Resale Price Maintenance And Market Coverage

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Abstract

This paper analyzes the impact of resale price maintenance (RPM) on market coverage and aggregate demand within vertically separated markets, modeled with a continuum of retailers serving heterogeneous markets that differ in size. We demonstrate that, while RPM eliminates double marginalization and consequently increases aggregate demand, it reduces market coverage. This reduction stems from the compression of downstream margins under RPM, rendering smaller markets unprofitable for retailers. However, we further show that the introduction of input price discrimination by the upstream firm, in conjunction with RPM, restores both maximized market coverage and aggregate demand.

Keywords: Resale Price Maintenance, Market Coverage, Competition Policy
JEL Codes: L42, L13, K21

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1 Introduction

This paper investigates the efficacy of uniform retail price policies, specifically Resale Price Maintenance (RPM), as a mechanism to enhance market coverage. Partial market coverage occurs when, for any given level of prices and costs, certain geographically defined market segments are not served. Consequently, consumers in these segments face substantial access barriers, such as extended travel distances (e.g., healthcare) or outright service exclusion (e.g., internet access). This situation can be deemed socially undesirable, particularly in the context of essential public services. For instance, in the European Union, these services include "housing, water and energy supply, waste and sewage disposal, public transport, health, social services, youth and family, culture and communication within society, including broadcasting, internet and telephony" (https://www.eesc.europa.eu/en/policies/policy-areas/services-general-interest).

When equilibrium market characteristics such as demand or price deviate from policy objectives, particularly in the provision of public services, governmental intervention may be considered necessary. From an economic perspective, the central task is usually to identify the most efficient regulatory mechanism to achieve the desired policy outcome. Efficiency, in this context, encompasses minimizing costs, including taxes, price distortions, administrative burdens, and disincentives such as diminished quality investments. For instance, while incentive regulation may prove effective in sectors like rail passenger transport or network operation, it may be too complex or impractical in other sectors such as pharmacies supplying prescription drugs to the general population or the rollout of broadband internet access in rural areas. Consequently, this paper examines the use of uniform retail pricing, specifically RPM, as a regulatory instrument to address instances where market coverage falls short of policy goals.

The relevance of this exercise is stressed when considering the example of prescription drugs. In some countries, prices (or co-payments) for some or, sometimes, all prescription drugs are uniform across regions or even the entire country. Examples include Germany, France, Canada, Austria, New Zealand or Switzerland. In other countries, such as the United States, Japan or Australia, prices (or co-payments) are non-uniform, with varying regulatory intensity. Retail price regulations, or the absence thereof, usually also affect the margins of pharmacies. Relevance is illustrated by a ruling of the European Court of Justice (ECJ) concerning the regulatory system of drug prices in Germany. On October 16, 2016, in Case C-148/15, the ECJ ruled that "the main proceedings, which provides for a system of fixed prices for the sale by pharmacies of prescription-only medicinal products for human use, *cannot be justified on grounds of the protection of health and life of humans*, within the meaning of that article, inasmuch as *that legislation is not appropriate for attaining the objectives pursued* (italics added by the authors)."[1] The court ruled that uniform retail prices for prescription drugs in Germany poses a restriction of trade between member states, especially with respect to online pharmacies abroad. Against this background, a member state has to show that such a restriction is justified. In the particular case, the court was apparently not convinced that RPM was the appropriate tool to achieve the goal of ensuring "a safe and high-quality supply of medicinal products to the German population" (par. 32). Against this background, we investigate whether and, if so, under which conditions, RPM can be an appropriate policy tool to increase market coverage.

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[1] https://curia.europa.eu/juris/document/document.jsf?docid=184671&mode=req&pageIndex=1&dir=&occ=first&part=1&text=&doclang=EN&cid=1042789

[2] https://curia.europa.eu/juris/document/document.jsf?docid=184671&mode=req&pageIndex=1&dir=&occ=first&part=1&text=&doclang=EN&cid=1042789

this background, we investigate whether and, if so, under which conditions, RPM can be an appropriate policy tool to increase market coverage.

In doing so, we analyze a model that is comprised of a continuum of markets, differentiated by size (e.g., population or income). Variations in the number of markets served are interpreted as changes in market coverage. In the context of the aforementioned examples, a higher market coverage would be interpreted as more rural areas having access to broadband internet or pharmacies. Downstream markets are segmented, as in Götz (2013) and Miklós-Thal and Shaffer (2021), and, if profitable, served by a monopolistic downstream retailer. These retailers are supplied by a monopolistic upstream firm. In the absence of RPM, retail prices are determined by downstream retailers; with RPM, the upstream monopolist sets retail prices. Retailer entry into a given market occurs when, given that market's size, the margin between wholesale and retail prices is high enough to cover fixed costs. Markets failing to meet this profitability threshold remain unserved.

