

## **APPENDIX: THE FLOW OF MONEY THROUGH THE PHARMACEUTICAL DISTRIBUTION SYSTEM**

### **SECTION A: CALCULATING GROSS AND NET MARGINS FROM SEC FILINGS**

We estimated gross and net margins as a fraction of net sales for all companies in our sample, using information from their 2015 SEC filings (forms 10K and 20F). When net sales were not available, we used net revenues instead, which may include other sources of revenue besides the sale of pharmaceuticals. For most companies, gross margins were calculated as gross profit (that is, net sales less cost of goods sold or COGS) as a percentage of net sales. In some cases, gross profits were reported directly on the income statement, in which case we used the reported figure in the gross margin calculation. We compared the reported gross profit with the gross profit calculated as net revenue less COGS. In all instances, the reported gross profit differed by no more than 2% from the calculated gross profit. We also calculated net margins, that is, net income or net earnings as a percentage of net revenue.

For companies with multiple lines of business (for example, a company with both specialty pharmacy and pharmacy benefits management operations), SEC rules require separate reporting by business when those businesses are large enough to constitute “reportable segments.” In these cases, we used segment-specific financial results to calculate gross margins for the business of interest, dividing gross profits for the segment by segment net revenues. However net profits are typically not reported at the segment level, making it impossible to calculate segment-specific net margins. In these cases, we estimated segment net profits by multiplying gross profits for the segment by the ratio of net-to-gross profits for the company as a whole.

When a company reported financial results for the US market separately, we used US financials to calculate US-specific margins; otherwise, we calculated margins from the company’s global results. To explore the possibility that global margins could differ systematically from US margins and bias our results, we compared average gross margins for all manufacturers with those for manufacturers with >50% of revenues in the US. The results were similar—while the average gross margin across all companies was 71.1%, the average across only those companies with more than half of their revenues in the US was 72.9%. All currencies were converted to US dollars based on exchange rates at the end of the reported fiscal year.

We calculate average sector margins by weighting the gross and net margins of each company in the sector by its share of total US sector revenues represented in our sample. We also used SEC filings to calculate gross and net margins for manufacturers by drug type. In this analysis, we classified manufacturers as either generic or brand producers. For companies that produce both brand and generic products, the gross margins for both business segments were calculated separately when possible. If the SEC filings did not present the data by business segment for the margin analysis, then the company was categorized based on the business segment that produced the majority of net sales/revenues. The results of this categorization are presented in Table 1 in the main article.

### **SECTION B: SENSITIVITY ANALYSES—ALTERNATIVE GROSS MARGIN CALCULATIONS**

To check the robustness of our margin results, we also calculated gross margins using alternative data sources when available. We were able to do this for the pharmacy and insurer sectors.

### **ALTERNATIVE PHARMACY MARGINS**

The Centers for Medicare and Medicaid Services (CMS) provides data on pharmacies' drug acquisition costs in the National Average Drug Acquisition Cost (NADAC) dataset,<sup>1</sup> which provides retail community pharmacy acquisition costs for all outpatient drugs covered under Medicaid. The acquisition cost data are collected through monthly surveys of pharmacies and are intended to serve as a "national benchmark that is reflective of the prices paid by retail community pharmacies to acquire prescription and over-the-counter covered outpatient drugs."<sup>2</sup> The NADAC data provide the average acquisition cost per unit calculated using the survey responses, where the average acquisition costs are provided by drug group (active ingredient, strength, dosage, and route of administration) and drug category (single source, innovator multiple source, or non-innovator multiple source). CMS also provides monthly consumer drug pricing data from retail community pharmacies for Medicaid covered outpatient drugs for the first three months in 2013, in the National Average Retail Price (NARP) dataset.<sup>3</sup> Specifically, the NARP data provide the average retail price per unit paid to pharmacies, by National Drug Code (NDC).

These data can be used to calculate an alternative measure of pharmacy gross profits, by subtracting NADAC pharmacy acquisition costs from the NARP retail prices. This strategy isolates pharmacies' gross profits from pharmacy activities alone, rather than combining it with other retail sales activities as may be the case when profits are calculated using SEC filings.

