If the drug costs are expected to be paid fully by the patient, the physician-patient values Crestor over simvastatin by DKK 7.60 per day more than they value it for another patient. In columns 2 and 4, we include drug-specific fixed effects for the lowest coinsurance tier reached in the previous year. These are jointly significant and result in smaller estimated effects of *Expected OOP* but have little effect on the estimated physician valuations.[24]

The Table 4 specifications rely on the assumption that the disutility of out-of-pocket drug costs does not depend on whether the patient receiving the prescription is a physician or not. In Appendix Table A7, we show the estimates of equation 8, in which we allow the sensitivity to expected out-of-pocket costs to differ between physician-patients and other patients. The estimated coefficient on Predicted OOP x Physician-Patient is significant and positive in all specifications, implying that prescribers are more sensitive to the out-of-pocket costs of their non-physician patients than to their own out-of-pocket costs. Taking this difference in price sensitivity into account suggests

[22] The valuation is calculated as $\frac{\beta}{\Phi_1}$ in the case of lowest expected coinsurance, and $\frac{\beta}{\Phi_1+\Phi_2}$ in the case of highest expected coinsurance.

[23] In our sample, the correlation in end-of-year coinsurance rates across spending years is 0.68. For the full sample of all prescription drug users in Denmark, the corresponding correlation is 0.69.

[24] Individuals without any prior spending are excluded in Table 4, as their prior end-of-year coinsurance rate is not defined. Including them and setting their prior end-of-year coinsurance to 100% yields similar results.

that physicians' willingness to pay ranges from DKK 7.70 to DKK 12.20 when faced with 100% coinsurance.

Overall, the results in Tables 4 and Appendix Table A7 suggest that moral hazard is not a major driver of physicians' greater willingness to choose costly drugs for themselves as opposed to other patients. Appendix Tables A8 and A9 show similar corresponding results for the sample restricted to statin-initiating physicians and their patients.

6.4 Interpreting Physician's Additional Valuation of More Potent Statins

We have thus far considered only the statin prescribed, not its dosage. The clinical literature groups different drug-dose combinations as "low intensity," "moderate intensity," and "high intensity" based on the expected level of cholesterol reduction. While the more potent statins allow for high intensity levels of cholesterol reduction with higher dosages, their lower dosages achieve similar levels of cholesterol reduction (moderate intensity) as simvastatin at high dosages. If physician-patients are not only receiving Crestor and Lipitor prescriptions at higher rates but are also obtaining higher intensity drug-dose combinations, our findings would indicate that physicians value the health benefits of cholesterol reduction more highly for themselves than for their patients. On the other hand, if physician-patients do not appear to be getting higher intensity treatment, as measured by the expected cholesterol reduction of each drug-dose combination, then their higher usage of Lipitor and Crestor would indicate their preference for a smaller dose of a more potent statin over a larger dose of a less potent statin.

To explore whether physician-patients are more likely to receive high-intensity treatment, we plot the shares of prescriptions for each statin-dose combination in Appendix Figure A5. Among physician patients, 8.4% (vs. 7.8% of non-physician patients) initiate treatment with a low-intensity statin, 88.0% (vs. 82.1%) with a medium-intensity statin, and 9.2% (vs. 3.5%) with a

high-intensity statin (see Appendix Figure A5). While there is a notable 5.7 percentage point difference in their receipt of high-intensity statins, there is also a stark difference in drug choice among medium-intensity statin prescriptions. To explore physicians' willingness to pay for Lipitor or Crestor conditional on medium-intensity treatment, we replicate Table 3 with a sample that excludes patients receiving either low-intensity or high-intensity statin prescriptions. Physicians still appear to have substantially higher willingness to pay for Crestor or Lipitor as opposed to simvastatin, compared to other patients (see Appendix Table A10).

These findings suggest that the higher use of Lipitor (and Crestor) among physician patients is not solely explained by differences in preferences for more aggressive cholesterol reduction, but in large part due to choosing a lower dose of a stronger statin over a higher dose of a less potent statin.

6.5 Imperfect Agency and Limited Attention

We now shift focus to examine how prescribing physicians react to major changes in a drug class. If physicians who take statins themselves have a stronger incentive to stay informed about the relative costs and benefits of different statins, they may pay more attention and respond more quickly to patent expirations or new clinical evidence. We test this hypothesis by comparing the prescribing patterns of statin-using physicians and other physicians after Lipitor's prescribing expiration. [25]

First, to check whether the patient base differs between physicians with and without personal experience, we compare their patients' demographics, health indicators, and prior year coinsurance in Appendix Table A11. We find no significant differences.

[25] We define statin-using prescribers, or physicians with statin experience, as those who filled at least one statin prescription prior to 2010, to ensure they had begun before Lipitor's patent expiration. We identify 961 PCPs who received statin treatment in 2010, including those who received prescriptions from hospitals rather than PCP clinics

Next, we see in Figure 3 that statin-using physicians are more likely to start new patients on Lipitor/atorvastatin than non-statin-using physicians after (but not before) its patent expiration.[26] Table 5 shows results of a difference-in-differences regression that includes year-quarter fixed effects, patient characteristics, and either physician characteristics, in columns 1 and 3, or physician fixed effects, in columns 2 and 4.[27] The estimated coefficient of 0.07 in column 2 is statistically significant and indicates that in the years following Lipitor's patent expiration, prescribers who were themselves statin users increased their prescribing of generic Lipitor (atorvastatin) by 7 percentage points more than other prescribers.

In columns 3 and 4, we add another dimension of physician heterogeneity that could influence the attention physicians devote to news about statins: the number of statin-using patients they serve.[28] Indeed, the results show that a physician's number of statin patients is positively associated with a larger response to Lipitor's patent expiration. Controlling for this, however, does not change the significance of statin-using PCP x post patent expiry. This analysis provides suggestive evidence that physicians have limited attention or time constraints in following drug class developments, and those with more to gain from new information on drugs' costs and benefits appear to become informed more rapidly. Treating a larger number of statin-using patients, and to a greater degree, being one of those patients, appear to increase the likelihood of staying well-informed.

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[26] We also explore whether statin-using physicians respond more strongly to the publication of the 2008 Jupiter study with greater prescribing of Crestor. Appendix Figure A6 shows these results, which are noisy and inconclusive due to the much smaller prescribing probability of Crestor.

[27] We estimate the following linear probability model, where the outcome variable is an indicator equal to one if patient *i* is prescribed Lipitor as the initial prescription by prescriber *j* at time *t*:

$$y_{ijt} = \beta_1 \cdot Exp_j + \beta_2 \cdot Exp_j \times Post_t + X_{ij}B \cdot + \tau_t + \theta_j + \varepsilon_{ijt}$$

The variable *Exp* is an indicator for whether physician *j* has personal experience with statins, and *Post* is an indicator for the period following Lipitor's patent expiration. The vector *X* includes patient and physician characteristics. The specification includes year-by-quarter fixed effects τ_t and prescriber fixed effects θ_j.

[28] We calculated the number of distinct patients who received a statin prescription from the physician's clinic in the year 2010, prior to the patent expiration.

7. Conclusion

We find that in a setting where physicians serve as dual agents for both patients and the national health insurance program, they are more likely to use newer, more potent and more expensive cholesterol-lowering drugs for themselves than for the average patient. This difference persists when controlling for indicators of health risk such as age, sex, and proxies for chronic conditions, as well as socioeconomic factors such as income and education. It also persists after one of the more potent drugs undergoes patent expiration and becomes available at a much lower price. These findings point towards an imperfect agency explanation rather than unobserved preference variation or responses to differential cost-sensitivity of non-physician versus physician-patients.