We show that, in that setup, RPM decreases retail prices by eliminating double marginalization. While this increases aggregate demand, RPM leads to a decrease in market coverage relative to a non-RPM regime. This reduction arises from the compression of downstream margins under RPM, rendering smaller markets unprofitable for retailers. However, this effect is offset when the upstream firm implements input price discrimination (IPD) alongside RPM. In that case, the efficient level of market coverage is achieved (in the absence of transfer payments). This outcome is achieved because IPD allows for targeted reductions in wholesale prices within smaller markets. Consequently, the optimal market coverage and demand outcomes, absent further regulatory intervention, are achieved through the combined application of RPM and input price discrimination.

This study advances the literature in two principal areas: first, the analysis of efficiency in public service provision, which is, in general, a key element of regulatory economics, and, second the literature on RPM.

In regulatory economics, the primary focus is typically on mitigating market failures, such as monopolistic inefficiencies arising from information asymmetry (Baron & Myerson, 1982; Laffont & Tirole, 1986). Besley and Ghatak (2003) offer a broader theoretical framework for the efficient provision of public services. Notably, and closely related to our model from a technical perspective, Foros and Kind (2003) and Götz (2013) examine the impact of uniform input pricing versus IPD on market coverage and penetration within telecommunications and broadband sectors. By specifically analyzing the efficiency of uniform retail pricing and RPM as policy instruments to enhance market coverage, this paper introduces a distinct contribution to this body of literature.

Since the seminal work of Telser (1960), an extensive body of research has emerged that examines the welfare implications of RPM. A core finding is that RPM serves as a mechanism to internalize vertical externalities, notably double marginalization (Mathewson & Winter, 1983; Perry & Groff, 1985). Furthermore, RPM can enhance welfare by mitigating free-riding, particularly in service provision (Mathewson & Winter, 1984, 1986). However, beyond its potential to suppress downstream price competition, RPM may also negatively impact service quality (Dertwinkel-Kalt & Wey, 2024; Hunold & Muthers, 2017) and facilitate collusion (Hunold & Muthers, 2024; Jullien & Rey, 2007).[3] By demonstrating that RPM can function as an efficient regulatory instrument for policymakers to expand market coverage or demand beyond the "free" market equilibrium, this study addresses a gap in the existing literature. It is crucial to acknowledge that our model pertains to specific scenarios, such as public service provision, where policy objectives like maximizing market coverage are relevant. In this context, we echo d'Aspremont and Motta (2000, p. 126), who conclude that "under certain (admittedly strong) conditions, intermediate degrees of price competition might be optimal".

This article is structured as follows. Section 2 introduces our model. Subsequently, Section 3 discusses regimes where the upstream firm is able to set market-specific wholesale prices (input price discrimination). Section 4, in contrast, presents the respective analyses when the upstream firm is forced to set uniform wholesale prices. Section 5 concludes.

2 The Model

Consider a market for a homogeneous product. The product is produced by an upstream monopolist. Assume that production costs are zero. It is sold by multiple downstream retailers, each active in separate markets. (The concept is discussed in more detail at the end of this section.) In case a market is covered, exactly one retailer is active in that market. Retailers face fixed cost f. The upstream producer sells the product at a wholesale price w to retailers. By assumption, the entire bargaining power lies with the upstream firm, so that it can make a "take-if-or-leave-it" offer.

[3] Hunold and Muthers (2024) provide a comprehensive review of the RPM literature, which is recommended to interested readers.

Downstream markets are characterized by their market size θ, with $\theta \in [0, 1]$. The larger θ implies a larger market size. We assume that market size affects demand multiplicatively so that demand in market θ reads

$$q_\theta = \theta q(p). \tag{1}$$

This approach, which models heterogeneous markets by scaling demand with a market-specific parameter, builds on frameworks by Krugman (1979), Melitz and Redding (2014), and Melitz and Ottaviano (2008), who model market size heterogeneity in trade and competition models in a similar fashion. Similar specifications are also used in IO applications by, e.g., Chen (2022), d'Aspremont and Motta (2000), and Herweg and Müller (2014).

