Understanding profit margins of medical providers from prescription drugs: evidence from Taiwan

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Background: This study empirically estimates the magnitude and associated determinants of profit margins that medical providers earn from prescription drugs based on Taiwan’s pharmaceutical market.

Methods: Our main data set is from the population-based claims data compiled by the National Health Insurance Research Database covering three waves of price adjustment: July–December 2004, October 2007–September 2008 and October 2009–September 2010. Only drugs whose reimbursement prices were adjusted using the R-zone formula were used as samples for this study. By calculating the difference between retail and wholesale prices for 796 pharmaceutical products, we can estimate the profit margin determinants using the regression model.

Results: We found evidence that suppliers of generic drugs tend to offer larger discounts to medical providers than suppliers of brand-name drugs. In addition, the countervailing power of wholesale pharmaceuticals, as measured by the discount rate offered by pharmaceutical manufacturers, is positively associated with the degree of competition within the pharmaceutical market and the size of the market itself.

Conclusions: Our findings imply that the profit-seeking behaviour exhibited by medical providers is the engine of competitive forces in Taiwan’s prescription drug market. This creates financial incentives for them, which in turn influences their choices of prescription drugs.

Keywords: National Health Insurance, profit margin, profit-seeking behaviour

Introduction

In the prescription drug market, a prescription is required before a drug can be purchased. This makes physicians act as “front-line professional agents” who make consumption decisions on behalf of their patients.1 The underlying rationale for the prescription requirement is that patients do not know what specific drugs are appropriate for a particular treatment. However, the information asymmetry between physicians and their patients also puts physicians in an advantageous position in terms of ‘advising’ their patients in making decisions that might not be in the patients’ best interest, even if they are fully informed. When the physician does not act in the best interest of the patient due to information asymmetry, an agency problem occurs.2,3 There are many studies that show that agency problems exist with regard to physicians’ prescription decisions.4–7

A driving force that induces physicians to act as imperfect agents in the prescription decision is the fact that they can be unduly influenced by financial motivation, as they earn a profit directly from prescribing specific drugs. The importance of the pharmaceutical market in the health sector has increased in recent years due to pharmaceutical innovation.8,9 Therefore studies have focused on the potential influence of the agency problem on this market.

On the one hand, the agency problem in the pharmaceutical market may lead to distortion in terms of the relative prices of prescription drugs and other healthcare services. In view of the positive profit margin on prescription drugs, providers have a financial incentive to substitute prescription drugs for other healthcare services. This, in turn, can lead to overprescribing. On the other hand, another price distortion appears between brand-name and generic drugs. As a result, the physicians choose drugs based on the profit margins they receive rather than on the drugs’ efficacy, safety or cost.5,10

Although previous studies provide evidence that the profit margin affects both the demand for prescription drugs and the physicians’ choice of drug, little is known about the magnitude...
and the associated determinants of profit margins for individual drugs. A growing body of empirical research has attempted to fill this gap by quantifying the magnitude of the profit margins that medical providers earn in the prescription drug market.\textsuperscript{4,6,7,11} Lizuka\textsuperscript{6} used the same R-zone formula to compute the mark-up by calculating the difference between the wholesale price (physicians’ purchasing price) and the retail price, and found that physicians’ prescription choices are affected by the profit margin. By using rich micro-panel data, Lizuka\textsuperscript{7} further found that the physician heterogeneity of responses to profit margins between generic and brand-name drugs. In the context of US drugstores, Ellison and Snyder\textsuperscript{11} noted that supplier competition is a prerequisite for countervailing power (i.e., the extent to which large buyers are able to reap discounts from suppliers) and found that hospitals obtain relatively larger discounts than drugstores. Epstein and Johnson\textsuperscript{1} compared the average wholesale price and the wholesaler acquisition cost to compute profit margins and found that even oncologists are influenced by financial incentives when making prescription decisions.