We combined the NADAC and the NARP data to estimate pharmacy gross margins in the overall, brand, and generic drug markets using the following steps: First, the top 20 active ingredients, in terms of the number of prescriptions dispensed in the US market, and the top 20 brand name drugs, in terms of non-discounted spending in the US, were identified using an IMS report on the US prescription drug market.<sup>4</sup> These top ingredients and branded drugs were then matched to NDCs. On average, 94% of the NDCs included in the top ingredient sample were generic drugs; as such, we categorized the top ingredients as generics. The NADAC and NARP data were then aggregated to the NDC-dosage-month level, and an analytic sample consisting of the NDCs for each of the top generic and brand name drugs was developed. The gross profit for each NDC in the sample was calculated as the difference between NADAC and NARP values, and the gross margin was calculated as the gross profit divided by the NARP value. Finally, average gross margins for each drug in the top generic and top branded drug lists were calculated by averaging gross margins across all NDCs (equally weighted) corresponding to that drug. To determine sales for each drug in our lists, we used 2013 sales data from the IMS report for branded drugs, and the number of prescriptions sold in 2013 (also from the IMS report) times the NARP value for each generic drug. The average gross margin for each category (all drugs, brand only, generic only) was then calculated as the sales-weighted average gross margin for all drugs in the category of interest.

Calculated in this manner, for all drugs together, gross margins were similar to those calculated using SEC data: 23.1% using the NARP and NADAC data, compared to 20.1% using SEC data.

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### **ALTERNATIVE INSURER MARGINS**

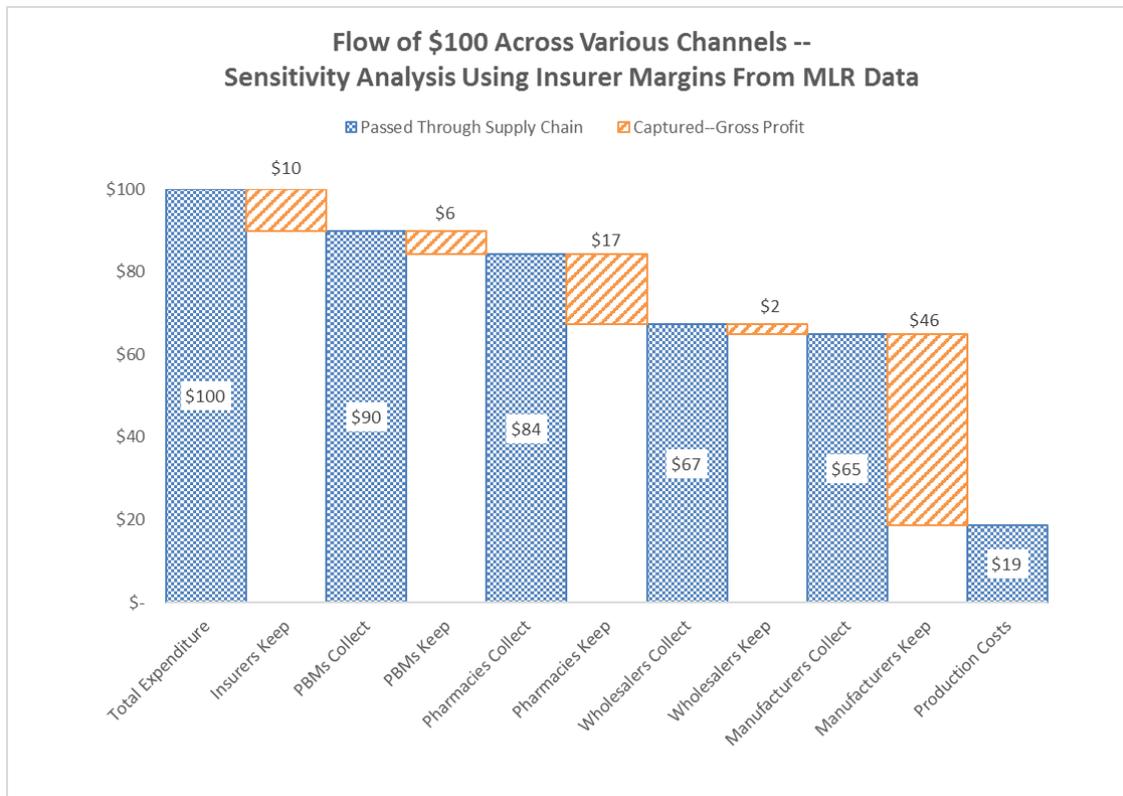
For insurers, the CMS Medical Loss Ratio (MLR) Public Use Files include yearly data for all insurers by market on the dollar value of total claims paid, and the MLR, or the fraction of premiums spent on claims or health quality improvement efforts.<sup>5</sup> The Affordable Care Act established a regulation requiring insurers' MLR to be at least 80-85%, effectively capping the fraction of premiums available for administration, marketing and profits, or 1-MLR, at