The function $q(p)$ has the usual properties of demand functions ($q' < 0, q'' \leq 0$). In that setup, the downstream profits on the market θ read

$$\pi_\theta(p, w; \theta) = \theta q(p)(p - w) - f. \tag{2}$$

Accordingly, the size of the smallest market that is still covered, henceforth referred to as the marginal market, follows from $\pi(p, w; \theta) = 0$:

$$\tilde{\theta}(p, w) \equiv \frac{f}{q(p)(p - w)}. \tag{3}$$

The properties of $\tilde{\theta}(p, w)$ that are relevant for the following analyses can be summarized as follows:

$$\frac{\partial \tilde{\theta}}{\partial p} < 0 \;\forall\; p < p_M; \frac{\partial \tilde{\theta}}{\partial w} > 0, \frac{\partial^2 \tilde{\theta}}{\partial w^2} > 0. \tag{4}$$

The denominator of $\tilde{\theta}$ basically contains downstream profits. Consequently, the size of the marginal market $\tilde{\theta}$ decreases in p for all prices below the monopoly price p_M. In a similar vein, $\tilde{\theta}$ increases in w at an increasing rate. Ceteris paribus, a lower $\tilde{\theta}$ means that a larger share of the interval of possible market sizes is covered, i.e., market coverage increases. Higher retail prices p and lower wholesale prices w thus, c.p., increase market coverage.

Using the size of the marginal market as described in (3), we can formulate aggregate demand Q and upstream profits Π:

$$Q(p; \theta) = \int_{\tilde{\theta}(p,w)}^{1} \theta q(p) \, d\theta \tag{5}$$

$$\Pi(p, w; \theta) = \int_{\tilde{\theta}(p,w)}^{1} \theta q(p) w \, d\theta. \tag{6}$$

In (3) the wholesale price w affects the size of the marginal market $\tilde{\theta}$. In general, the upstream firm will take this effect into account when optimizing over w or p (in the case of RPM).

The aforementioned setup has the following properties. First, since market size θ and demand $q(p)$ are multiplicative, retail prices, in general, are independent of θ. Second, small markets will not be served without intervention. The smallest market $\theta = 0$ is not served without any form of transfer. With this trade-off in mind, in the following sections, we will analyze how RPM affects *market coverage* in different settings.

The economy consists of multiple markets of sizes $\theta \in [0, 1]$, which we interpret as the number of customers served by each retailer. Markets with $\theta = 0$ are the smallest and those with $\theta = 1$ are the largest markets. With uniform retail prices, there is no price competition between retailers serving different market sizes θ.

Discussion and Context of the Model

In the remainder of this section, we discuss the setup of segmented markets in more detail. We assume that market sizes θ are randomly distributed across a country. Our model basically assumes that a reatailer basically needs to sell x to break even. Retailers selling less than x incur economic losses and leave the market. In larger markets, entry could occur, however, only if the market supports that. Against that background, it does not matter whether a retailer serves x units in an urban or in a rural area. The only difference is that, in a rural area, the geographical coverage of each retailer is larger. In other words, in urban areas, there are more retailers located close to each other, each one selling at least x units.

While it is reasonable to assume that there is a lower bound on the market size that supports one retailer, it is not clear whether imposing this upper bound on the market size is realistic. In reality, there may be substantial entry barriers (sunk costs) arising from, for instance, the lack of appropriate staff or premises, substantial bureaucratic burdens or expensive marketing campaigns. Note that our model does not cover the entry/exit problem. Our model rather builds on the notion that there are multiple retailers serving markets of different sizes, as explained above.

Another central feature of our model is that markets are segmented, namely, there is not competition between retailers. This captures markets where the spatial component is important. For instance, internet access cannot be transferred from one city to another, irrespective of retail prices. Another example would be pharmacies. If a patient needs medication, she will travel to the closest pharmacy to get it, especially with health insurance. When the population in that patient's hometown is low, running a pharmacy there does not pay off and the patient needs to travel to the next town.

The given setup is specifically tailored to capture crucial aspects of public service, in particular the spatial dimension and, associated to that, the role of suppliers (in our setting: retail outlets) that offer these services to the general public. There is a trade-off between costs and coverage. Offering services even in a country's most remote and least populated regions does not make sense from an economic perspective. However, the equilibrium coverage without any intervention may fall behind policy goals, if, for instance, a significant part of the population living in rural areas have to travel long distances to get to the next physician, pharmacy or Kindergarten, or have no access to broadband internet. In this paper, we cannot answer the question of what the politically desired market coverage or demand is. We ask the question whether, and, if yes, how RPM can help to achieve the stated policy goal.

3 Input Price Discrimination

The starting point of the analysis is a situation in which the upstream firm engages in input price discrimination (DeGraba, 1990; Katz, 1987; Yoshida, 2000). That is, w is conditional on θ. Henceforth, refer to input price discrimination as IPD. Whether IPD is possible depends on the respective markets or the rules implemented in those markets. This is less likely the case when retailers can engage in arbitrage or when menu costs are too high (e.g., when the number of downstream markets is large).