This study contributes to the growing body of literature on this subject in the context of Taiwan’s pharmaceutical market, where medical providers (clinician physicians or hospitals) are able to earn profits directly from prescription drugs. In Taiwan, this profit margin, which is the price concession on transactions between providers and pharmaceutical firms through the wholesale pharmaceutical market, is implicitly acknowledged by the regulator of the healthcare market. The National Health Insurance Administration (NHI) regularly conducts market surveys to update the National Health Insurance (NHI) reimbursement price to approximate that of the wholesale market. We calculate the profit margins for 796 pharmaceutical products by calculating the difference between the regulated payment price and the unregulated wholesale price. We then empirically estimate the determinants of profit margin to test several hypotheses regarding the countervailing power in the pharmaceutical market—that is, the ability of larger buyers (e.g., larger hospitals) to extract discounts from suppliers (e.g., pharmaceutical manufacturers). Ellison and Snyder\textsuperscript{11} used countervailing power to represent the bargaining power of large buyers against the market power of large suppliers. In other words, large buyers can extract more benefits from price concessions with suppliers, and research results show that hospitals tend to receive larger discounts than drugstores, as there is competition among the suppliers of pharmaceutical products.

The major contributions of our analysis are as follows. First, empirical studies on the determinants of profit margins for prescription drugs have been largely confined to the USA and Japan, where the separation between drug prescribing and dispensing has been either a social norm (as in the USA) or has become increasingly popular (as in Japan).\textsuperscript{4,6,7,11} Studies are still needed in other countries, because healthcare systems vary substantially from one country to another. Second, previous research has often focused on specific types of prescription drugs, namely physician-administered anticancer drugs, hypertension drugs and antibiotics.\textsuperscript{6,7,11} In this study we used 222 molecular entities (which covers more types of prescription drugs) to investigate the determinants of profit margin, hence this study is broader in scope than most studies.

Background

Taiwan has a healthcare system where physicians both prescribe and dispense drugs. With this practice, and the government’s price controls on pharmaceutical products, physicians and hospitals are able to earn profits directly from the sale of prescription drugs. In addition, providers have financial incentives to substitute prescription drugs for other medical treatments such as tests, time spent on diagnoses or surgical treatments. Pharmaceutical expenditures consequently account for a larger share of healthcare expenditures in Taiwan.

The government in Taiwan provides universal coverage for both prescription drugs and other healthcare services through what is known as the NHI programme. Under this programme, a national formulary (positive list) that includes all pharmaceuticals eligible for reimbursement is created. One of the important characteristics of this formulary is its long reimbursement list. Around 26 000 prescription drugs have been approved by the single public payer since its establishment in 1995, and more than half of these were still being reimbursed as of 2010. This feature is similar to South Korea’s programme, but it stands in stark contrast to many Organisation for Economic Co-operation and Development countries, whose insurance formularies typically include only 3000–8000 drugs.\textsuperscript{12}

Although more than 26 000 drugs are listed in Taiwan’s NHI formulary, providers include only a relatively small number of drugs in their own formularies. This practice gives hospitals significant market power in the pharmaceutical market. As will be discussed later, there is price competition in Taiwan’s wholesale market, although the government regulates the reimbursement price. There is a long list of substitutable drugs within a given therapeutic group, thus pharmaceutical manufacturers are forced to compete by cutting wholesale (acquisition) prices.\textsuperscript{10}

To control the cost of public insurance, the government regulates the reimbursement price of prescription drugs (P), which is the price paid on behalf of patients. However, it does not regulate the acquisition price (P\textsubscript{a}), the wholesale price hospitals and clinics secure from the pharmaceutical manufacturers in the wholesale market.

At the time of entry, the single public payer (NHI) uses a mix of strategies to determine the reimbursement price (also referred to as the launch price) for each specific brand-name and generic drug, including references to existing products and to international comparisons; it also considers the drug’s therapeutic value.\textsuperscript{10,13} Following entry into the market, the public payer conducts a market survey of wholesale prices and uses the results to update the reimbursement prices of existing drugs. As mentioned, the government regulates only the payment price and not the wholesale price, which is the basis for clinic and hospital purchases of drugs from pharmaceutical manufacturers. The difference between the reimbursement and wholesale price is the profit margin earned by the clinics and hospitals. To ‘squeeze’ this profit margin, the public payer regularly conducts market surveys to collect information on the actual average wholesale price (AWP) and then readjusts the reimbursement price level. During 1999–2010, the public payer updated the reimbursement prices seven times following results of AWP market surveys (see Appendix 1).
Methods