Does this agency problem have welfare costs, or does it reduce the social loss from moral hazard? Our findings indicate that even when physicians are responsible for paying almost the entire additional cost of a stronger treatment out of pocket, they remain willing to pay large premiums for a more potent drug. This suggests that national prescribing guidelines reduce welfare, in this setting, by leading physicians to underutilize therapies they frequently perceive as cost-effective for their own treatment.

In the prescription drug market, identifying first-best prescribing is notoriously difficult for several reasons. First, physicians may not observe the costs their patients face for different medications, nor their cost-sensitivity (Carrera et al. 2018). Second, patients may fail to fill a drug prescribed by their physician because they are misinformed or inattentive to its value (Baicker, Mullainathan, and Schwartzstein, 2015, Chandra, Flack, and Obermeyer, 2021). Third, physicians may not fully internalize a patient's expected utility from a drug, the agency problem we highlight in this work. As Sacks (2014) notes, when agency and information problems are intertwined, "market demand data do not necessarily reveal either patient or doctor preferences" (p. 4).

Our focus on physician self-prescribers overcomes several of these hurdles. A self-prescribing physician can access information about any drug's expected benefits, price, and out-of-pocket cost while evaluating options, and does not rely on an imperfect agent to select what he or she can purchase. Thus, our estimates of physicians' valuation of stronger statins, identified through their choices for their own use, also make a novel contribution. Our approach may be useful in future work exploring welfare impacts of institutional guidelines both in healthcare and other contexts. Lastly, while prior work has treated physician-patients as uniformly better informed than other patients, our paper introduces the notion that physicians with certain health conditions might endogenously acquire better information on the drug class.

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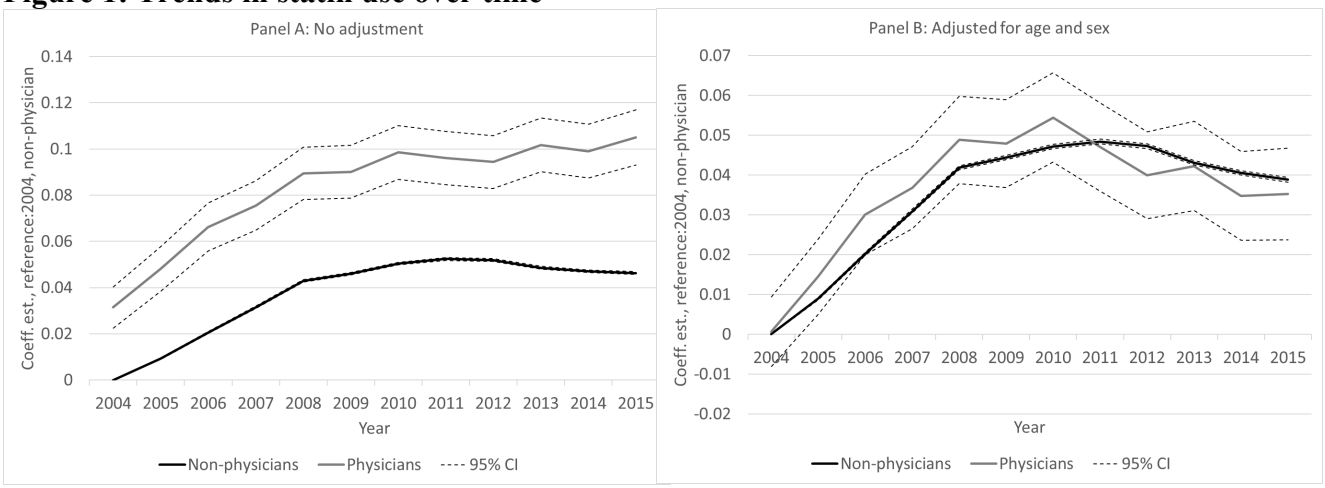
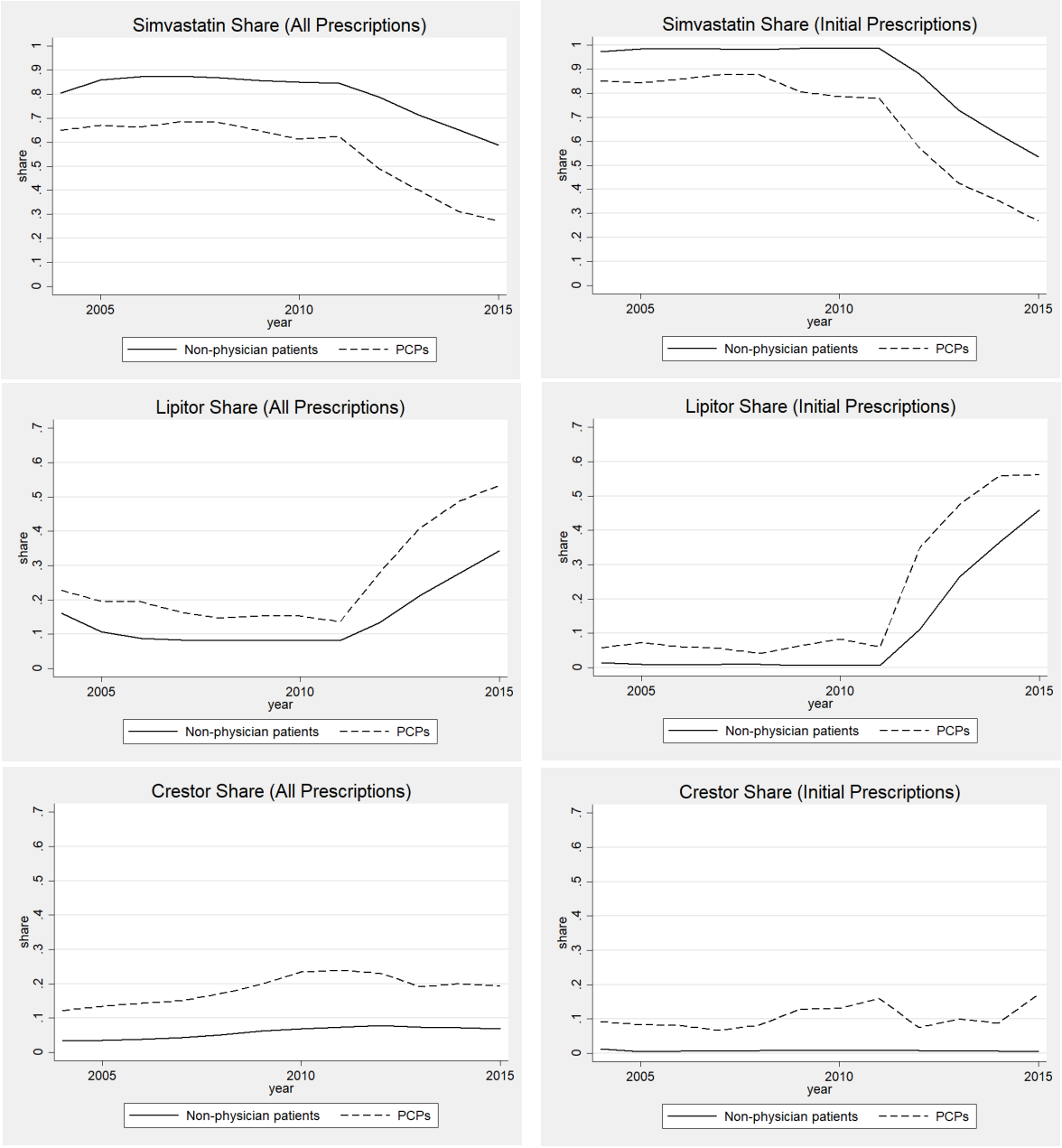
FIGURES AND TABLES