We analyze two regimes with IPD, one without RPM and one with RPM. The former is presented in Section 3.1 and the latter in Section 3.2.

3.1 Input Price discrimination, no RPM

Consider a regime characterized by input price discrimination (IPD) and by retailers setting retail prices (no RPM). Given that downstream firms are monopolists in each market θ, retail prices follow from a standard monopoly problem. Differentiating downstream profits (2) gives the FOC

$$q(p) + (p - w_\theta)q'(p) = 0, \tag{7}$$

where w_θ is a market specific wholesale price. Let $p(w_\theta)$ be defined as the monopoly retail price, i.e., the maximizer of (7). Note that in every market θ, retailers set different prices depending on the respective wholesale price w_θ.

Anticipating $p(w_\theta)$, the upstream firm can adjust w_θ in a way that the retailer serving market θ breaks even:

$$\theta q(p(w_\theta))(p(w_\theta) - w_\theta) - f = 0. \tag{8}$$

In other words, w_θ is chosen such that retail prices cover average costs, $p(w_\theta) = w_\theta + \frac{f}{\theta q(p(w_\theta))}$.

As markets differ in size and retailers face fixed cost, it is not profitable for the upstream firm to serve every market. To see this, consider a very small market with $\theta \to 0$. In such a market, wholesale prices would have to be negative for the retailer to cover fixed costs f, therefore, it is not profitable for the upstream firm to serve such a market. In other words, serving a retailer is profitable as long as wholesale prices are not lower than marginal costs. Thus, the marginal market is the one in which the retailer can cover its fixed costs with $w_\theta = 0$. We define the size of this market by $\tilde{\theta}_{IPD}$. Existence of $\tilde{\theta}_{IPD}$ is stated in Lemma 1.

Lemma 1. $\exists\ \theta = \tilde{\theta}_{IPD} : \theta q(p(0))p(0) - f = 0.$

Proof. The existence of $\tilde{\theta}_{IPD}$ follows from the intermediate value theorem. $p(0)$ follows from Equation (8) and is independent of θ. $\theta q(p(0))p(0) - f = 0$ is continuous in θ. For $\theta = 0$, we have $-f < 0$ and for $\theta = 1$, $q(p(0))p(0) - f > 0$ holds by definition, as otherwise no market would be covered.

□

At that point, we can analyze the properties of a regime with IPD and without RPM. Of particular interest are market coverage and market demand.

As described in the previous section, market coverage refers to the size of the interval $[\tilde{\theta}, 1]$, where $\tilde{\theta}$ denotes the marginal market (see (3)). If that interval becomes larger, smaller markets are served, which we interpret as an expansion of market coverage. Accordingly, market coverage is maximized when $\tilde{\theta}$ is minimized, which is the case when $q(p)(p - w)$ is maximized.

With input price discrimination, wholesale prices in the smallest market are zero (Lemma 1) and the retailer sets monopoly prices. Accordingly, $q(p)(p-w)$, and, therefore, market coverage is maximized.

However, market demand, which is the sum of quantities sold in all markets being served ($\theta \geq \tilde{\theta}$) (see Equation (5)), is not maximized because in each market being served, retail prices are elevated with monopolistic overcharges (double marginalization).[4]

3.2 Input Price Discrimination and RPM

Next, consider a regime with IPD and RPM. That is, in contrast to the former section, the upstream firm sets retail prices. In order to determine the equilibrium outcome, first consider wholesale prices. With take-it-or-leave-it contracts, the upstream firm can set w such that

$$\pi_\theta \overset{!}{=} 0 \;\Leftrightarrow\; w(\theta, p; f) = \frac{\theta p q(p) - f}{\theta q(p)} \tag{9}$$

to extract downstream surplus in every market θ. The smallest market the upstream firm is willing to serve is where the corresponding wholesale price (9) is non-negative:

$$w(\theta, p; f) = \frac{\theta p q(p) - f}{\theta q(p)} \geq 0 \;\Leftrightarrow \theta \geq \frac{f}{pq(p)} \equiv \tilde{\theta}_{IPD+RPM}. \tag{10}$$

At this point, we distinguish between RPM that takes the form of market-specific retail prices (market-specific RPM) and a regime where the upstream firm charges a uniform retail price (uniform RPM). The former regime is analyzed in Section 3.2.1 and the latter in Section 3.2.2.

3.2.1 Market-specific RPM

With market-specific RPM, the upstream firm sets p_θ for every market $\theta \geq \tilde{\theta}_{IPD+RPM}$. The maximization problem reads

$$\max_{p_\theta} \; q(p_\theta) w(\theta, p; f) \;\forall\; \theta \geq \tilde{\theta}_{IPD+RPM}, \tag{11}$$

from which we obtain the standard monopoly problem as FOC (see (7) with

[4] This result would change with two-part tariffs. The upstream firm would set $w_\theta = w = 0$, thereby eliminating double marginalization, and f_θ to extract downstream surplus for all $\theta \in [\theta_{IPD}, 1]$.