Measurement of profit margin

According to the principle of price adjustment set by the single public payer, the R-zone formula is applied to select drugs that allow medical providers to keep profit margins within a reasonable range. In the fifth wave of price adjustment, this formula was adopted for drugs that had received patent protection for their molecules after 1984. The timeline of the patent protection period shifted to 1986 and 1988 in the sixth and seventh waves of price adjustment, respectively. Based on the R-zone formula used by the NHIA, the regulated price in period $t$ ($P_t$) for the existing product is

$$P_t = P_0 - \theta \times P_t^{-1},$$

(1)

where $P_0$ is the weighted average acquisition (wholesale) price, which is defined as

$$P_0 = (1 - \theta) \times P = P - \theta \times P,$$

(2)

where $\theta$ is the discount rate offered by the pharmaceutical manufacturers. $\alpha$ is a ‘reasonable zone’ for the profit margin, in that it allows medical providers to cover the technical fees and transaction costs of dispensing drugs. Equation (1) states that the public payer uses the weighted average of the wholesale acquisition price obtained from a market survey and the reimbursement price in the previous period to set the regulated price in the current period. Since the public payer has never publicly released the results of market surveys, $P_0$ is unobservable by outside parties. In addition, during the first to fourth waves of price adjustments, the public payer did not set a consistent value for the ‘reasonable zone’ of profit margin. Thus $\alpha$ is also a value unknown to outside parties, making it difficult to trace the true value of the wholesale price through information on the regulated reimbursement prices in two consecutive periods (e.g., $P_t$ and $P_{t-1}$). However, the regulator has publicly announced setting $\alpha=0.15$ since 2004, and this allows us to trace the AWP through Equation (1) as

$$P_0 \downarrow = P_0^* - 0.15 \times P_t^{-1}.$$

(3)

Based on Equation (2), we can calculate the mean discount rate offered by the pharmaceutical manufacturers ($\theta$) as

$$\theta = \left( P_t^{-1} - P_0 \downarrow \right) / P_t^{-1}.$$

(4)

In summary, according to Equation (3), we can compute backwards to obtain the AWP ($P_0 \downarrow$) by using information on the new regulated price ($P_t$) and the old regulated price ($P_{t-1}$). We then use Equation (4) to calculate the mean price discount rate that the pharmaceutical manufacturers offer to medical providers in the wholesale market. Ellison and Snyder\textsuperscript{11} refer to this discount rate as the ‘countervailing power’ in wholesale pharmaceuticals. Since the R-zone formula is the key to empirically deriving discount rates, this study examines only those drugs for which the reimbursement price adjustment is based on this formula. Drugs for which the price adjustment is based on other principles—such as the guaranteed floor price or the maximum price adjustment for individual products—are excluded from this study.

Data sources

The data utilized in this study are derived from two primary sources. The first is data on the adjustment of the regulated reimbursement price as released by the NHIA during the fifth to seventh waves of price adjustment. This data set includes drug codes, drug names, brand names, patent dates, new approved prices, molecule names, manufacturers, dosage forms and group codes. Drugs within a group are those with the same molecule and dosage forms. We select samples from pharmaceutical products for which the reimbursement prices were updated in these three price adjustment waves using the same pricing rules. This in turn enables us to trace their wholesale prices by way of Equation (3).

Based on this criterion, we identify a sample of 796 products whose reimbursement prices have been adjusted according to Equation (1) and where the value of $\alpha$ equals 0.15. These drugs are significant in Taiwan’s pharmaceutical market in terms of market size since the total sales of these drugs account for >45% of the NHIC’s pharmaceutical expenditure—even though the number of selected drugs in our study accounts for only 3% of the drugs included in the NHI formulary.

Price adjustment was done in three waves during the following three periods: July–December 2004, October 2007–September 2008 and October 2009–September 2010. The second data source is the population-based claims data compiled by the NHIC database for each of the three aforementioned periods. This database provides information regarding the use of each prescription drug. We aggregate patient-level prescription information to obtain product-level use data. Similarly, molecule-level data can be obtained by aggregating product-level use data. Based on the drug codes, we can identify the reimbursement price of each drug, as these are included in the NHIC formulary.