Figure 1: Trends in statin use over time



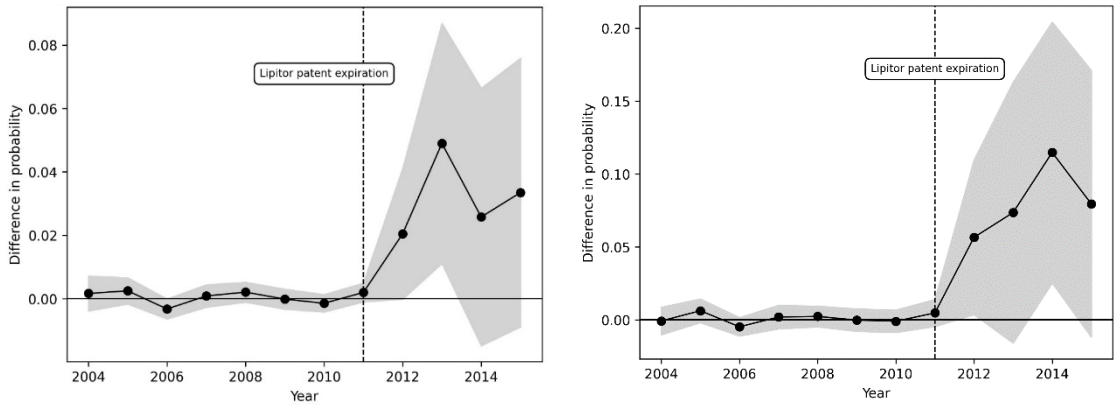
Notes: The figures show coefficient estimates from a linear probability model of statin use (1+ purchase in a given year) on year dummies interacted with Physician dummy, defined as being a statin user who is also employed as a physician. The sample includes all employed adults ages 40-70 with at least one physician visit (if not a physician themselves) in the previous year.. Non-physicians in 2004 is the base category and shown at zero on the vertical axis.

Figure 2: Statin shares over time



Notes: The figures plot raw drug shares conditional on statin usage (left-hand panels) and statin initiations (right-hand panels) for statin users who are also primary care physicians (PCPs) and nonphysician patients. Lipitor's patent expired in 2012, instigating a sharp increase in its prescribing shares. Note that we combine generic atorvastatin with Lipitor in our analyses because generic substitution is mandated, required for insurance coverage, and pervasive.

Figure 3: Lipitor prescribing difference by prescriber's personal use of statin



All Clinics *Solo Clinics Only*

Notes: Dots represent point estimates of the difference in the probability of starting Lipitor/atorvastatin by year associated with the prescriber personally being a statin user. The gray area represents 95% confidence intervals based on standard errors clustered at the prescriber clinic level. Patient characteristics and physician characteristics (age, sex) are included as controls. Physician-patients are excluded from this sample.

Table 1: Descriptive Statistics of Statin Users

	Pre-2004 Statin Users			2004-2015 Statin Initiators		
	Non-physicians	Physicians		Non-physicians	Physicians	
VARIABLES	Mean	Mean	P-value	Mean	Mean	P-value
Age	53.56	58.96	<0.01	54.08	58.04	<0.01
Male	0.67	0.86	<0.01	0.56	0.81	<0.01
Education level (share Master's degree or above	0.05	1.00	<0.01	0.05	1.00	<0.01
Income (DKK 1,000)	365.65	864.18	<0.01	377.32	986.90	<0.01
Charlson Comorbidity Index	0.44	0.32	<0.01	0.13	0.13	0.80
AMI	0.08	0.05	0.03	0.00	0.00	0.63
Cerebral Infarction	0.03	0.04	0.48	0.00	0.00	0.89
Transient Ischaemic Attack	0.03	0.01	0.01	0.00	0.01	0.27
In-patient hospital bed days	9.71	6.47	<0.01	2.57	3.02	0.22
Any indicator drug use (0/1)	0.73	0.81	<0.01	0.53	0.64	<0.01
Number of indicator drugs	1.74	1.97	0.01	1.05	1.24	<0.01
Co-insurance tier reached in previous subsidy year (percent of price paid out of pocket)						
0%	0.01	0.01	0.51	0.003	0.01	0.23
15%	0.37	0.52	<0.01	0.15	0.24	<0.01
25%	0.16	0.17	0.49	0.14	0.17	0.012
50%	0.09	0.07	0.13	0.11	0.11	0.84
100%	0.38	0.23	<0.01	0.59	0.47	<0.01
Observations	112,163	300		171,588	834	

Notes: Descriptive statistics of study sample by physician-patient status. Sample includes statin users of ages 40-70 who are currently employed. For non-physician patients, at least one visit to a general practitioner in the past year is also a requirement to appear in the sample, but we include in this table only the first year that each statin user appears. P-values from two-tailed tests are reported.

Table 2. Initial Prescriptions of Stronger Statins over Simvastatin

$Y = Ln(s_j/s_0)$	OLS (1)	OLS (2)	OLS (3)	IV (4)
Price difference (DKK)	-0.28***	-0.13***	-0.13***	-0.27***
	(0.01)	(0.05)	(0.05)	(0.01)
Physician-patient x Crestor	2.83***	2.79***	2.79***	2.83***
	(0.13)	(0.13)	(0.13)	(0.12)
Physician-patient x Lipitor	2.18***	2.15***	2.15***	2.18***
	(0.14)	(0.14)	(0.14)	(0.13)
Post X Lipitor		2.25***	1.58**	
		(0.66)	(0.65)	
Time since pat. Exp. X Lipitor			0.10***	
			(0.01)	
Observations	177	177	177	177
PCP's additional valuation for drug (DKK/ day)				
Lipitor	7.68***	16.0***	16.7***	8.16***
	(0.54)	(5.69)	(6.40)	(0.65)
Crestor	9.98***	20.8***	21.7***	10.6***
	(0.58)	(7.17)	(8.08)	(0.72)

Notes: The dependent variable is the log share of initial prescriptions for each stronger statin (Lipitor, Crestor) minus the log share of initial prescriptions for simvastatin, by quarter and by type of patient (physician, non-physician). The maximum number of observations over our time period is 192 (12 years x 4 quarters x 2 populations x 2 stronger statins), but we have 177 due to some quarters having no physician-patients initiating statin treatment. Observations are weighted by the number of initial prescriptions used to calculate each share. All specifications include Lipitor and Crestor fixed effects. *** p<0.01

Table 3: Physician-Patient Valuation of Statin Potency

	Non-initial Prescriptions		Initial Prescriptions			
	(1)	(2)	(3)	(4)	(5)	(6)
Price (DKK per pill)	-0.11***	-0.11***	-0.30***	-0.30***	-0.21***	-0.21***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Physician-Patient x Potency	1.16***	1.05***	2.86***	2.39***	2.82***	2.35***
	(0.07)	(0.07)	(0.13)	(0.14)	(0.12)	(0.14)
Recommended					0.43**	0.45**
					(0.18)	(0.15)
Time Since Patent Exp.					0.10***	0.10***
					(0.01)	(0.01)
Controls:						
Age & sex	YES	YES	YES	YES	YES	YES
Health & indicator drug use	YES	YES	YES	YES	YES	YES
Education & income	NO	YES	NO	YES	NO	YES
Previous statin purchased	YES	YES	-	-	-	-
Observations	3,508,213	3,508,213	172,561	172,561	172,561	172,561
PCP's additional valuation for self-treatment (DKK/ day)						
Potency	10.70***	9.64***	9.43***	7.87***	13.30***	11.20***
	(0.64)	(0.68)	(0.43)	(0.49)	(1.07)	(1.04)

Notes: Coefficients from conditional logit model with base choice defined as simvastatin. Potency is scaled from 0 (simvastatin) to 100 (Crestor), with Lipitor falling in between, according to percentage LDL reduction expected from average dose. PCP's additional valuation, reported at the bottom of the table, is the Physician-Patient x Potency coefficient divided by the Price coefficient. Columns (1) – (2) are based on non-initial prescriptions and control for the previous statin used to account for state persistence. Column (3) – (6) are based on initial statins prescriptions only. Health and indicator drug use variables include controls for use of each individual indicator drug, the Charlson Comorbidity Index, prior AMI, prior cerebral infarction, prior transient ischemic attack, and the number of in-patient hospital bed days in the previous year. Separate intercepts for Crestor and Lipitor are estimated. Standard errors are clustered at the prescriber level and shown in parentheses (** p<0.05, *** p<0.01).