$w = 0$, irrespective of θ. This implies that with market-specific RPM, retail prices will be the monopolistic retail price for a wholesale price that equals marginal costs. This applies to every market, i.e., there will be a uniform retail price.

3.2.2 Uniform RPM

Consider a scenario where the upstream firm sets a uniform retail price. Given wholesale prices $w(\theta, p; f)$ (see (9)) and the marginal market $\tilde{\theta}_{IPD+RPM}$ (see (10)), the upstream firm's objective reads

$$\max_{p} \int_{\tilde{\theta}_{PD}}^{1} \theta w(\theta, p; f) q(p) \, d\theta, \tag{12}$$

and the corresponding FOC simplifies to

$$\frac{\left(p^2 q(p)^2 - f^2\right)\left(p q'(p) + q(p)\right)}{2p^2 q(p)^2} \overset{!}{=} 0. \tag{13}$$

The solution to FOC (13) is characterized by the monopoly price with $w = 0$, $pq'(p) + q(p) = 0$.[5] Thus, the solution is the same as with market-specific RPM (see Section 3.2.1).

The first notable property of the regimes with RPM is that vertical externalities are internalized, i.e., double marginalization is eliminated, since retail prices follow from a monopoly problem with $w = 0$. This property of RPM has repeatedly been shown in the literature (see, e.g., Perry and Groff (1985) or Mathewson and Winter (1983)). This property of RPM leads to an expansion of demand compared to a scenario without RPM (see Section 3.1).

Market coverage with RPM, on the other hand, is on the same level as without RPM (Section 3.1). In particular, the marginal market is the same, i.e., market coverage is maximized, because in the market where $w = 0$, we have have monopoly prices. We can thus conclude that, in our setting, IPD ensures maximum market coverage because wholesale prices decrease to marginal costs in small markets, and RPM enhances demand, as it internalizes vertical externalities.

[5] Technically, the first term in parenthesis $p^2 q(p)^2 - f^2 = 0$ would be another candidate solution. The resulting price $p = \frac{f}{q(p)}$, however, gives negative wholesale prices in all markets except in $\theta = 1$ (see (9)).

4 Uniform Wholesale Prices

4.1 Uniform Wholesale Prices, no RPM

Next, consider a regime with uniform input prices and without RPM. Uniform input prices might be motivated by prohibitively large transaction costs when bargaining over market specific input prices on a continuity of downstream market. Under this regime, retail prices are determined by downstream firms. Given that downstream firms are monopolists in each market θ, retail prices follow the standard monopoly problem. Differentiating downstream profits (2) gives the FOC

$$q(p) + (p - w)q'(p) = 0. \tag{14}$$

Accordingly, retail prices will be a function of w. The upstream firm anticipates $p(w)$ in its optimization problem

$$\max_{w} \Pi(w; p(w), \theta) = \int_{\tilde{\theta}(p(w),w)}^{1} \theta q(p(w))w \, d\theta. \tag{15}$$

The FOC of Problem (15) can be simplified to:[6]

$$\frac{q(p(w))}{2}\left(1 - \tilde{\theta}(p(w), w)^2\right) =$$
$$w(q(p(w))\tilde{\theta}(p(w), w)\frac{\partial\tilde{\theta}(p(w), w)}{\partial w} - \frac{w}{2}\left(1 - \tilde{\theta}(p(w), w)^2\right)\frac{\partial q(p(w))}{\partial p}\frac{\partial p(w)}{\partial w}. \tag{16}$$

The LHS of the FOC (16) captures the increase in profits from sales to the infra-marginal downstream firms from higher wholesale prices w. The RHS captures the costs of raising w. It consists of two components. First, an increase in w reduces market coverage as it increases the size of the marginal market $\tilde{\theta}$ as $\frac{\partial\tilde{\theta}}{\partial w} > 0$ (see Equation (4)). This effect is captured by the first term of the RHS. The second term captures the drop in revenues that follows from an increase in w via a decrease in demand. Since retail prices increase in w, an increase in w decreases the demand of all infra-marginal downstream firms.

[6] Note that $\frac{\partial\tilde{\theta}}{\partial p} = 0$ when $q(p) + (p - w)q'(p) = 0$. Consequently, $-wq(p(w))\tilde{\theta}(p(w), w)\frac{\partial p}{\partial w}\frac{\partial\tilde{\theta}}{\partial p} = 0$ because equation (14) must hold in equilibrium.