Theoretical framework

As noted by Ellison and Snyder\textsuperscript{11} supplier competition is a necessary condition for larger-buyer discounts. Thus both buyer size and supplier competition are required for countervailing power. Following this framework, in combination with the institutional features of the pharmaceutical market in Taiwan, we specify that the discount rate ($\theta$) is a function of the number of competing products in the same market (N), the buyer size (M) and the therapeutic value of drugs (A),\textsuperscript{10} that is,

$$\theta = \theta \left( N, M, A \right).$$

(5)

All things being equal, the discount rate is positively associated with $N$ and $M$ but is negatively associated with $A$. This is
because an increase in the intensity of supplier competition and an increase in buyer size give buyers more advantage in getting better price concessions from suppliers. Thus the countervailing power gained by the medical provider (\( \theta \)) is positively associated with the number of competing products within the same market and the buyer’s size.

In addition, medical providers can get higher countervailing power from the suppliers of lower-quality products, such as generic drugs, without conducting a bio equivalence (BE) test than that of high-quality products, such as brand-name drugs with significant therapeutic advances over existing products. This inverse relationship between the therapeutic value and the countervailing power can be simplified by observing the relationship between the versions of the drugs and the countervailing power. In general, we predict that medical providers could gain greater countervailing power from suppliers of generic drugs than from suppliers of brand-name drugs.

**Empirical specification**

Based on the theoretical framework of this model, an empirical model that explains the determinants of the discount rate can be expressed as follows:

\[
\log (\theta_{ijkt}) = \alpha_1 + \alpha_2 Brand_{ijt} + \alpha_3 V_{it} + \alpha_4 HHIs_{ijkt} + \alpha_5 N_{ijkt} + \\
+ \alpha_6 N_{ikjt} + \alpha_7 (\text{MarketSize})_{jt} + \alpha_8 PrivShare_{it} + \alpha_9 HospShare_{jt} + \alpha_{10} W1 + \alpha_{11} W2 + \eta_{ijkt} + \varepsilon_{ijkt},
\]

where \( i, j, k \) and \( t \) denote the drug, molecule market, therapeutic market and survey period, respectively, and \( \varepsilon_{ijkt} \) is the random error. We start the analysis by using an ordinary least squares (OLS) regression and with separate models for the generic and branded subsamples. Cluster standard errors at the therapeutic market level are applied for the pooled OLS model.

**Table 1** provides definitions and summary statistics for the variables used in our estimation. The data show that the mean discount rate is 28%. In addition, this study used two variables to measure the perceived quality of drugs: \( Brand \) is a dummy variable for brand-name drugs and \( BE \) is a dummy variable for generic drugs that have passed the BE test. **Table 1** shows that in our study sample, 58% of the products are brand-name drugs and 49% of the generic drugs have passed the BE test.

In our study, the supplier market is defined in terms of molecule markets and therapeutic markets. We define molecule markets by molecule names, suggesting that drugs with the same molecule but different strengths or dosage forms will still be classified within the same market. Therapeutic markets are defined by the fourth level of the Anatomical Therapeutic Chemical (ATC) classification code, because substitution opportunities not only affect choices between generic drugs and brand-name counterparts, but also among therapeutic equivalents. Therefore, for each price-survey period, we measure supplier competition by using the Herfindahl–Hirschman Index (HHI) of competing drugs as approved by the NHIA within the same molecule market and the number of molecules approved by the NHIA within the same therapeutic market. The HHI for each molecule market is calculated as the sum of the squares of market share for each product within a molecule market. A higher HHI value is associated with a lower degree of competition in a molecule market. As shown in **Table 1**, the mean HHI of the generic market is 6089. The mean number of competing molecules within the same therapeutic market is 3.1. The mean number of forms within the same molecule is around 1.9.

With regard to the buyer-size effect, since the price adjustment is based on the weighted average wholesale price, the transaction wholesale prices obtained by individual providers are not available, resulting in a lack of information on the scale of individual buyers. We therefore use the market share of medical centers and metropolitan hospitals as a proxy to measure the buyer-size effect, given that medical centers and metropolitan hospitals are likely to be large buyers within the market. Indeed, **Table 1** shows that, on average, about 60% of all prescription drugs are purchased by medical centers and metropolitan hospitals.