Table 4. Physician-Patient Valuation of Potency by Predicted Out-of-pocket Costs

	Initial Prescriptions			
	(1)	(2)	(3)	(4)
Price (DKK per pill)	-0.28***	-0.29***	-0.18***	-0.19***
	(0.01)	(0.01)	(0.02)	(0.02)
Predicted OOP (Price X Previous CI)	-0.04***	-0.03***	-0.03***	-0.02***
	(0.01)	(0.01)	(0.01)	(0.01)
Physician-Patient x Potency	2.41***	2.39***	2.38***	2.36***
	(0.15)	(0.15)	(0.15)	(0.15)
Recommended			0.60***	0.58***
			(0.20)	(0.20)
Time Since Patent Exp.			0.10***	0.10***
			(0.01)	(0.01)
Controls:				
Age, sex, drugs, educ, income	YES	YES	YES	YES
Lagged CI FEs	NO	YES	NO	YES
Joint test of significance for lagged CI FEs				
Test statistic	-	26.83	-	25.88
p value	-	<0.001	-	0.001
Observations	166,208	166,208	166,208	166,208
Physician's additional valuation for self-treatment (DKK/ day)				
Expected Coinsurance=0%	8.67	8.35	13.30	12.40
	(0.56)	(0.55)	(1.45)	(1.31)
Expected Coinsurance=100%	7.54	7.60	11.20	11.30
	(0.48)	(0.49)	(1.11)	(1.13)

Notes: Coefficients from conditional logit model for initial prescriptions with base choice defined as simvastatin. Potency is scaled to be 0 for simvastatin and 100 for Crestor, with Lipitor falling in between, according to percentage LDL reduction expected from average dose. Predicted OOP coefficient is the price multiplied by the lowest coinsurance rate attained in the previous subsidy year, either 0, 15, 25, 50, or 100%. In columns 2 and 4 we include fixed effects for each of these prior year coinsurance rates interacted with the drug choices. Physician's additional valuation, reported at the bottom of the table, is the Physician-Patient x Potency coefficient divided by the Price coefficient (for Expected CI=0%) or the sum of the Price coefficient and Predicted OOP coefficient (for Expected CI=100%). Individuals without any prior spending are excluded from the sample in this table. Standard errors are clustered at the prescriber level. *** p<0.01.

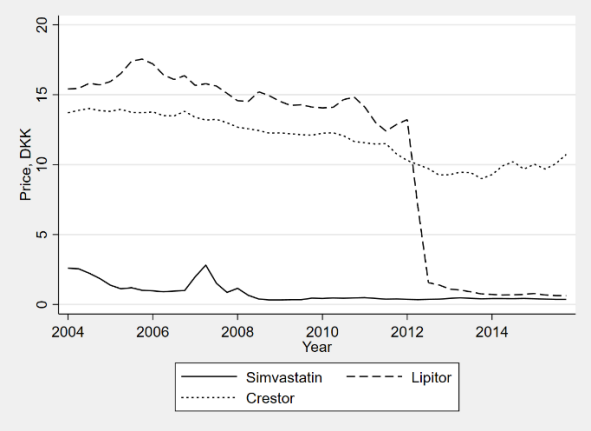
Table 5. Changes in Lipitor Prescribing After its Patent Expiration

	(1)	(2)	(3)	(4)
Statin-using PCP	0.003		0.003	
	(0.002)		(0.002)	
Statin-using PCP x Post-patent expiry	0.08**	0.07**	0.06**	0.06**
	(0.03)	(0.03)	(0.03)	(0.03)
# Statin patients, 100s			-0.00	
			(0.00)	
# 100s of Statin patients x Post-patent expiry			0.03***	0.02***
			(0.01)	(0.01)
Qrt. X Year F.E.	YES	YES	YES	YES
Prescriber F.E.	NO	YES	NO	YES
Patient SES & health	YES	YES	YES	YES
Observations	55,750	55,750	55,750	55,750

Notes: Estimated on the subsample of prescriptions from solo-PCP clinics.
Standard errors are clustered at the prescriber level. ** p<0.05, *** p<0.01.

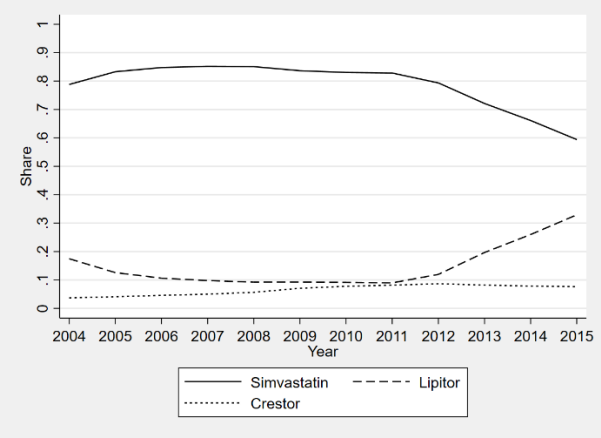
APPENDIX FOR ONLINE PUBLICATION

Figure A1: Price per pill by drug



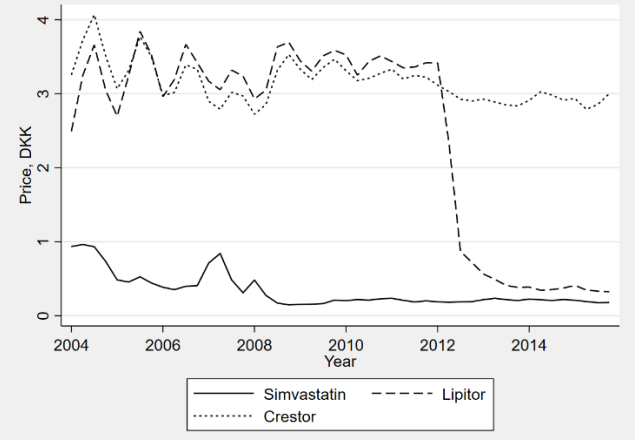
Notes: Price in DKK per pill by quarter drug 2015 prices. In the first quarter of 2012, Lipitor (atorvastatin) began being sold as a generic formulation.