4.2 Resale Price Maintenance

Under RPM with uniform wholesale prices, the upstream firm has control over (p, w). The upstream firms maximization problem reads as follows:

$$\max_{p,w} \Pi = \int_{\tilde{\theta}(p,w)}^{1} \theta q(p) w \, d\theta. \tag{17}$$

Notice that in contrast to the situation without RPM, retail prices p no longer result from the profit maximization problem downstream, but instead are directly derived from the upstream profit maximization. The equilibrium of (p, w) follows from the FOCs of problem (17):

$$\frac{\partial \Pi}{\partial p} = \frac{w}{2}\left(1 - \tilde{\theta}(p,w)^2\right)\frac{dq}{dp} - wq(p)\tilde{\theta}(p,w)\frac{\partial \tilde{\theta}(p,w)}{\partial p} \stackrel{!}{=} 0. \tag{18}$$

$$\frac{\partial \Pi}{\partial w} = \frac{q(p)}{2}\left(1 - \tilde{\theta}(p,w)^2\right) - wq(p)\tilde{\theta}(p,w)\frac{\partial \tilde{\theta}(p,w)}{\partial w} \stackrel{!}{=} 0. \tag{19}$$

To compare the RPM to the previously analyzed regime with uniform prices (*not* RPM, abbreviated with N), define p_N and p_R as the equilibrium retail prices in the respective regimes. In the same way, define w_N and w_R as equilibrium wholesale prices in the regimes None and RPM, respectively.

Before analyzing the relation between prices in the two regimes, we first explain the economic effects that influence this relationship. In doing so, it is reasonable to manipulate FOC (19) to match FOC (16):

$$\frac{q(p_R)}{2}\left(1 - \tilde{\theta}(p_R,w)^2\right) = wq(p_R)\tilde{\theta}(p_R,w)\frac{\partial \tilde{\theta}(p_R,w)}{\partial w}. \tag{20}$$

As before, the LHS of (20) states the upstream firm's gain from increasing w, i.e., *ceteris paribus*, it earns higher profits from selling to all infra-marginal downstream firms. The RHS captures the costs of an increase in w, which manifests itself in an increase in the size of the marginal market $\tilde{\theta}$ (lower market coverage).

The difference between FOCs (16) and (20) is that, first, they are evaluated at different retail prices, and second, that under the "None" regime (equation 16) an increase in w translates into a decrease in sales to all infra-marginal downstream firms, which results from p_N increasing in w.

At that point, it cannot be clearly identified which of the two regimes yields higher wholesale or retail prices. In the RPM regime, vertical externalities are internalized, which *ceteris paribus* leads to lower retail prices.

However, a decrease in retail prices leads to a lower market coverage as the size of the marginal market $\tilde{\theta}$ increases. These two opposing effects also translate into an ambiguity regarding wholesale prices because the upstream firm takes into account that wholesale prices affect retail prices in the regime None. Lemma 2 states that retail and wholesale prices are lower under RPM, indicating the internalization of vertical externalities is generally a stronger effect than the impact of retail and wholesale prices on market coverage. This result is illustrated by figure 1.

Lemma 2. *Let (w_R, p_R) and (w_N, p_N) denote equilibrium wholesale and retail prices in the RPM and None regimes, respectively. It holds that $p_N > p_R$ for all $w > 0$ and $w_N > w_R$.*

Proof. First, we show that $p_R < p_N$. Noting that $\tilde{\theta}(p, w) = \frac{f}{q(p)(p-w)}$, the derivative $\frac{\partial \Pi}{\partial w}$ (see (19)) can be re-arranged such that:

$$\frac{\partial \Pi}{\partial p} = \frac{fw\tilde{\theta}(p,w)\left(q(p) + \frac{dq(p)}{dp}(p-w)\right)}{q(p)(p-w)^2} + \frac{w}{2}\frac{dq(p)}{dp}\left(1 - \tilde{\theta}(p,w)^2\right). \quad (21)$$

Let p_N be the maximizer of downstream profits (see (14). At p_N, it holds that $q(p) + \frac{dq(p)}{dp}(p-w) = 0$. When evaluating (21) at p_N, the first summand of that expression is zero. The second term is negative for all $w > 0$ and $\tilde{\theta} < 1$ since $\frac{dq(p)}{dp} < 0$. Hence, $\frac{\partial \Pi}{\partial p} < 0$ at $p = p_N$, such that $p_N > p_R$ for all $w > 0$ and $\tilde{\theta} < 1$.