To evaluate whether the price cut by the public payer reduces the discount rate over time, we include two dummy variables to present the time period of the price adjustment. The data show that 46% and 32% of group observations belong to the sixth and seventh price adjustment actions, respectively, with the fifth price adjustment serving as the reference group.

**Results**

**Descriptive analysis**

**Figure 1** shows the frequency distribution of the mean discount rate for the 796 products in our study sample. Overall, the results show that the discount rate ranges from 15% to 57%, with the mode being concentrated at 20%. This is higher than previous anecdotal evidence, where the profit rates of prescription drugs in Taiwan range from 5% to 40%.\(^\text{14}\) **Figure 2** shows the same distribution pattern, but by drug version. Across generic drugs, there is substantial variation in the discount rate. In contrast, the discount rates of brand-name drugs are concentrated in a relatively narrow range. This suggests that branded firms are less likely to offer a larger discount rate, such as >40%, as many generic-drug firms do.

**Table 2** presents the quantile distribution of the discount rates. In general, the discount rates of generic drugs are greater than those of brand-name drugs across all quantiles. The distribution presented in **Table 1** shows that across these three survey periods, more than half of the price concessions from pharmaceutical procurement resulted in discount rates of >30% for generic drugs and >25% for brand-name drugs. The mean discount rate for generic drugs ranges from 30% to 33% across the three study periods—a figure that is higher than that of brand-name products, by about 8 percentage points. **Table 2** also shows that the discount rate increased by about 3 percentage points between 2004 and 2010 for both generic and brand-name drugs. This may have been due to the entry of new firms each year and the newer drugs they introduce are more likely to be listed in the sixth and seventh price adjustment waves.
Table 1. Variable names, definitions and descriptive statistics

| Variables | Definition                                                                 | Full sample | Generic subsample | Branded subsample |
|-----------|---------------------------------------------------------------------------|-------------|-------------------|-------------------|
| $\theta$  | Discount rate                                                             | 0.28 (0.10) | 0.32 (0.11)       | 0.25 (0.07)       |
| Brand     | Dummy variable: 1 for brand-name drug, 0 otherwise                         | 0.58 (0.49) | NA                | NA                |
| BE        | Dummy variable: 1 for generic drug that passed BE test, 0 otherwise        | NA          | 0.49 (0.50)       | NA                |
| Drug vintage (V) | Number of months from entry into the NHI formulary until the price-adjustment period | 52.58 (34.23) | 36.32 (24.97)   | 64.31 (35.19)     |
| $HHI_{GC}$ | HHI of each molecule market                                               | 6089.15     | 5245.12           | 6699.34           |
| $N_{FC}$  | Number of dosage forms with the same molecule                              | 1.85 (1.05) | 2.07 (1.18)       | 1.68 (0.92)       |
| $N_{TC}$  | Number of molecules within the same therapeutic market (ATC code at the fourth level) | 3.09 (1.93) | 2.94 (1.82)       | 3.19 (2.00)       |
| Market size | Sales of each molecule (in millions of TWD)                              | 317 (506)   | 392 (566)         | 262 (451)         |
| PrivShare | Market share of private hospitals                                         | 0.64 (0.26) | 0.63 (0.31)       | 0.65 (0.22)       |
| LHospShare | Market share of medical centres and metropolitan hospitals               | 0.59 (0.32) | 0.18 (0.26)       | 0.43 (0.23)       |
| W1        | Dummy variable: 1 for the sixth price adjustment, 0 otherwise             | 0.46 (0.50) | 0.50 (0.50)       | 0.43 (0.50)       |
| W2        | Dummy variable: 1 for the seventh price adjustment, 0 otherwise          | 0.32 (0.47) | 0.34 (0.47)       | 0.30 (0.46)       |
| Observations, n |                                                     | 796         | 334               | 462               |

Values presented as mean (standard deviation).
TWD: Taiwan dollar.

Figure 1. Density of discount rates ($n=796$).