15-20% (the lower amount for large group market insurers). If they do not meet these requirements, plans must provide an annual rebate to enrollees. To comply with the law, health insurers must therefore submit data on premium revenues and claims from which to calculate the MLR. MLR data are provided for each insurer-market combination, where markets include individual, small group, and large group. For each market, insurers provide the dollar value of total claims paid and the MLR.

To generate alternative estimates for insurer gross margins, we therefore used the MLR data to calculate the 2014 claim-weighted average MLR, excluding observations with a MLR value of zero (an MLR of zero implies the insurer paid no claims and is therefore unrealistic), and defined the gross margin as 1-MLR. The same insurer margin was used for the overall market, brand, and generic drugs because the MLR data do not distinguish by drug category.

The average insurer gross margins calculated in this manner were 11.6%, slightly more than half of the 22.2% calculated from SEC filings. This may be due to different accounting practices for expenditures on quality improvement activities in the MLR calculations versus the SEC filings. As a sensitivity analysis, Figure A1 shows how the flow of \$100 through the distribution system differs when insurer margins calculated from the CMS MLR files are used. The share of funds captured as gross margins by insurers falls from \$19 to \$10 when the MLR data are used instead of SEC filings, and the share of funds captured by manufacturers rises from \$41 to \$46. The share of funds captured by PBMs, Pharmacies and Wholesalers also rise slightly when MLR data are used, as do the production costs.

**Figure A1: Sensitivity Analysis: Flow of a hypothetical \$100 expenditure on prescription drugs through the US retail distribution system, insurer margins from MLR data**



**SECTION C: CALCULATING THE SHARE OF DRUG PAYMENTS ORIGINATING AS PREMIUMS**

For the analysis of how an expenditure of \$100 flows through the distribution system, it was necessary to estimate the fraction of that expenditure originating as out-of-pocket payments, since this money goes directly to the PBM and is therefore not subject to the insurer’s gross margin when we calculate the accrual to the insurer. To do this, we used data from two sources: the 2014 Medical Expenditure Panel Survey (MEPS), and the 2015 SEC filings of the sample of insurers listed in Table 1.

The MEPS data provide estimates of annual total prescription drug expenditures, by payer, and out-of-pocket payments made by beneficiaries for prescription drugs.

MEPS provides data on prescription drug expenditures and insurance coverage at the person level, and was used to determine the fraction of total prescription drug expenditures that are paid by insurance versus out-of-pocket (OOP), for three drug categories: all prescription drugs, brand drugs, and generic drugs. Using the 2014 MEPS Full Year consolidated data file, we assigned each person to private insurance only if he or she reported private insurance coverage for strictly more months out of the year than any other insurance category (e.g. Medicaid, Medicare, other public insurance, self-pay, etc.).

We further utilized the 2014 MEPS Prescribed Medicine (PM) file to assign prescriptions as branded or generic. To do this, we linked the PM file to the Medi-span database<sup>6</sup> by NDC, and used the Medi-span “multi\_source\_code” and “name\_type\_code” variables to define branded and generic. NDCs that did not appear in Medi-span or were missing one or both variables were not assigned to either.