Next, we show that $w_R < w_N$). In doing so, substitute $\tilde{\theta} = \frac{f}{q(p)(p-w)}$ into the objective under RPM (17) and differentiate with respect to w and p to get the following expressions:

$$\frac{\partial \Pi}{\partial p} = \frac{1}{2}w\left(\frac{f^2\left((p-w)q'(p) + 2q(p)\right)}{q(p)^2(p-w)^3} + q'(p)\right) \quad (22)$$

$$\frac{\partial \Pi}{\partial w} = \frac{q(p)}{2} - \frac{f^2(p+w)}{2q(p)(p-w)^3} \quad (23)$$

Differentiating (23) with respect to p gives:

$$\frac{\partial^2 \Pi}{\partial w \partial p} = \frac{(p-w)\frac{dq}{dp}\left(f^2(p+w) + q(p)^2(p-w)^3\right) + 2f^2q(p)(p+2w)}{2q(p)^2(p-w)^4} \quad (24)$$

At the profit-maximizing retail price under RPM p_R, (22) equals zero. In order to analyze (24) at p_R, re-arrange $\frac{\partial \Pi}{\partial p} \overset{!}{=} 0$ for $\frac{dq}{dp}$ and substitute the resulting expression

$$-\frac{2f^2q(p)}{(p-w)\left(f^2+p^2q(p)^2+w^2q(p)^2-2pwq(p)^2\right)}$$

into (23) gives

$$\frac{\partial^2 \Pi}{\partial w \partial p}\Big|_{p=p_R} = \frac{f^2w\left(f^2+3q(p)^2(p-w)^2\right)}{f^2q(p)(p-w)^4+q(p)^3(p-w)^6} > 0. \tag{25}$$

In other words, at $p = p_R$ the slope of the upstream firm's profit in w increases. Thus, if p incrementally increases towards the optimal price in Regime None p_N, the slope of profits in w increases and so does the optimal wholesale price w. However, this is not optimal because at $p = p_R$ the upstream firm achieves it's highest iso-profit line since $\frac{\partial \pi}{\partial p} = 0$ holds. Thus, an upwards deviation in retail prices p beyond the optimal price p_R comes along with an increase in wholesale prices w. Thus, for any $p > p_R$, wholesale prices will increase. Thus, since $p_N > p_R$, we will have $w_N > w_R$.

□

At that point, we can show that RPM decreases market coverage. In doing so, note that market specific downstream profits are defined as $\pi_\theta = \theta\pi - f$ and, therefore, $p_M = \arg\max_p \theta\pi - f$ is equivalent to $p_M = \arg\max_p \pi$ as θ is multiplicative and f additive, so that both terms drop out from the FOC. In what follows, we use the term π to denote downstream profits without accounting for market size θ and fixed cost f.

RPM decreases market coverage when $\tilde{\theta}(p_R, w_R) > \tilde{\theta}(p_N, w_N)$, which corresponds to

$$\underbrace{q_N(p_N)(p_N - w_N)}_{\pi(p_N,w_N)} > \underbrace{q_R(p_R)(p_R - w_R)}_{\pi(p_R,w_R)}. \tag{26}$$

We proof that by showing that the opposite cannot be true. In doing so, notice that in the None regime, the downstream firms are able to set retail prices, whereas in the RPM regime, the upstream firm chooses both retail and wholesale prices. If downstream profits were maximized for (p_R, w_R) (i.e., if $\pi(p_R, w_R)$ was higher than $\pi(p_N, w_N)$ and (26) was violated) the downstream firm would commit to setting $p = p_R$ for every w. If this was an equilibrium, the upstream firm would anticipate that $p = p_R$ and set $w = w_R$ to maximize its own profits (see Equation (19)). However, if the upstream firm sets w_R