Empirical results

The empirical results in Table 3 are derived from Equation (5) using full samples and subsamples of generic and brand-name drugs. We find that the discount rate of brand-name drugs is significantly lower than that of generic drugs, and this is consistent with the theoretical prediction of the countervailing power model.\cite{11} Based on the results from the full sample, the estimated coefficient indicates that the discount rate of brand-name drugs is around 20% lower than that of generic drugs. It is worth noting that this profit advantage of generic drugs might be short term.\cite{7} Because we did not use panel data, we cannot trace the long-term trend of profit margins.
Figure 2. Density of discount rates for generic and brand-name drugs.

Table 2. Quantile distribution of the discount rate

| Period                  | Version | Minimum | 25%  | 50%  | 75%  | Maximum | Mean  | n    | Cross-brands |
|-------------------------|---------|---------|------|------|------|---------|-------|------|--------------|
| Cross-periods           | Generic | 0.152   | 0.306| 0.409| 0.569| 0.322   | 0.278 | 334  | 0.278        |
|                         | Branded | 0.151   | 0.282| 0.509| 0.246|         |       | 462  |              |
| July 2004–December 2004 | Generic | 0.158   | 0.299| 0.374| 0.515| 0.305   | 0.305 | 54   | 0.252        |
|                         | Branded | 0.154   | 0.205| 0.251| 0.483| 0.228   | 0.238 | 123  |              |
| October 2007–September 2008 | Generic | 0.155 | 0.306 | 0.387 | 0.563 | 0.319 | 0.28 | 166 | 0.28         |
|                         | Branded | 0.156   | 0.230| 0.283| 0.509| 0.248   | 0.248 | 199  |              |
| October 2009–September 2010 | Generic | 0.152 | 0.311 | 0.432 | 0.569 | 0.335 | 0.305 | 114 | 0.294        |
|                         | Branded | 0.151   | 0.239| 0.304| 0.506| 0.260   | 0.260 | 140  |              |
| Overall                 | Generic | 0.151   | 0.252| 0.335| 0.569| 0.278   | 0.278 | 796  |              |
|                         | Branded | 0.200   | 0.252| 0.335| 0.569| 0.278   | 0.278 | 796  |              |

The estimated coefficient of BE is significantly positive in the generic subsample, suggesting that generic drugs that passed a BE test could obtain a higher discount rate. This may result from the fact that the initial reimbursement prices of generic drugs that passed a BE test are higher than those that did not.

The estimated result also shows that in the branded subsample, drug vintage (i.e. the age of a drug since its launch on Taiwan’s market) correlates positively with the discount rate, which indicates that branded firms are able to offer a higher discount rate to medical providers as their drugs become older. However, the effect of drug vintage is not statistically significant in the generic subsample.

With respect to the HHI of the generic market, we find a significant and negative impact on the discount rate in the generic subsample, indicating that generic-drug firms are more likely to give a higher discount rate to medical providers if they face a less-concentrated market (i.e. a lower HHI value). We also find that the coefficient of the number of competing molecules is both significant and positive in the branded subsample, indicating that branded firms would offer a high discount rate to medical providers if they were to face more competitors in the same therapeutic market. These results suggest that competitive forces with regard to generic drugs are driven by competition in the generic market (i.e. generic competitors), but competitive forces for brand-name drugs arise from competition within the therapeutic market.

In addition, the coefficient of the number of dosage forms with the same molecule is significant and negative in both the full sample and the generic subsample, suggesting that drugs with different dosage forms might give pharmaceutical firms more bargaining power in lowering the discount rate. This is because innovation in dosage form creates additional value for these drugs, which in turn leads to a discount advantage. This is similar
to the case in the Japanese prescription drug market where the first mover had the advantage.6

With respect to the buyer-size effect, we found that the market share of larger hospitals does not have a significant effect on the discount rate.10 However, the ownership type of the hospital has a significant effect on the discount rate. The estimated results indicate that pharmaceutical manufacturers are likely to offer medical providers a higher discount rate if their products are more highly concentrated among private hospitals. A plausible explanation for this result is that private hospitals are more responsive to financial incentives than public hospitals.15-17 In other words, the countervailing power is likely to be more prevalent among private rather than public hospitals.