Figure A2: Drug share over time



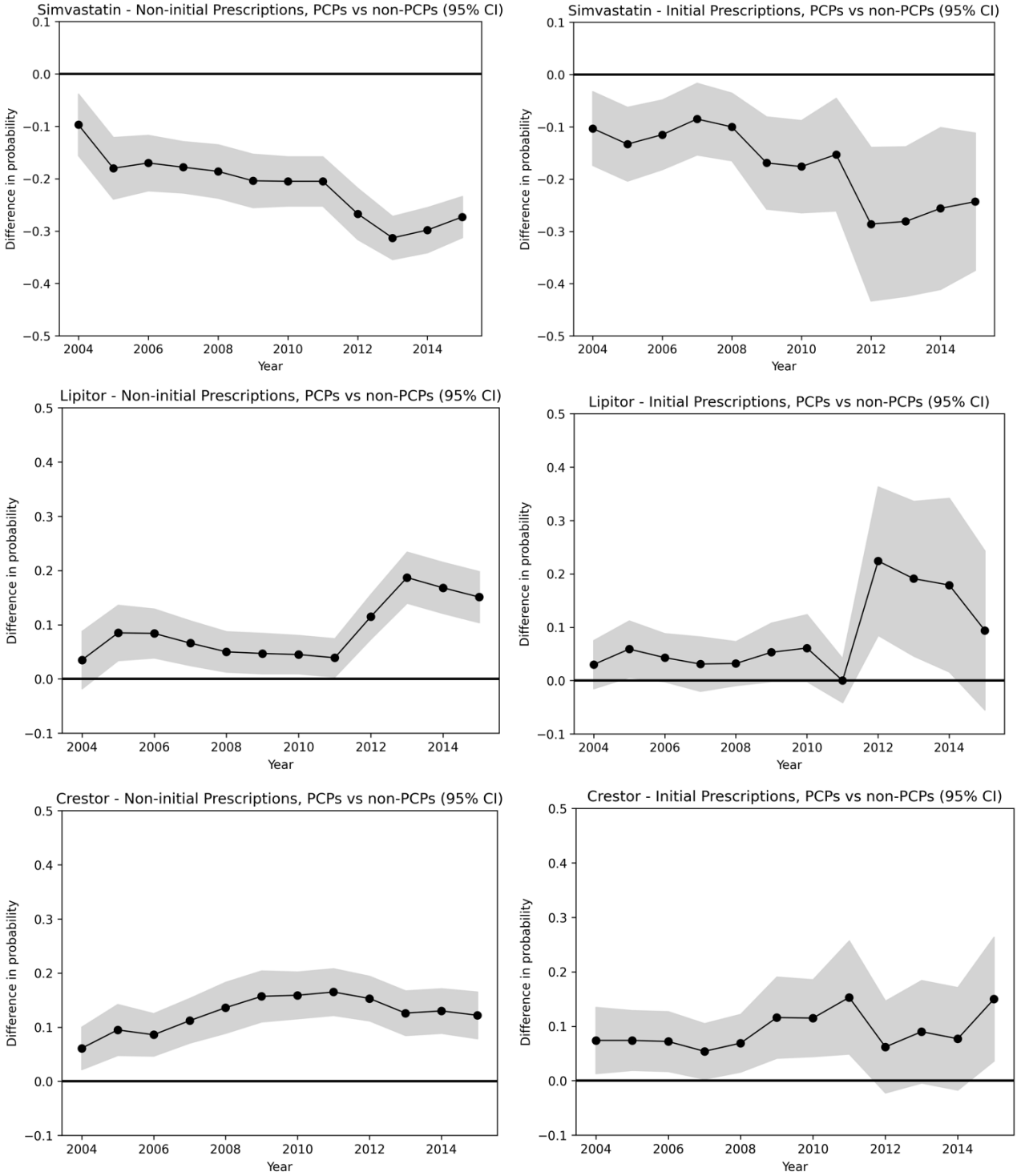
Notes: 2012, Lipitor began being sold as a generic.

Figure A3: Out-of-pocket price per pill by drug



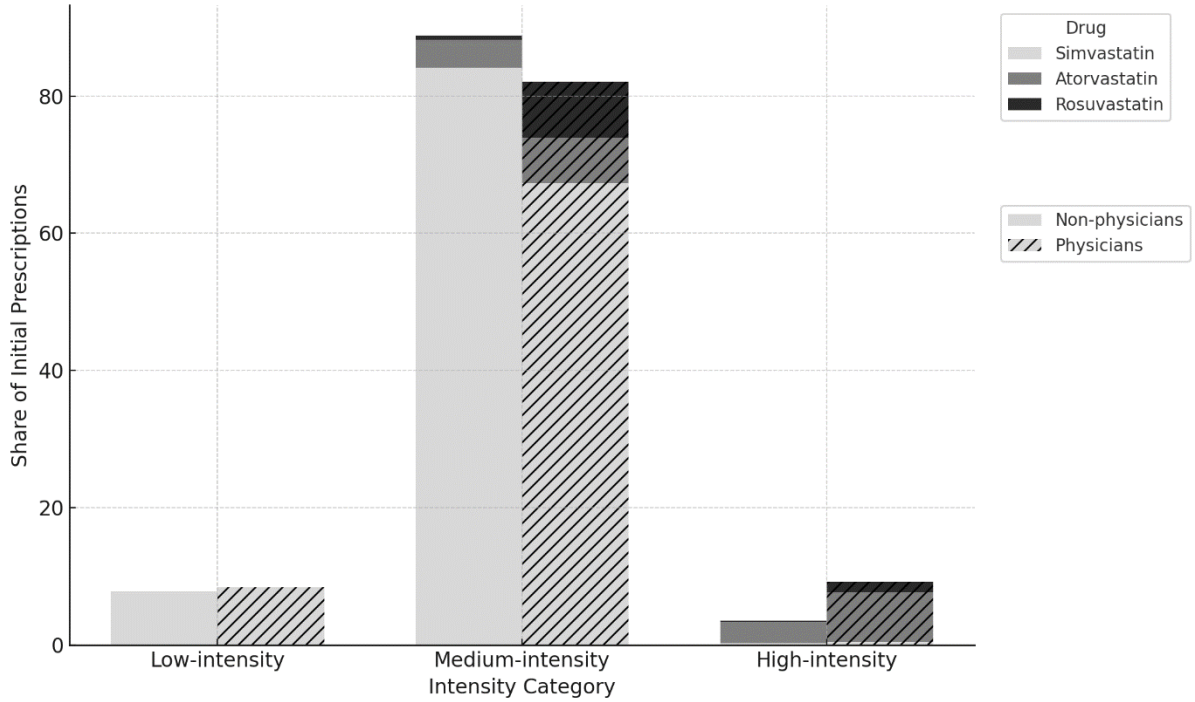
Notes: Price in DKK per pill by quarter drug in 2015 prices. In 2012, Lipitor began being sold as a generic. Coinsurance shares depend on a subsidy schedule that resets for each patient after one year has elapsed since the start of their last subsidy schedule (see Section 2.1).

Figure A4: PCP vs. non-PCP difference in statin use by year (95% CI)



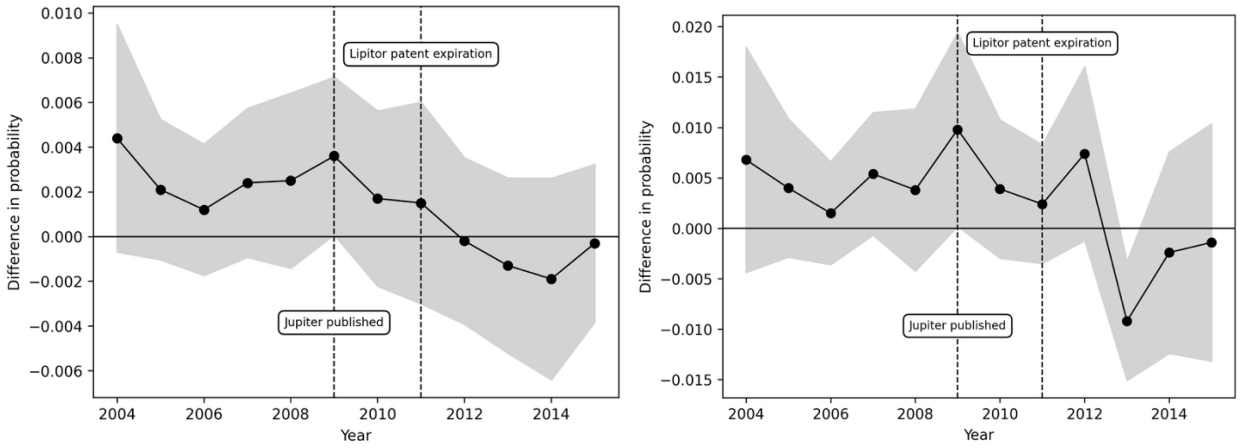
Notes: Linear probability model-based differences in each statin's use, conditional on a statin prescription, for patients who are active primary care physicians (PCPs) vs. other patients (non-PCPs). Adjusted for demographics, use of other prescription drugs as proxies for relevant chronic conditions, income deciles, education, coinsurance rate controls, and prescribing clinic fixed effects. Each black dot represents the year-specific coefficient on PCP and the grey area shows the 95% confidence interval.