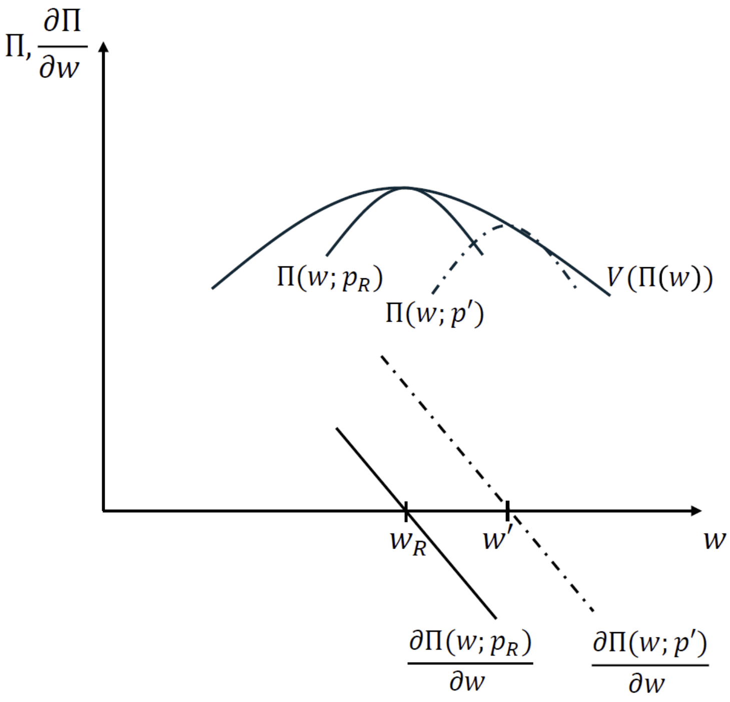

Figure 1: Illustration of lemma 2. Illustrative profit functions of the upstream firm $\Pi(w;p)$ and the first order condition for the profit maximum with respect to w are included for the profit maximizing price under the RPM regime, p_R, as well as some price $p' > p_R$. p', thus, illustrates a deviation from p_R towards p_N. Note that the first order condition with respect to w takes positive values when evaluated for prices $p' > p_R$, as argued in equation 25.

in the first place, the downstream firms would set a different price than p_R, since otherwise equilibrium retail and wholesale prices would be the same in the None regime as under RPM. It was states in Lemma 2 that this is not the case.

Hence, (26) must hold in equilibrium. We consequently have that $\tilde{\theta}(p_R, w_R) > \tilde{\theta}(p_N, w_N)$ such that market coverage decreases under RPM.

Finally, we show that demand aggregated across all markets is higher under RPM Q_R than it is under the regime without RPM, N, Q_N, $Q_R > Q_N$. In doing so, differentiate (5) with respect to p and w to obtain:

$$\frac{\partial Q}{\partial p} = -\frac{\partial \tilde{\theta}}{\partial p}\tilde{\theta}(p,w)q(p) + \frac{1}{2}\frac{dq}{dp}\left(1 - \tilde{\theta}(p,w)^2\right), \tag{27}$$

$$\frac{\partial Q}{\partial w} = -\frac{\partial \tilde{\theta}}{\partial w}\tilde{\theta}(p,w)q(p). \tag{28}$$

Since $\frac{\partial \tilde{\theta}}{\partial w} > 0$, (28) is negative. Hence, *ceteris paribus*, the lower w, the higher market coverage and the higher total demand Q. The first term in (27) is positive because $\frac{\partial \tilde{\theta}}{\partial p} < 0$. The second term is negative. Hence, Q is maximized over p when

$$-\frac{\partial \tilde{\theta}}{\partial p}\tilde{\theta}(p,w)q(p) = -\frac{1}{2}\frac{dq}{dp}\left(1-\tilde{\theta}(p,w)^2\right) \tag{29}$$

holds.

To show that $Q_N < Q_R$, notice that w cancels out in the FOC $\frac{\partial \Pi}{\partial p} = 0$ under RPM (see Equation (18)) such that this FOC takes the identical functional form as (29). In the regime None, prices are determined by the FOC $q(p) + \frac{dq}{dp}(p-w) = 0$ (see Equation (14)). Thus, for any given w, total demand under RPM will be higher than in the regime None becasue the FOC that maximizes Π over p under RPM has the identical functional form as the FOC that maximizes Q over p. Since total demand Q also decreases in w (equation 28) and it holds that $w_R < w_N$ (see Lemma 2), we have $Q_N < Q_R$ in equilibrium.

5 Conclusion

This paper has demonstrated the complex trade-offs inherent in the implementation of resale price maintenance (RPM) in vertically separated markets. The elimination of double marginalization under RPM effectively stimulates aggregate demand. At the same time, however, RPM reduces market coverage, as lower downstream margins force retailers to withdraw from less profitable, smaller markets. This highlights the potential for RPM to potentially exacerbating distributional inequities in favor of larger markets.

These results change when the upstream firm can charge market-specific wholesale prices, i.e., with input price discrimination (IPD). When the upstream firm can implement market-specific wholesale prices, it can strategically reduce input prices in smaller markets, thereby restoring second-best market coverage. Achieving first-best market coverage necessitates transfer payments.

Combining RPM with IPD allows for maximizing market coverage and demand. This suggests that a carefully calibrated approach, combining RPM with flexible input pricing mechanisms, can achieve superior market outcomes compared to either policy in isolation.

It is essential to recognize the context-specific nature of our analysis. Our results are primarily relevant to vertically separated markets, particularly those exhibiting public service characteristics, such as healthcare, cultural goods, and internet access. The model's focus on a monopolistic upstream firm with limited contractual flexibility also presents opportunities for future research exploring more complex market structures and pricing strategies.

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