We also found that the market size of prescription drugs has a significantly positive impact on the discount rate, indicating that hospitals and clinics are more likely to receive a higher discount rate in the wholesale pharmaceutical market if more prescription drugs are sold. The results indicate that the elasticity of the discount rate with respect to market size is around 0.03, suggesting that a 10% increase in the market size (in terms of sales value) leads to an increase in the discount rate of about 0.3%. In addition, we find that this market size effect is greater for generic drugs rather than for brand-name drugs.

Finally, we find that the dummy variable representing the price survey period has a positive effect on the discount rate. This result lends no support to the argument that price adjustments are periodically beneficial in ‘squeezing’ the profit margins earned by medical providers. A plausible explanation for this result is that the pharmaceutical market is dynamic, as many new firms enter the market each year, which in turn fuels competition in the wholesale pharmaceutical market. As noted, supplier competition is a necessary condition for countervailing power,11 so new entrants among pharmaceutical products will continue to rely on a price-competition strategy (i.e. by offering price discounts to medical providers) to penetrate the market. As a result, competition arising from new entries may provide an ‘offsetting force’ that weakens the effect of a price-cutting policy on the size of profit margins.

Conclusions

This study examined the prescription drug market in Taiwan to investigate how much medical providers earn from prescription drugs under a system where they can earn profits directly from the pharmaceutical market. In addition, this study addressed the question of what major economic variables shape the magnitude of the profit margins on individual drugs. Using a selected sample of 796 important pharmaceutical products consumed in Taiwan, this study made several important findings.

First, we found that the discount rate ranges from 15% to 57%, with the mean being 28%. This indicates that the profit margin earned by medical providers in the wholesale pharmaceutical market is not insignificant. Second, we found that generic-drug firms tend to offer a larger price discount to medical providers than brand-name firms. Third, we found that the degree of competition in the pharmaceutical market has a significant and positive effect on the discount rate, which is positively associated with the size of the prescription drug market (in terms of sales). All these important findings are consistent with the theoretical prediction of countervailing power, thus indicating that competition in the wholesale market and the size of the market are important factors in determining the price discount pharmaceutical manufacturers offer to medical providers.

An important implication of this study is that the existence of discount rates offered by pharmaceutical manufacturers in the wholesale market is a persistent market outcome, in spite of a series of government policy efforts to cut reimbursement price levels. This means that the current pricing policy—which forced reimbursement prices to decline over time—does not remove price concessions from pharmaceutical manufacturers, as long as the wholesale pharmaceutical market remains unregulated.

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### Table 3. OLS regression results of discount rates

| Variables | Full sample | Generic subsample | Branded subsample |
|-----------|-------------|-------------------|-------------------|
| Brand     | -0.196***   | NA                | NA                |
|           | (0.033)     |                   |                   |
| BE        | 0.107**     | 0.107**           | NA                |
|           | (0.036)     | (0.038)           |                   |
| Drug vintage (V) | 0.001*      | 0.000             | 0.001**           |
|           | (0.000)     | (0.001)           | (0.000)           |
| log(HHI<sub>GC</sub>) | -0.058*     | -0.077*           | -0.032            |
|           | (0.024)     | (0.035)           | (0.033)           |
| N<sub>TC</sub> | 0.026***    | 0.012             | 0.034***          |
|           | (0.006)     | (0.010)           | (0.008)           |
| N<sub>FC</sub> | -0.039**    | -0.038*           | -0.033            |
|           | (0.013)     | (0.018)           | (0.019)           |
| PrivShare | 0.185***    | 0.200***          | 0.179*            |
|           | (0.043)     | (0.054)           | (0.070)           |
| LHospShare | -0.071     | -0.030            | -0.123            |
|           | (0.048)     | (0.064)           | (0.072)           |
| log(market size) | 0.028***    | 0.035***          | 0.023**           |
|           | (0.006)     | (0.010)           | (0.007)           |
| W1        | 0.045       | 0.022             | 0.058*            |
|           | (0.024)     | (0.048)           | (0.028)           |
| W2        | 0.066*      | 0.062             | 0.062             |
|           | (0.029)     | (0.054)           | (0.034)           |
| Constant  | -1.431***   | -1.347**          | -1.780***         |
|           | (0.262)     | (0.410)           | (0.351)           |
| R<sup>2</sup> | 0.3009      | 0.1773            | 0.2105            |
| n         | 796         | 334               | 462               |

Cluster standard errors at the therapeutic market level are reported in parentheses. * and ** denote statistical significance at the 10%, 5% and 1% levels, respectively.
As a result, the profit-seeking behaviour of medical providers is the engine of competitive forces in Taiwan’s prescription drug market, and this in turn generates financial incentives for them as they make prescription decisions.