Figure A5: Statin intensity by physician and non-physician patients and drug



Notes: The graph shows the distribution of treatment intensity at first prescription, by patient type (physician vs. non-physician patients) and intensity or level of cholesterol expected from the prescribed drug-dose.

Figure A6. Crestor prescribing difference, prescribers with versus without personal use of statin



Notes: Dots represent point estimates of the difference in the probability of starting Crestor associated with the prescriber's personal use of statins. The gray area represents 95% confidence intervals based on standard errors clustered at the prescriber clinic level. Patient characteristics and physician characteristics (age, sex) are included as controls. Physician-patients own prescriptions are excluded from this sample.

Table A1: Characteristics of Statin Drugs

	Simvastatin	Atorvastatin	Rosuvastatin
Expected LDL reduction at dose			
5mg	-	-	0.45 (M)
10mg	0.32 (L)	0.39 (M)	0.51 (M)
20mg	0.38 (M)	0.45 (M)	0.57 (H)
40mg	0.44 (M)	0.51 (H)	0.63 (H)
80mg	-	0.57 (H)	-
Share of initial prescriptions at dose Non-physician patients:			
5mg	-	-	0.1
10mg	7.8	1.4	0.5
20mg	33.3	2.7	0.1
40mg	50.8	2.7	0.03
80mg	0.3	0.4	-
Share of initial prescriptions at dose Physician-patients:			
5mg	-	-	1.4
10mg	8.4	3.1	7.2
20mg	24.6	3.5	1.0
40mg	42.7	5.4	0.5
80mg	0.5	1.8	-

Notes: Within drug test for difference in strength, physicians vs. non-physicians: Simvastatin: $\chi^2(4)$=9.97, p=0.04. Atorvastatin: $\chi^2(4)$=13.9, p=0.003. Rosuvastatin: $\chi^2(4)$=4.04, p=0.26.

Table A2: Descriptive Statistics of Statin Users by patient type – pre-2004 users

VARIABLES	Non-physicians Mean	SD	Physicians Mean	SD	P-value
Age	53.56	7.08	58.96	6.98	<0.001
Male	0.67	0.47	0.86	0.35	<0.001
Education level (share Master's degree or above	0.05	0.23	1.00	0.00	<0.001
Income (DKK 1,000)	365.65	263.74	864.18	432.72	<0.001
No indicator drug use (0/1)	0.27	0.44	0.19	0.40	0.00
Number of indicator drugs	1.74	1.51	1.97	1.51	0.01
Nitrates	0.14	0.35	0.16	0.36	0.54
Beta blockers	0.39	0.49	0.45	0.50	0.02
Diabetes	0.19	0.39	0.11	0.31	<0.001
Warfarin	0.04	0.20	0.07	0.26	0.04
Diuretics	0.31	0.46	0.37	0.48	0.03
ACE Inhibitors	0.25	0.43	0.29	0.45	0.19
ARBs	0.42	0.49	0.52	0.50	<0.001
Charlson Comorbidity Index	0.44	0.79	0.32	0.68	0.00
AMI	0.08	0.27	0.05	0.23	0.03
Cerebral Infarction	0.03	0.17	0.04	0.19	0.48
Transient Ischaemic Attack	0.03	0.16	0.01	0.10	0.01
In-patient hospital bed days	9.71	24.57	6.47	17.06	0.00
Co-insurance tier reached in previous subsidy year (percent of price paid out of pocket)					
0%	0.01	0.10	0.01	0.08	0.51
15%	0.37	0.48	0.52	0.50	<0.001
25%	0.16	0.36	0.17	0.38	0.49
50%	0.09	0.28	0.07	0.25	0.13
100%	0.38	0.48	0.23	0.42	<0.001
Observations	112,163		300		

Notes: Descriptive statistics of study sample by physician-patient status. Sample includes statin users of ages 40-70 who are currently employed. For non-physician patients, at least one visit to a general practitioner in the past year is also a requirement to appear in the sample, but we include in this table only the first year that each statin user appears. P-values from two-tailed tests are reported. [a] : Any hospitalization (0/1) within the last five years prior to statin initiation.

Table A3: Descriptive Statistics of Statin Users by patient type – 2004-2015 initiators

VARIABLES	Non-physicians Mean	SD	Physicians Mean	SD	P-value
Age	54.08	6.25	58.04	6.62	<0.001
Male	0.56	0.50	0.81	0.39	<0.001
Education level (share Master's degree or above	0.05	0.22	1	0.00	<0.001
Income (DKK 1,000)	377.32	230.81	986.896	587.66	<0.001
No indicator drug use (0/1)	0.47	0.50	0.361	0.48	<0.001
Number of indicator drugs	1.05	1.26	1.240	1.29	<0.001
Nitrates	0.03	0.16	0.092	0.29	<0.001
Beta blockers	0.19	0.39	0.320	0.47	<0.001
Diabetes	0.08	0.27	0.073	0.26	0.32
Warfarin	0.02	0.14	0.036	0.19	0.01
Diuretics	0.27	0.44	0.266	0.44	0.87
ACE Inhibitors	0.17	0.37	0.152	0.36	0.26
ARBs	0.29	0.45	0.300	0.46	0.62
Charlson Comorbidity Index	0.13	0.51	0.132	0.45	0.80
AMI	0.00	0.06	0.005	0.07	0.63
Cerebral Infarction	0.00	0.06	0.004	0.06	0.89
Transient Ischaemic Attack	0.00	0.07	0.008	0.09	0.27
In-patient hospital bed days	2.57	11.62	3.02	10.60	0.22
Co-insurance tier reached in previous subsidy year (percent of price paid out of pocket)					
0%	0.00	0.05	0.00600	0.08	0.23
15%	0.15	0.36	0.243	0.43	<0.001
25%	0.14	0.35	0.173	0.38	0.012
50%	0.11	0.31	0.108	0.31	0.84
100%	0.59	0.49	0.470	0.50	<0.001
Observations	171,588		834		

Notes: Descriptive statistics of study sample by physician-patient status. Sample includes statin users of ages 40-70 who are currently employed. For non-physician patients, at least one visit to a general practitioner in the past year is also a requirement to appear in the sample, but we include in this table only the first year that each statin user appears. P-values from two-tailed tests are reported. [a] : Any hospitalization (0/1) within the last five years prior to statin initiation.