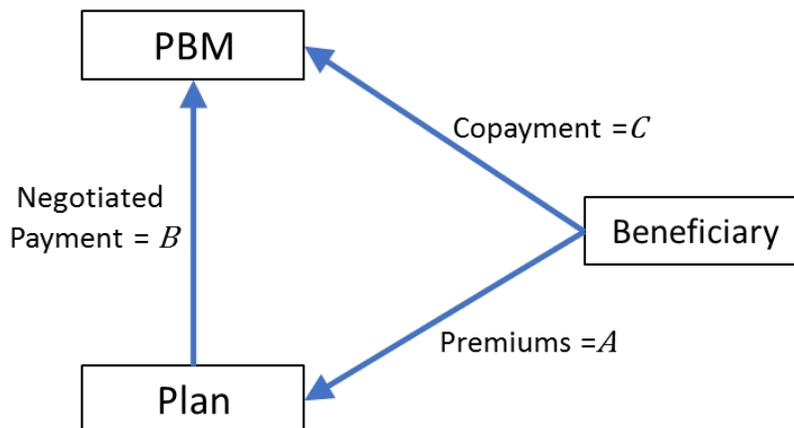
For each person, we calculated total OOP prescribed medicine costs (RXSF14x) and total prescribed medicine payments (RXXP14x) for 2014 as the sum across all prescriptions for the year. We assumed total prescribed medicine payments were the payments made to PBMs. We also summed OOP costs separately for branded and generic prescriptions. We then aggregated total payments and total OOP costs over the population, using person-level survey weights (PERWT14f). Aggregate payments to PBMs were calculated separately for the categories of all prescription drugs, branded drugs, and generic drugs.

Consider Figure A2 below, which shows the payments from beneficiaries to health plans and PBMs, and from health plans to PBMs. Beneficiaries pay premiums to their health plans in the amount of  $A$ , and when a drug is purchased, beneficiaries pay a copayment of  $C$  to the PBM, while health plans pay PBMs the negotiated amount  $B$ . We wish to estimate the fraction of the total expenditures on drugs that is accounted for by premiums, that is, we are looking for

$$X = \frac{A}{A + C}$$

The MEPS data provide us with estimates of both  $C$ , the total amount of copayments made for drugs, and  $B+C$ , the total payments to PBMs for drugs (Table A1). Subtracting the two values, we can obtain  $B$ , the plan payments to PBMs for drugs.

**Figure A2. Payment Flows from Beneficiaries to Health Plans and PBMs, and Health Plans to PBMs**



**Table A1. Total and out-of-pocket for prescription drugs from the 2014 Medical Expenditure Panel Survey data**

Drug market	Out-of-pocket payments (C)	Total payments (B+C)
Overall	\$22,296,820,337	\$142,623,075,250
Brand	\$11,752,432,026	\$68,691,551,405
Generic	\$8,758,161,927	\$34,084,169,566

From the SEC filings, we have calculated the average insurer gross margin

$\pi_{insurer} = (A - B)/A$ , which is the share of premiums that commercial health plans spend on drugs. Thus, using the estimate of  $B$  from the MEPS data, we can solve for  $A = B/(1 - \pi_{insurer})$ , and combine this with the estimate of  $C$  from the MEPS data to derive an estimate of  $X=87.4\%$  for the overall drug market, 86.2% for the brand market, and 78.8% for the generic market.

#### SECTION D: CALCULATING THE FLOW OF FUNDS THROUGH THE DISTRIBUTION SYSTEM

To calculate how a \$100 expenditure on pharmaceuticals from a retail pharmacy is allocated throughout the distribution system, we rely on the conceptual framework in Figure 1 and the parameter estimates in Table 2 in the main article. As calculated in the preceding section for the overall drug market, 87.4%, or \$87.40 of the original \$100 expenditure, originates as premium payments, with the remaining \$12.60 originating as a patient out-of-pocket expenditure. The patient out-of-pocket payment goes directly to the PBM, while the remaining \$87.40 is a premium payment to the insurer, and is subject to the insurer’s gross margin, estimated at 22.2%. Thus, the insurer accrues 22.2% of \$87.40, or \$19.40 as gross profit. The insurer sector passes through what remains, or \$87.40 - \$19.40 = \$68.00 to the next sector in the chain, PBMs.

PBMs thus take in \$68.00 from insurers, and \$12.60 from patient out-of-pocket expenditures. To the combined revenue of \$80.60 is applied the PBM gross margin, estimated at 6.3%, to calculate the funds accrued as gross profits in the PBM sector, or \$5.08. The remaining \$75.52 is passed on to the next sector in the chain, pharmacies, to which the 20.1% pharmacy margin is applied, resulting in \$15.18 accrued by pharmacies. The remaining \$60.34 is passed to wholesalers, and the wholesaler gross margin of 3.7% is applied, resulting in \$2.23 accrued by wholesalers. The remaining \$58.11 passes on to manufacturers, who accrue 71.1% or \$41.31 as gross profit, and pass the remaining \$16.80 to production costs.

## REFERENCES

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