Therefore, given the financial incentives associated with making prescription decisions, medical providers need to weigh both the patients’ welfare and the profits of providers before making such decisions. This study found that there are different profit margins for different drug versions and that competition within the drug market results in profit-seeking behaviour among medical providers rather than cost-saving behaviour with respect to patients or public payers, such as the NHIL programme. This imperfect agency problem suggests that the welfare of patients may be sacrificed for non-clinical reasons. Future policy should pay further attention to breaking the conflict of interest between prescribing and dispensing drugs by promoting a further separation of prescribing and dispensing policy.

This study has three major limitations. First, because the drugs used as samples are those that received patent protection for their molecules after 1984, old drugs were likely excluded from our analysis. In other words, our sample contained a relatively large share of newly approved drugs, and most of the relatively old drugs were excluded from our study because the public payer employs more complicated measures (rather than the R-zone formula) to adjust their reimbursement prices. This may have led to an estimation bias, as the magnitude of the profit margins, especially for old generic drugs, may have been underestimated. However, if the discount rate of a drug is <15%, it was excluded from the price adjustment list, thus implying that our discount rate estimation may have been overestimated. In addition, drugs adjusted according to other principles, such as the guaranteed floor price or the maximum price adjustment for individual products, were excluded from this study. Thus the results herein should be interpreted with caution.

Second, the variables of market characteristics, such as market size and number of competing pharmaceutical products, may suffer from endogenous issues. Future studies may find suitable instrument variables or an identification strategy to solve endogenous problems.

Third, this study used product-level data to calculate the mean discount rate. However, doing so does not provide information on the countervailing power of individual medical providers or on whether individual medical providers use legal or illegal approaches to secure price concessions from the suppliers of pharmaceutical products. Therefore, using firm-level data to estimate the magnitude of the countervailing power of individual hospitals, and understanding how individual hospitals exercise that countervailing power in practice, will be an important avenue for future research.

**Author’s contributions** Y-ML is responsible for the reported research and participated in the concept and design, analysis and interpretation of data and drafting and revising the manuscript.

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**Competing interests** None declared.

**Ethical approval** The data source utilized in this study is existing and publicly available from the NHIA and maintained by the Ministry of Health and Welfare in Taiwan. Therefore it is exempt from human subject regulations under 45 Code of Federal Regulation (CFR) 46.101(b)(4).

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# Appendix 1

Summary of Taiwan’s NHI market price survey

| Survey  | Survey time period        | Adjustment principles | Number of items with prices being reduced | Predicted cost savings (in millions of TWD) | Effective date       |
|---------|---------------------------|-----------------------|-------------------------------------------|---------------------------------------------|----------------------|
| First   | 1999                      | No R-zone             | 8961                                      | 500                                         | 1 April 2000        |
| Second  | 2000                      | No R-zone             | 9801                                      | 4600                                        | 1 April 2001        |
| Third   | 2001                      | No R-zone             | 8162                                      | 5700                                        | 1 March 2003        |
| Fourth  | 2002                      | No R-zone             | 581                                       | 2430                                        | 1 November 2004     |
| Fifth   | July 2004–December 2004   | R-zone for drugs that obtained patents after 1984 | 5358                                      | 15,000                                      | 1 November 2006     |
| Sixth   | October 2007–September 2008 | R-zone for drugs that obtained patents after 1986 | 7600                                      | 5870                                        | 1 October 2009      |
| Seventh | October 2009–September 2010 | R-zone for drugs that obtained patents after 1988 | 7300                                      | 9100                                        | 1 November 2011     |