Table A4: Statin use on the extensive margin

Y = Statin user	(1)	(2)	(3)	(4)
Physician-patient	0.046***	0.002	-0.014***	-0.001
	(0.004)	(0.004)	(0.004)	(0.004)
Male		0.034***	0.023***	0.023***
		(0.000)	(0.000)	(0.000)
Indicator Drugs:				
Nitrates			0.223***	0.223***
			(0.002)	(0.002)
Beta-blockers			0.060***	0.060***
			(0.001)	(0.001)
Diabetes drugs			0.359***	0.358***
			(0.002)	(0.002)
Warfarin			0.030***	0.030***
			(0.002)	(0.002)
Diuretics			0.021***	0.020***
			(0.001)	(0.001)
ACE Inhibitors			0.050***	0.050***
			(0.001)	(0.001)
ARBs			0.139***	0.138***
			(0.001)	(0.001)
CCI (1-5)			0.060***	0.060***
			(0.001)	(0.001)
CCI (>6)			-0.027***	-0.027***
			(0.003)	(0.003)
In-hospital bed days			-0.000***	-0.000***
			(0.000)	(0.000)
Prev. AMI			0.392***	0.392***
			(0.003)	(0.003)
Prev. Cerebral Infarction			0.361***	0.361***
			(0.004)	(0.004)
Prev. Transient Ischemic Attack			0.216***	0.216***
			(0.004)	(0.004)
Constant	0.085***	0.068***	0.018***	0.018***
	(0.000)	(0.000)	(0.000)	(0.000)
Age FE	NO	YES	YES	YES
Income ventiles	NO	NO	NO	YES
Education	NO	NO	NO	YES
Observations	15,252,611	15,252,611	15,252,611	15,252,609
R-squared	0.004	0.050	0.260	0.260

Notes: Sample includes 1 observation per person-year. All registered PCPs between the ages of 40 and 70 appear once per year, along with other employed Danish adults ages 40-70 who visited a PCP at least once in the year. Statin user is equal to one if at least one statin prescription was purchased by the patient. Linear probability model, standard errors clustered at the individual level. Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A5: Physician Valuation of Lipitor and Crestor

	Non-initial Prescriptions		Initial Prescriptions			
	(1)	(2)	(3)	(4)	(5)	(6)
Price (DKK per pill)	-0.108***	-0.109***	-0.304***	-0.303***	-0.211***	-0.210***
	(0.001)	(0.001)	(0.005)	(0.005)	(0.015)	(0.015)
Physician-Patient x Lipitor	0.974***	0.941***	1.552***	1.438***	1.546***	1.426***
	(0.064)	(0.068)	(0.158)	(0.167)	(0.159)	(0.169)
Physician-Patient x Crestor	1.087***	0.959***	2.859***	2.307***	2.816***	2.262***
	(0.075)	(0.079)	(0.129)	(0.150)	(0.129)	(0.149)
Recommended					0.439**	0.450**
					(0.184)	(0.154)
Time Since Patent Exp.					0.097***	0.097***
					(0.005)	(0.005)
Controls:						
Age & sex	YES	YES	YES	YES	YES	YES
Health & indicator drug use	YES	YES	YES	YES	YES	YES
Education & income	NO	YES	NO	YES	NO	YES
Previous statin purchased	YES	YES	-	-	-	-
Observations	3,508,213	3,508,213	172,561	172,561	172,561	172,561
PCP's additional valuation for self-treatment (DKK/ day)						
Lipitor	9.00***	8.65***	5.11***	4.74***	7.32***	6.78***
	(0.60)	(0.63)	(0.53)	(0.55)	(0.91)	(0.93)
Crestor	10.0***	8.82***	9.42***	7.61***	13.3***	10.8***
	(0.70)	(0.74)	(0.45)	(0.51)	(1.09)	(1.04)

Notes: Coefficients from conditional logit model. Base choice is simvastatin. PCP's additional valuation for Lipitor and Crestor, reported at the bottom of the table, is the Physician-Patient x drug coefficient divided by the Price coefficient. Columns (1) – (2) are based on non-initial prescriptions and control for the previous statin used to account for state persistence. Column (3) – (6) are based on initial statins prescriptions only. Health and indicator drug use variables include controls for use of each individual indicator drug, the Charlson Comorbidity Index, prior AMI, prior cerebral infarction, prior transient ischemic attack, and the number of in-patient hospital bed days. Standard errors are clustered at the prescriber level. Separate intercepts for Crestor and Lipitor are estimated. *** p<0.01.

Table A6: Physician Valuation of Statin Potency
Subsample: Self-prescribers and patients at their clinics

	Non-initial Prescriptions		Initial Prescriptions			
	(1)	(2)	(3)	(4)	(5)	(6)
Price (DKK per pill)	-0.109***	-0.079***	-0.308***	-0.308***	-0.230***	-0.229***
	(0.002)	(0.002)	(0.007)	(0.007)	(0.023)	(0.022)
Physician-Patient x Efficacy	1.273***	1.424***	2.791***	2.651***	2.759***	2.620***
	(0.077)	(0.121)	(0.145)	(0.190)	(0.144)	(0.189)
Recommended					0.329	0.339
					(0.268)	(0.267)
Time Since Patent Exp.					0.092***	0.092***
					(0.009)	(0.009)
Controls:						
Age & sex	YES	YES	YES	YES	YES	YES
Drugs for other chronic conditions	YES	YES	YES	YES	YES	YES
Education and income	NO	YES	NO	YES	NO	YES
Indicator for prev. drug	YES	YES	-	-	-	-
Observations	1,514,837	1,514,837	76,681	76,681	76,681	76,681
PCP's additional valuation for self-treatment (DKK/ day)						
Efficacy	11.7***	18.1***	9.06***	8.60***	12.0***	11.4***
	(0.74)	(1.64)	(0.51)	(0.65)	(1.27)	(1.38)

Notes: Columns (1) – (2) are based on non-initial prescriptions and control for the drug last filled by the same patient. Column (3) – (6) are based on initial statins prescriptions only, with one observation per patient. Standard errors are clustered at the prescriber level. *** p<0.01.

Table A7: Valuation of Potency with Heterogeneity in Sensitivity to Out of Pocket Costs

	Initial Prescriptions			
	(1)	(2)	(3)	(4)
Price (DKK per pill)	-0.278***	-0.286***	-0.178***	-0.190***
	(0.005)	(0.006)	(0.016)	(0.017)
Predicted OOP (Price X Previous CI)	-0.043***	-0.029***	-0.036***	-0.019***
	(0.005)	(0.007)	(0.005)	(0.006)
Predicted OOP X Physician-Patient (Price X Previous CI X PCP)	0.045**	0.053***	0.039**	0.046**
	(0.020)	(0.019)	(0.020)	(0.019)
Physician-Patient x Potency	2.120***	2.061***	2.122***	2.061***
	(0.201)	(0.195)	(0.199)	(0.193)
Recommended			0.597***	0.577***
			(0.197)	(0.195)
Time Since Patent Exp.			0.098***	0.098***
			(0.005)	(0.005)
Controls:				
Age, sex, drugs, educ, income	YES	YES	YES	YES
Lagged CI FEs	NO	YES	NO	YES
Joint test of significance for lagged CI FEs				
Test statistic	-	28.87	-	27.73
p value	-	<0.001	-	<0.001
Observations	166,208	166,208	166,208	166,208
Physician's additional valuation for self-treatment (DKK/ day)				
Expected Coinsurance = 0%	7.64	7.20	11.9	10.8
	(0.75)	(0.71)	(1.58)	(1.40)
PCP, Expected Coins.= 100%	7.70	7.84	12.2	12.7
	(0.55)	(0.57)	(1.49)	(1.63)

Notes: Based on initial prescriptions only. Coefficients from conditional logit model. Base choice is simvastatin. Potency is scaled to be 0 for simvastatin and 100 for Crestor, with Lipitor falling in between, according to percentage LDL reduction expected from average dose. Physician's additional valuation, reported at the bottom of the table, is the Physician-Patient x Potency coefficient divided by the Price coefficient (for Expected CI=0%) or the Predicted OOP coefficient (for Expected CI=100%), respectively. For these specifications, we exclude individuals without ant prior spending, as their prior end-of-year spending is not defined. Including them and setting their prior end-of-year coinsurance to 1 yields similar results. Standard errors are clustered at the prescriber level. *** p<0.01.

Table A8. Valuation of Potency by Predicted Out-of-pocket Costs
Subsample: Self-prescribers and patients at their clinics

	Initial Prescriptions			
	(1)	(2)	(3)	(4)
Price (DKK per pill)	-0.283***	-0.289***	-0.192***	-0.202***
	(0.008)	(0.010)	(0.024)	(0.025)
Price X Previous CI	-0.042***	-0.032***	-0.036***	-0.022**
	(0.007)	(0.010)	(0.007)	(0.009)
Physician-Patient x Efficacy	2.572***	2.563***	2.542***	2.534***
	(0.192)	(0.192)	(0.190)	(0.191)
Recommended			0.093***	0.093***
			(0.009)	(0.009)
Time Since Patent Exp.			-0.192***	-0.202***
			(0.024)	(0.025)
Controls:				
Age & sex	YES	YES	YES	YES
Drugs for other chronic conditions	YES	YES	YES	YES
Education and income	YES	YES	YES	YES
Lagged CI FEs	NO	YES	NO	YES
Joint test of significance for lagged CI FEs				
Test statistic	-	12.02	-	10.62
p value	-	0.150	-	0.224
Observations	73,959	73,959	73,959	73,959
PCP's additional valuation for self-treatment (DKK/ day)				
Previous CI=0	9.08***	8.86***	13.3***	12.5***
	(0.72)	(0.73)	(1.93)	(1.81)
Previous CI=1	7.91***	7.97***	11.2***	11.3***
	(0.62)	(0.63)	(1.46)	(1.49)

Notes: This table replicates the specifications of Table 4 using a subsample of self-prescribing physicians and the other patients initiating statin treatment at the same clinics. Standard errors are clustered at the prescriber level and shown in parentheses: *** p<0.01, ** p<0.05.

Table A9. Valuation of Potency with Heterogeneity in Sensitivity to Out of Pocket Costs Subsample: Self-prescribers and patients at their clinics

	Initial Prescriptions			
	(1)	(2)	(3)	(4)
Price (DKK per pill)	-0.282***	-0.289***	-0.191***	-0.202***
	(0.008)	(0.009)	(0.024)	(0.025)
Predicted OOP (Price X Previous CI)	-0.045***	-0.034***	-0.039***	-0.024***
	(0.007)	(0.010)	(0.007)	(0.009)
Predicted OOP X Physician-Patient (Price X Previous CI X PCP)	0.052**	0.057***	0.047**	0.052**
	(0.021)	(0.021)	(0.021)	(0.020)
Physician-Patient x Potency	2.220***	2.178***	2.220***	2.178***
	(0.244)	(0.240)	(0.242)	(0.239)
Recommended			0.540*	0.522*
			(0.288)	(0.286)
Time Since Patent Exp.			0.093***	0.093***
			(0.009)	(0.009)
Controls:				
Age, sex, drugs, educ, income	YES	YES	YES	YES
Lagged CI FEs	NO	YES	NO	YES
Joint test of significance for lagged CI FEs				
Test statistic	-	13.47	-	11.91
p value	-	0.10	-	0.16
Observations	73,959	73,959	73,959	73,959
Physician's additional valuation for self-treatment (DKK/ day)				
Expected Coinsurance = 0%	7.87***	7.54***	11.6***	10.8***
	(0.91)	(0.89)	(1.98)	(1.82)
PCP, Expected Coins.= 100%	8.06***	8.18***	12.2***	12.5***
	(0.70)	(0.72)	(1.92)	(2.04)

Notes: This table replicates the results of Table A7 for the subsample of self-prescribing physicians and the other patients initiating statin treatment at their clinics. Standard errors are clustered at the prescriber level. *** p<0.01.

Table A10: Physician Valuation of Lipitor and Crestor: Medium-Intensity Prescriptions

	Non-initial Prescriptions		Initial Prescriptions			
	(1)	(2)	(3)	(4)	(5)	(6)
Price (DKK per pill)	-0.067***	-0.067***	-0.302***	-0.302***	-0.210***	-0.208***
	(0.002)	(0.002)	(0.006)	(0.006)	(0.020)	(0.020)
Physician-Patient x Lipitor	0.785***	0.681***	1.324***	1.138***	1.314***	1.122***
	(0.109)	(0.113)	(0.195)	(0.204)	(0.199)	(0.209)
Physician-Patient x Crestor	1.047***	0.917***	3.044***	2.454***	3.004***	2.410***
	(0.115)	(0.121)	(0.143)	(0.166)	(0.143)	(0.166)
Recommended					0.439**	0.450**
					(0.184)	(0.154)
Time Since Patent Exp.					0.097***	0.097***
					(0.005)	(0.005)
Controls:						
Age & sex	YES	YES	YES	YES	YES	YES
Health & indicator drug use	YES	YES	YES	YES	YES	YES
Education & income	NO	YES	NO	YES	NO	YES
Previous statin purchased	YES	YES	-	-	-	-
Observations	2,873,739	2,873,739	152,885	152,885	152,885	152,885
PCP's additional valuation for self-treatment (DKK/ day)						
Lipitor	11.8***	10.1***	4.38***	3.77***	6.27***	5.38***
	(1.65)	(1.68)	(0.66)	(0.68)	(1.11)	(1.10)
Crestor	15.7***	13.6***	10.1***	8.12***	14.3***	11.6***
	(1.76)	(1.83)	(0.50)	(0.58)	(1.45)	(1.34)

Notes: Coefficients from conditional logit model. Base choice is simvastatin. PCP's additional valuation for Lipitor and Crestor, reported at the bottom of the table, is the Physician-Patient x drug coefficient divided by the Price coefficient. Columns (1) – (2) are based on non-initial prescriptions and control for the previous statin used to account for state persistence. Column (3) – (6) are based on initial statins prescriptions only. Health and indicator drug use variables include controls for use of each individual indicator drug, the Charlson Comorbidity Index, prior AMI, prior cerebral infarction, prior transient ischemic attack, and the number of in-patient hospital bed days. Standard errors are clustered at the prescriber level. Separate intercepts for Crestor and Lipitor are estimated. Prescriptions with the following strengths are dropped: Simvastatin 5, 10, 80 mg. Lipitor: 40, 80 mg. Crestor: 20, 40 mg. *** p<0.01.

Table A11. Patient characteristics by physician own-experience with statins

	No experience		Pre-experience	
	Mean	SD	Mean	SD
Age	54.20	6.29	54.02	6.23
Male	0.56	0.50	0.56	0.50
Education level (share Master's degree or above	0.06	0.24	0.05	0.23
Income (DKK 1,000)	382.65	241.38	377.33	232.53
No indicator drug use (0/1)	0.47	0.50	0.47	0.50
Number of indicator drugs	1.06	1.26	1.04	1.25
Nitrates	0.03	0.16	0.03	0.16
Beta blockers	0.19	0.39	0.19	0.40
Diabetes	0.09	0.28	0.08	0.27
Warfarin	0.02	0.14	0.02	0.14
Diuretics	0.27	0.44	0.27	0.44
ACE Inhibitors	0.17	0.38	0.16	0.37
ARBs	0.29	0.46	0.29	0.45
Charlson Comorbidity Index	0.13	0.51	0.13	0.51
Previous AMI	0.004	0.060	0.004	0.061
Previous Cerebral Infarction	0.003	0.056	0.003	0.059
Transient Ischemic Attack	0.005	0.073	0.005	0.068
In-hospital bed days	2.65	12.18	2.51	11.30
Co-insurance tier reached in previous subsidy year (percent of price paid out of pocket)				
0%	0.00	0.05	0.00	0.05
15%	0.15	0.36	0.16	0.36
25%	0.14	0.35	0.14	0.35
50%	0.11	0.31	0.11	0.31
100%	0.60	0.49	0.59	0.49
n=	70823		91558	

Notes: Descriptive statistics of patients at their first prescription by physician own-experience with statins. "Experience" is defined as having had at least one statin fill in 2010 or earlier (prior to the year of Lipitor's patent expiration).